# Phase II
## Site Characterization Sampling and Analysis Plan

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Columbia Falls, Flathead County
Montana

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# ACRONYM LIST

| **Acronym:** | **Definition:** |
|---|---|
| AOC | Administrative Settlement Agreement and Order on Consent |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| ASTM | American Society for Testing and Materials |
| AVS | Acid Volatile Sulfide |
| BERA WP | Baseline Ecological Risk Assessment Work Plan |
| BHHRA WP | Baseline Human Health Risk Assessment Work Plan |
| BRAWP | Baseline Risk Assessment Work Plan |
| CAS | Chemical Abstracts Service |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFAC | Columbia Falls Aluminum Company, LLC |
| CFR | Code of Federal Regulation |
| CLP | Contract Laboratory Program |
| COC | Chain of Custody |
| COPC | Contaminants of Potential Concern |
| COPEC | Constituents of Potential Ecological Concern |
| CSM | Conceptual Site Model |
| DO | Dissolved Oxygen |
| DQO | Data Quality Objectives |
| DU | Decision Unit |
| DUP | Field Duplicate |
| DUSR | Data Usability Summary Report |
| EB | Equipment Blank |
| EDD | Electronic Data Deliverable |
| EPC | Exposure Point Concentration |
| ERAG | Ecological Risk Assessment Guidance |
| FB | Field Blank |
| FNU | Formazin Nephelometric Units |
| FS | Feasibility Study |
| FSP | Field Sampling Plan |
| FT-BLS | Feet Below Land Surface |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| GW | Groundwater |
| HASP | Health and Safety Plan |
| HCL | Hydrochloric Acid |
| IDW | Investigation Derived Waste |
| ISM | Incremental Sampling Methodology |
| ISS | Incremental Soil Sample |

| **Acronym:** | **Definition:** |
|---|---|
| IT | Information Technology |
| ITRC | Interstate Technology & Regulatory Council |
| LANL | Los Alamos National Laboratory |
| LCS | Laboratory Control Sample |
| LiDAR | Light Detection and Ranging |
| LNAPL | Light Non-Aqueous Phase Liquids |
| MBMG | Montana Bureau of Mines and Geology |
| MCL | Maximum Contaminant Levels |
| MDEQ | Montana Department of Environmental Quality |
| MDL | Method Detection Limit |
| MP | Management Plan |
| MPDES | Montana Pollutant Discharge Elimination System |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MW | Monitoring Well |
| NAD | North American Datum |
| NAVD | North American Vertical Datum |
| NCP | National Contingency Plan |
| NOAA | National Oceanic and Atmospheric Administration |
| NTU | Nephelometric Turbidity Units |
| ORP | Oxygen Reduction Potential |
| OSHA | Occupational Safety and Health Administration |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyls |
| PCDDs | Polychlorinated dibenzo-p-dioxins |
| PCDFs | Polychlorinated dibenzofurans |
| PID | Photoionization Detector |
| PQL | Practical Quantitation Limit |
| PVC | Polyvinyl chloride |
| PW | Porewater |
| PWP | Porewater Point |
| QA/QC | Quality Assurance/Quality Control |
| QAPP | Quality Assurance Protection Plan |
| RI | Remedial Investigation |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| RSL | Regional Screening Levels |
| SAP | Sampling and Analysis Plan |
| SB | Soil Boring |
| SCDM | Superfund Chemical Data Matrix |

| **Acronym:** | **Definition:** |
|---|---|
| SD | Sediment |
| SDP | Sediment Point |
| SEM | Simultaneously Extracted Metals |
| SLERA | Screening Level Ecological Risk Assessment |
| SO | Soil |
| SOP | Standard Operating Procedure |
| SPL | Spent Potliner |
| SVOC | Semivolatile Organic Compounds |
| SW | Surface Water |
| SWP | Surface Water Point |
| TAL | Target Analyte List |
| TB | Trip Blank |
| TBC | To Be Considered |
| TCL | Target Compound List |
| TDC | Total Dissolved Carbon |
| TDS | Total Dissolved Solids |
| TEQ | Total Toxic Equivalencies |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| $UCL_{mean}$ | Upper Confidence Limit of the Mean |
| USCS | Unified Soil Classification System |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| VOC | Volatile Organic Compounds |
| WC | Waste Characterization |
| WCL | Waste Characterization Liquids |
| WCS | Waste Characterization Solids |

# 1. INTRODUCTION

On behalf of Columbia Falls Aluminum Company, LLC (CFAC), Roux Associates, Inc. (Roux Associates), has prepared this Phase II Site Characterization Sampling and Analysis Plan (Phase II SAP) as part of the ongoing Remedial Investigation/Feasibility Study (RI/FS) of the Superfund Site referred to as Anaconda Aluminum Co. Columbia Falls Reduction Plant (a/k/a Columbia Falls Aluminum Plant), located two miles northeast of Columbia Falls in Flathead County, Montana (hereinafter, "the Site"). The RI/FS is being conducted pursuant to the Administrative Settlement Agreement and Order on Consent (AOC) dated November 30, 2015, between CFAC and the United States Environmental Protection Agency (USEPA) (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 08-2016-0002). The Phase II SAP was developed in accordance with the Scope of Work included with the RI/FS Work Plan for the Site (Roux Associates, 2015a); and relied on background information and data collected during the Phase I Site Characterization (Roux Associates, 2017a).

## 1.1 Purpose and Objectives

The purpose of the Phase II Site Characterization is to supplement the findings from the Phase I Site Characterization completed in 2017 (Roux Associates, 2017a), and to address the data gaps identified in the draft Baseline Human Health Risk Assessment Work Plan (BHHRA WP) (EHS Support, 2017a) and draft Baseline Ecological Risk Assessment Work Plan (BERA WP) (EHS Support, 2017b). The data collected as part of the Phase I and Phase II Site Characterization will be utilized to complete the risk assessment and feasibility study for the Site. A more detailed description of the objectives is provided in Section 3.0.

This Phase II SAP consists of two parts: 1) a Field Sampling Plan (FSP) that describes the data gathering and sampling activities, and the associated fieldwork procedures for the Phase II Site Characterization; and 2) a Quality Assurance Project Plan (QAPP) that describes the policy, organization, and functional activities; the data quality objectives (DQOs); and, the quality assurance (QA) and quality control (QC) protocols necessary to achieve DQOs of the Phase II Site Characterization. DQO development is provided in Section 6.5 of this SAP. No conclusions are drawn in this SAP. With the exception of the temporal variability discussion (Section 2.5), all data interpretation statements contained in this SAP have been taken from prior USEPA-approved data summary reports. The remainder of the Phase II SAP is organized as follows:

PART 1 – Field Sampling Plan (FSP)

- Section 2 – Site Background and RI/FS Project Status
- Section 3 – Phase II Site Characterization Objectives
- Section 4 – Phase II Sampling Plan
- Section 5 – Field Sampling Procedures

PART 2 – Quality Assurance Project Plan (QAPP)

- Section 6 – Group A: Project Management
- Section 7 – Group B: Data Generation and Acquisition
- Section 8 – Group C: Assessment and Oversight
- Section 9 – Group D: Data Validation and Usability

This Phase II SAP has been developed in general accordance with the USEPA RI/FS Guidance (USEPA, 1988), USEPA Guidance for Quality Assurance Project Plans (USEPA, 2002a), and the Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006).

# PART 1 – COLUMBIA FALLS ALUMINUM COMPANY PHASE II REMEDIAL INVESTIGATION FIELD SAMPLING PLAN

# 2. SITE BACKGROUND AND RI/FS PROJECT STATUS

The Site is located at 2000 Aluminum Drive near Columbia Falls, Flathead County, Montana. The Site is approximately 2 miles northeast from the center of Columbia Falls and the Site is accessed by Aluminum Drive via North Fork Road (County Road 486). The boundaries of the Site were defined in the RI/FS Work Plan (Roux Associates, 2015a) and are depicted in Figure 1. The Site consists of approximately 1,340 acres bounded by Cedar Creek Reservoir to the north, Teakettle Mountain to the east, Flathead River to the south, and Cedar Creek to the west.

The Site was operated as a primary aluminum reduction facility (commonly referred to as an aluminum smelter) from 1955 until 2009. The facility began with two potlines in 1955 and an annual capacity of 67,500 tons per year (using 120 pots per potline). A third potline was added in 1965, and the fourth and fifth potlines were added in 1968; increasing total aluminum production capacity at the Site to 180,000 tons per year. The plant expanded to 10 pot rooms in the 1960s. Aluminum production at the Site was suspended in 2009 due to a downturn in aluminum market conditions, and CFAC announced the permanent closure of the facility in March 2015. A detailed description of the operational history at the Site was provided in Section 2.7.2 of the RI/FS Work Plan (Roux Associates, 2015a).

Buildings and industrial facilities remaining at the Site at the start of the RI/FS in 2016 included offices, warehouses, laboratories, mechanical shops, paste plant, coal tar pitch tanks, pump houses, casting garage, and the potline facility. Decommissioning of the aluminum smelter is ongoing and is expected to be completed in the first quarter of 2019.

The Site also includes seven closed landfills, one open landfill that hasn't been used since 2009, material loading and unloading areas, two closed leachate ponds, and several wastewater percolation ponds. A detailed description of each Site feature was provided in Section 3.2 of the RI/FS Work Plan (Roux Associates, 2015a). A map showing the locations of Site features is provided for reference as Figure 2.

## 2.1 Phase I Site Characterization

CFAC and Roux Associates completed a Phase I Site Characterization in 2017, which included the collection and laboratory analysis of soil, sediment, groundwater, and surface water within and around Site features. The objectives of the Phase I Site Characterization, as outlined in the RI/FS Work Plan (Roux Associates, 2015a) included:

- Evaluate the conditions at all identified RI areas and Site features to determine which RI areas and Site features require further investigation and/or quantitative evaluation in the Baseline Risk Assessment.
- Refine the list of contaminants of potential concern (COPCs) that require further investigation at various RI areas and Site features so lists of laboratory analyses can be reduced during subsequent phases of investigation.
- Refine the understanding of groundwater flow and groundwater quality beneath the Site, particularly in the vicinity of potential receptors.
- Develop a more detailed understanding of bedrock topography and the depths, thicknesses, and extents of the various hydrogeologic units, both of which may influence groundwater flow and the distribution of COPCs in the subsurface.

- Begin to evaluate seasonal influences on groundwater/surface water interactions and contaminant concentrations in groundwater and surface water.
- Develop data to support the preparation of the Baseline Risk Assessment Work Plans (BRAWPs).
- Develop data to support identification and screening of remedial technologies as part of the FS.

The results of the Phase I Site Characterization are documented in the Phase I Site Characterization Data Summary Report (Phase I Data Summary Report) (Roux Associates, 2017a), the Screening Level Ecological Risk Assessment (SLERA) (Roux Associates, 2017b), and the Groundwater and Surface Water Data Summary Report (GW/SW Data Summary Report) (Roux Associates, 2017c). A summary of the nature and extent of contamination determined from the Phase I Site Characterization results is also provided in Section 2.1.1 below for reference.

### 2.1.1 Summary of Nature and Extent of Contamination Identified in Phase I Site Characterization

Data collected during the Phase I Site Characterization were compared to screening levels identified in the RI/FS Work Plan (Roux Associates, 2015a), the Phase I SAP (Roux Associates, 2015b), and Phase I SAP Addendum (Roux Associates, 2016a). The results of the screening conducted in the Phase I Site Characterization indicated that cyanide and fluoride in groundwater, and polycyclic aromatic hydrocarbons (PAHs) in soil, are the primary COPCs identified within the Site. A summary of key findings regarding the nature and extent of contaminants in each media is provided below. Details regarding the nature and extent of contamination, exceedances of human health and ecological screening criteria, and Phase I Site Characterization conclusions are identified in the Phase I Data Summary Report (Roux Associates, 2017a), the SLERA (Roux Associates, 2017b), and the GW/SW Data Summary Report (Roux Associates, 2017c).

**Soil/Sediment**

- Concentrations of PAHs exceed USEPA Protection of Groundwater Risk Based Soil Screening Levels, USEPA Residential Regional Screening Levels (RSLs) and USEPA Industrial RSLs in surface soil and shallow soil across most of the area surrounding the Main Plant, Paste Plant, and across the Operational Area. The widespread distribution of PAHs is attributed to the extensive handling and storage of PAH containing materials, such as petroleum coke and pitch, that were key components of the manufacturing process; as well as the aerial deposition of PAHs from historical plant emissions. The PAH concentrations decreased with depth, but still exceeded USEPA Residential RSLs in samples from the 10-12 feet below land surface (ft-bls) depth at the majority of locations to the north, east and south of the Main Plant. PAHs typically decreased to below USEPA Residential RSLs, below USEPA Protection of Groundwater Risk Based Soil Screening Levels, or to non-detect at locations to the west. It should be noted that the USEPA Protection of Groundwater Risk Based Soil Screening Levels are so low, such that for many analytes any detection results in an exceedance.
- Concentrations of PAHs and cyanide in soil exceed USEPA Protection of Groundwater Risk Based Soil Screening Levels, USEPA Residential RSLs, and USEPA Industrial RSLs in the North Percolation Ponds. The concentrations of COPCs decrease with increasing depth beneath the ponds. Beneath the Northwest Percolation Pond and West Percolation Pond, there are few or no exceedances of the Residential RSLs in the 10-12 ft-bls depth interval; however, beneath the Northeast Percolation Pond and ditches there still are PAHs exceeding the USEPA Industrial RSLs at the 10-12 ft-bls depth interval. In the South Percolation Ponds, similar COPCs were detected; however, the concentrations were generally much lower than those observed in the Northern Ponds. Cyanide concentrations in sediment did not exceed the USEPA Industrial RSL but exceeded the USEPA Residential RSL. PAHs were detected in sediment at concentrations exceeding Industrial and Residential RSLs. Fluoride was detected in 100% of sediment samples, but did not exceed the USEPA Residential or Industrial RSL in any of the sediment samples.

- Volatile Organic Compounds (VOCs) were frequently detected in soil samples across the Site, particularly, low level detections of benzene, toluene, ethylbenzene, and xylene (BTEX), but did not exceed USEPA Residential RSLs. Despite the frequency of VOCs detected, limited VOCs were detected that exceed the USEPA Protection of Groundwater Risk Based Soil Screening Levels, and no VOCs were detected with concentrations exceeding USEPA Residential or Industrial RSLs. The presence of BTEX may be related to petroleum coke and pitch materials used at the Site.
- Metals were detected in soil and sediment samples across the Site. Concentrations of some metals are consistent with regional estimates of background concentrations; however, the areal distribution and magnitude of metals concentrations around certain Site features (e.g., North Percolation Ponds and associated ditches) indicate that some metals may be present as a result of site operations. Exceedances of USEPA Residential RSLs and Protection of Groundwater Risk Based Soil Screening Levels were observed for several metals. The results of the Phase I Site Characterization suggest that additional background studies are warranted to evaluate the metal concentrations.
- Pesticides were not detected in any soil or sediment samples collected during the Phase I Site Characterization; however, mean and median method detection limits (MDLs) for some pesticides exceeded the lowest screening criteria.
- Polychlorinated biphenyls (PCBs) were not detected in discrete samples in the Site-wide soil dataset; however, PCBs were detected at concentrations exceeding USEPA Protection of Groundwater Risk Based Soil Screening Levels and USEPA Residential RSLs in four decision units (DUs) within the central portion of the Operational Area, as defined in the RI/FS Work Plan and presented on Figure 2. PCBs were not detected in sediment.
- Dioxin and furan detections were observed in several samples. Total toxic equivalencies (TEQs) exceeding the USEPA Protection of Groundwater Risk Based Soil Screening Levels and USEPA Residential RSL occurred in one surficial soil sample located in the West Rectifier Yard, and one shallow soil sample collected in the East Rectifier Yard.
- A list of soil and sediment exceedances relative to minimum ecological screening values is provided in Section 2.2.

**Groundwater**

- Elevated cyanide and fluoride concentrations exceeding screening levels were observed in groundwater within the upper hydrogeologic unit during four sampling events conducted between September 2016 and June 2017. The maximum concentrations were detected immediately downgradient of the West Landfill, Wet Scrubber Sludge Pond, and Center Landfill, suggesting that these features are the primary source areas for COPCs in groundwater. Cyanide and fluoride concentrations in groundwater downgradient of these Site features are generally orders of magnitude lower.
- In general, cyanide and fluoride were detected in the same monitoring well locations during each round of sampling and the primary source areas of cyanide and fluoride (i.e., the West Landfill, Wet Scrubber Sludge Pond, and Center Landfill) do not appear to change temporally. Iso-concentrations maps generated utilizing the Phase I data indicate that the overall shape of the spatial distribution of total cyanide and fluoride detections were similar across the four rounds and appears to mimic the groundwater flow directions from the primary source areas towards the Flathead River. The iso-concentration maps also indicate that the concentrations within the contoured area may vary seasonally, primarily in the areas immediately north and west of the Main Plant building.
- In each location where cyanide was detected, it exceeded the USEPA Tapwater RSL. Total cyanide was detected at concentrations greater than the DEQ-7 Human Health Standard / USEPA MCL in groundwater from monitoring wells screened in the upper hydrogeologic unit in 32% of samples during all four rounds of sampling. Total cyanide did not exceed the DEQ-7 Human Health Standard / USEPA MCL in any groundwater samples from monitoring wells screened below the upper hydrogeologic unit in all four rounds of sampling.

- Fluoride was detected at concentrations exceeding the USEPA Tapwater RSL in at least 90% of groundwater samples during all four rounds. Fluoride was detected at concentrations greater than the DEQ-7 Human Health Standard / USEPA MCL in 7% of all groundwater samples, but was not detected in any samples screened below the upper hydrogeologic unit.
- Where PAHs were detected in soil, the concentrations in soil exceeded the USEPA Protection of Groundwater risk based soil screening levels, suggesting a potential for impact to groundwater. However, PAHs were non-detect in all groundwater samples.
- VOCs were found infrequently in groundwater at the Site. There were typically no detections of VOCs in groundwater at concentrations exceeding USEPA Tapwater RSLs. 1,2-Dichloroethane and trichloroethene maximum concentrations in groundwater were above their respective USEPA Tapwater RSLs, but were only detected at a frequency of 2.5% or less, and the maximum concentrations were less than 1 ug/L. A single detection of 1,2-dichloroethane occurred in the shallow soil sample collected at CFMW-054; trichloroethene was not detected in soil. Although there were frequent detections of VOCs in soil, note that there were no VOCs detected in soil at concentrations exceeding a Residential RSL in any of the 132 shallow or 135 intermediate-depth samples analyzed for VOCs as part of the Phase I Site Characterization. As specified in the RI/FS Work Plan and the Phase I SAP (Roux Associates 2015a, b), the monitoring well locations sampled for VOCs were biased toward potential source areas to determine whether any of these constituents required further evaluation as COPCs. The fact that VOCs are not present in groundwater at levels of concern immediately downgradient of potential sources demonstrates that leaching from the soil into groundwater is not occurring or is negligible.

**Surface Water**

- Elevated concentrations of cyanide were detected in the Backwater Seep Sampling Area, and are consistent with the observed concentrations of cyanide in groundwater for this area, indicating that groundwater is the source of the cyanide concentrations measured in the Backwater Seep Sampling Area. Concentrations of cyanide up-river in the Flathead River were typically non-detect, further supporting that groundwater discharge is the source of the cyanide in the Backwater Seep Sampling Area.
- Cyanide was detected in isolated locations of Cedar Creek, including one detection at the upstream location, suggest that the detections may attributable to entrained sediment in the sample; as all of the samples with detections were unfiltered.
- At all locations where total cyanide was detected, concentrations of total cyanide exceed the USEPA Tapwater RSL. Total cyanide concentrations exceeded the DEQ-7 Human Health Standard of and/or the USEPA MCL only in the Backwater Seep Sampling Area. Total cyanide exceeded the DEQ-7 Acute Aquatic Life Standard in the Backwater Seep Sampling Area and South Percolation Pond, and exceeded the DEQ-7 Chronic Aquatic Life Standard in at least one sample in the Backwater Seep Sampling Area, Cedar Creek, South Percolation Ponds, and North Percolation Ponds.
- Concentrations of fluoride exceeded the USEPA Tapwater RSL in 85% of the samples collected during the four rounds of sampling. However, concentrations of fluoride only exceeded the DEQ-7 Human Health Standard / USEPA MCL in one sample from the North Percolation Pond. Fluoride concentrations exceeded the Minimum ESV of 120 µg/L in 64% of the surface water samples collected during all four rounds. There is no DEQ-7 Acute Aquatic Life Standard or DEQ-7 Chronic Aquatic Life Standard for fluoride.
- Concentrations of metals and PAHs in surface water exceeded their respective USEPA Tapwater RSLs and Department of Environmental Quality (DEQ)-7 Human Health Standard and/or USEPA MCL in the North-East Percolation Pond. Antimony and thallium were the only metals detected in surface water samples at concentrations exceeding their respective DEQ-7 Human Health Standard and/or USEPA MCL. Detected concentrations for dissolved metals including aluminum, cadmium, copper, and zinc exceeded their respective DEQ-7 Acute Aquatic Life Standards and DEQ-7 Chronic Aquatic Life Standards at a frequency of less than 5%. PAHs were detected in one sample from the North-East Percolation Pond at concentrations exceeding the DEQ-7 Human Health Standards.

Based on the elevated levels of PAHs observed in soil, it's likely that the soils/sediments within the pond are the source of the COPCs in the surface water from the pond.

- A list of surface water exceedances relative to minimum ecological screening values is provided in Section 2.2.

**Soil Vapor**

- Consistent with the preliminary Conceptual Site Model (CSM), soil and groundwater results from the Phase I Site Characterization indicate low potential for soil vapor exposure based on low VOC concentrations detected in soil and groundwater.

## 2.2 Screening Level Ecological Risk Assessment

The data collected as part of the Phase I Site Characterization was also utilized in a SLERA (Roux Associates, 2017b), which is Steps 1 and 2 of the Ecological Risk Assessment Guidance for Superfund (ERAGs) (USEPA, 2001). Based on conservative exposure assumptions, the SLERA identified constituents of potential ecological concern (COPECs) in surface water, sediment, and soil at the Site, and concluded that there was insufficient information to dismiss potential ecological risk. The following lists the chemical classes in sediment, surface water, and soil for COPECs selected for further evaluation in the BERA Work Plan based on their maximum concentrations exceeding their respective minimum ESVs. Additional details are included in the SLERA for constituents that were not detected but one half their MDL exceeded the lowest ESV, and therefore, were also carried forward for further analysis in the BERA WP. The SLERA recommended the completion of a Baseline Ecological Risk Assessment (BERA) to better understand ecological risk at the Site.

**Initial Selection of Sediment COPECs**

- Flathead River – cyanide, high molecular weight PAHs, and low molecular weight PAHs
- Cedar Creek – cyanide, high molecular weight PAHs, and low molecular weight PAHs
- North Percolation Ponds – cyanide, metals, high molecular weight PAHs and low molecular weight PAHs
- South Percolation Ponds – cyanide, metals, high molecular weight PAHs, and low molecular weight PAHs

**Initial Selection of Surface Water COPECs**

- Flathead River – cyanide, metals, fluoride
- Cedar Creek – metals
- Cedar Creek Reservoir Overflow Ditch – metals
- Industrial Landfill Area (Northern Surface Water Feature) – metals, fluoride
- South Percolation Ponds – metals, cyanide, fluoride

**Initial Selection of Soil COPECs**

- Industrial Landfill Area – cyanide, metals, SVOCs, fluoride
- Cedar Creek – cyanide, metals
- Cedar Creek Reservoir Overflow Ditch – cyanide, metals, SVOCs
- Background Area – cyanide, metals, SVOCs, fluoride

- Central Landfill Area – cyanide, metals, high molecular weight PAHs, low molecular weight PAHs, SVOCs, fluoride
- North Percolation Ponds – cyanide, metals, high molecular weight PAHs, low molecular weight PAHs, SVOCs, fluoride
- Western Area – cyanide, metals, SVOCs, fluoride
- Main Plant Area – cyanide, metals, high molecular weight PAHs, low molecular weight PAHs, SVOCs, fluoride
- Eastern Landfill Area – cyanide, metals, high molecular weight PAHs, SVOCs, fluoride
- Borrow Pit Area – cyanide, metals, SVOCs, fluoride
- South Percolation Ponds – cyanide, metals, SVOCs, fluoride
- Flathead River – metals, SVOCs

## 2.3 Expedited Risk Assessment Field Activities

Roux Associates conducted soil, sediment, and surface water sampling activities in and around the South Percolation Ponds and Backwater Seep Sampling Area October and November 2017. This work was conducted in accordance with the Expedited Risk Assessment SAP dated September 6, 2017 (Roux Associates, 2017d) to provide a better understanding of any potential human health or ecological risks in the Ponds, in anticipation of future high-water conditions in the Flathead River potentially causing significant erosion or failure of the dam on the east side of the Ponds. The sampling results and findings from the Expeditated Risk Assessment will be summarized in a technical memorandum for submission to USEPA in the first quarter of 2018. In addition, the results will be used as part of the BHHRA and BERA for the Site.

## 2.4 Risk Assessment Work Plans

The results of the Phase I Site Characterization and SLERA indicated that the presence of analytes in media at concentrations exceeding human health screening criteria and ecological screening criteria warranted further evaluation as part of a BHHRA and BERA.

The data collected during the Phase I Site Characterization were used to prepare the draft BHHRA WP and draft BERA WP, which were submitted to USEPA and Montana Department of Environmental Quality (MDEQ) on November 17, 2017 (EHS Support, 2017). The objective of the risk assessment work plans is to provide the methodology for completion of the BHHRA and BERA. Included in the risk assessment work plans are a review of the conceptual exposure models and discussion of potential exposure pathways for exposure areas. The exposure areas were defined considering both the current and reasonable anticipated future land use for the various areas of the Site and considering the types of habitats present. The boundaries of each exposure area were developed using professional judgement, and considered Site characteristics, current and potential future receptors, and the distribution of COPCs identified in the Phase I Site Characterization. The risk assessment work plans also provide an initial screening level evaluation of soil, groundwater, surface water, and sediment quality data from the Phase I Site Characterization program to provide a preliminary identification of COPCs and COPECs that may warrant further evaluation in the risk assessments. The preliminary screening of COPCs and COPECs will be updated with the results of the Phase II Site Characterization discussed in this Phase II SAP.

## 2.5 Evaluation of Temporal Variability in Phase I Site Characterization Data

Based upon an initial review of the draft BHHRA WP and draft BERA WP, USEPA requested further evaluation of the temporal variability in groundwater and surface water and discussion of how it may affect the Phase II SAP Scope of Work. Therefore, as part of the preparation of the Phase II SAP Scope of Work, Roux Associates evaluated the temporal variability of the hydrologic and concentration data for the surface water features and groundwater at the Site to adequately plan the proposed Phase II sampling events. The following sections describe the evaluation of the temporal variability of surface water and groundwater data. All graphs, tables, and data referenced in this section can be found in Appendix A.

### 2.5.1 Temporal Variability in Surface Water Discharge and Precipitation

During the Phase I Site Characterization, surface water discharge data for the Flathead River was reviewed from the nearest US Geological Survey (USGS) monitoring station (Station No. 12363000) located approximately three miles downstream of the Site. These data were used to evaluate the temporal variation in the River discharge rate and to assess whether the conditions observed during the Phase I Site Characterization were representative or atypical of long term conditions. A detailed evaluation of the current and historical discharge is included in the GW/SW Data Summary Report (Roux Associates, 2017c).

Appendix A1a presents a graph of the daily Flathead River discharge and daily precipitation from 2008 to 2017 at Station No. 12363000, approximately three miles downstream from the Site. This graph depicts a consistent pattern of discharge fluctuation occurring each year. High water conditions typically occur in May/June, and are followed by a relatively abrupt decline to low water conditions that typically occur from August through February; increasing discharge occurs in March/April before full return to high water in May/June.

Appendix A1b presents brackets for each surface water sampling period completed during the Phase I, along with the discharge and daily precipitation data. The graph shows that the first few months of 2017 (January through mid-March) had low discharge, followed by a few months of high discharge from mid-March to the end of July. The low-discharge period began at the end of July and continued through the end of the year. There was a quick increase in discharge preceded by heavy precipitation in late November to early December (i.e. snowfall). The graph also indicates that during the Phase I Site Characterization, the discharge pattern was generally consistent with the conditions described above; the single exception to this pattern occurred in October and November 2016 during the low-water season when there was a short-term increase in discharge in response to atypical heavy precipitation.

Peak discharge, minimum discharge, and total monthly precipitation was tabulated for each month in 2016 and 2017 as shown in Appendix A2a and A2b. The summary table also compares the data to the ten-year average discharge. The data indicates that the peak discharge occurred in May 2016 and June 2017, with discharge values of 29,600 cfs and 47,000 cfs, respectively. Minimum discharge occurred in January 2016 and February 2017, with discharge values of 3,350 cfs and 3,450 cfs, respectively. In general, 2016 was a year with lower average monthly discharge, with exception of October and November. Overall, 2017 was a year of higher discharge and greater extremes, with the discharge in March through June well above average discharge conditions, and the discharge in August through October below average discharge conditions.

The dates presented for maximum discharge over the last ten years are typically within May and June, and dates of minimum discharge over the last ten years range from October to March. These data indicate that

the Phase I Site Characterization maximum and minimum discharge events occurred within a representative timeframe consistent with historical data. These data also indicate that the high-water season is captured within a shorter one to two-month period, while the low-water season lasts for five to six months.

Appendix A2b summarizes the minimum, maximum, and mean yearly discharges of the Flathead River from 2008 to 2017, and provides the relative percent difference of the yearly values from the ten-year average. The data indicate that mean, minimum and maximum discharges in 2016 and 2017 during the Phase I Site Characterization were within 12 percent of the ten-year averages; except for the maximum discharge of 29,600 cfs in 2016 which was approximately 33 percent below the long-term average due to low precipitation amounts in early 2016 (as described below).

Appendix A2c presents the daily discharge and precipitation for each day during the Phase I sampling events. As discussed in prior documents, Round 1 occurred over a few months (June, August, September) so that Site features were wet when sampled. Discharge was high during the June sampling events with an average discharge of 22,687 cfs, but low during the late August/early September event with an average discharge of 3,890 cfs. Round 2 occurred in late 2016, with an average discharge of 6,476 cfs and an average daily precipitation of 0.06 inches. Round 3 occurred in March and April 2017 with an average discharge of 14,517 cfs and a daily average precipitation of 0.1 inches. Round 4 occurred in June 2017 with an average discharge of 27,063 cfs and an average daily precipitation of 0.12 inches. The South Percolation Pond risk assessment sampling occurred in October/November 2017 with an average discharge of 3,717 cfs and an average daily precipitation of 0.06 inches.

The average discharge during the South Percolation Pond expedited risk assessment sampling was less than the 2016 and 2017 minimum discharge averages of 5,607 cfs and 7,015, cfs respectively (Appendix 2a). As presented in the discharge graph (Appendix A1b), there were no peaks of high discharge during this sampling event. Further, the minimum discharge in 2017 was 3,450 cfs, and the average discharge during the South Percolation Pond expedited risk assessment sampling was 3,717 cfs. These data show that the sampling occurred during a period of minimal discharge in 2017. The conditions in the Flathead River at this time are representative of a low-flow condition during a relatively dry-season.

Appendix A3 presents the average precipitation for the last ten years. In 2017, the yearly precipitation total was 12.44 inches, which is 22% less than the 10-year average of 16 inches of precipitation. Appendix A3 also demonstrates that the beginning of 2017 (specifically February, March, and April) were wet months with elevated precipitation when compared to the ten-year average. Although early 2017 was wet, it was also followed by a long period of low precipitation for the remainder of the year (with the exception of sporadic spikes in precipitation).

The temporal variability of precipitation in the vicinity of the Site was evaluated using the precipitation data from Glacier National Park Airport (Kalispell, Montana) from 2008 to 2017. As shown in Appendix A3, the maximum monthly precipitation occurs in June during high-water season, and the minimum monthly precipitation occurs in August, just before or during low-water season. During the Phase I Site Characterization, the total annual precipitation for 2016 and 2017 was 16.45 inches and 12.44 inches, respectively; in comparison to the ten-year average annual precipitation of 16.00 inches. As also shown by Appendix A3, 2016 and 2017 were years where some monthly extremes were observed in terms of precipitation. In 2016, January through March were the driest months over the last ten-year period; while May through August had significantly higher precipitation than the average over the ten-year period, and October was the wettest month in last ten years. In 2017, February through April had much higher

precipitation than average, followed by well below average precipitation from May through December. The effects of the large precipitation events in March and April of 2017 are shown as the initial peak on the Flathead River discharge graph (Appendix A1b) followed by the typical higher peak in June, which is consistent with the high-water events of other years within the ten-year period.

The above data indicate that the 2016 and 2017 Phase I Site Characterization program captured a broad range of conditions that can occur in weather, and in turn a broad range of Flathead River discharge conditions.

### 2.5.2 Seasonal Variability of Cyanide and Fluoride Concentrations in Surface Water

Cyanide and fluoride have been identified as the primary COPCs in Site groundwater and surface water as documented in Phase I Data Summary Report, GW/SW Data Summary Report and the risk assessment work plans. Therefore, these constituents were selected for detailed review in the evaluation of temporal variability. The fluoride and cyanide concentrations in the Backwater Seep Sampling Area from the four surface water sampling rounds during the Phase I Site Characterization is graphically presented with Flathead River discharge, as shown in Appendix A4 and A5, respectively. The graphs show that the maximum concentrations of fluoride and cyanide occurred during the low-water sampling round performed in September 2016, followed by the low-water sampling round performed in December 2016. Concentrations were generally lower in March 2017 and June 2017 (the high-water sampling events).

Concentrations of total cyanide and fluoride at all surface water sampling locations from the four surface water sampling rounds, were tabulated for comparison in an effort to identify any clear seasonal variations. For each analyte, the minimum and maximum concentrations at each sampling location were highlighted to identify their associated sampling round. The comparison table is provided in Appendix A6.

The seasonal data for fluoride indicate the minimum concentrations most often occurred during Round 1 (September 2016, low water), and the maximum concentrations most often occurred during Round 4 (June 2017, high water). The notable exceptions to this trend were the samples from Backwater Seep Sampling Area as previously described. The data for total cyanide do not show a clear seasonal trend due to the large percentage of non-detect results, with the exception of the highest concentrations occurring in the Backwater Seep Sampling Area during low water conditions (Round 1, Sept 2016), coincident with the high fluoride concentrations in this area.

The four seasonal rounds of sampling data indicate the maximum concentrations of key COPCs and COPECs in Backwater Seep Sampling Area of the River occur during low flow conditions. However, given that only one year of sampling has been conducted, a better understanding of temporal variations can be obtained by additional data collection during the Phase II Site Characterization. The current data indicate that collection of samples during both low-water and high-water conditions should be sufficient to capture the range of conditions.

### 2.5.3 Temporal Variability in Groundwater Elevation and Precipitation

During the Phase I Site Characterization, Roux Associates reviewed groundwater elevation data collected by the Montana State Bureau of Mines from a pressure transducer that is deployed in existing monitoring well CFMW-007/TW-3 (identified ID 87873 in the Montana Bureau of Mines and Geology [MBMG] website well database [MBMG, 2017]) at the Site. This pressure transducer has been recording groundwater elevation data since February 1996 when it was first installed. The pressure transducer collected one daily

measurement from 1996 through 2005; and collected measurements on an hourly basis from 2006 through 2017. It is noted that water levels from 1996 to 2009 are representative of water levels under pumping conditions during operation of the CFAC plant, and water levels from 2009 to present are based on non-pumping conditions. These changes in pumping conditions could also have an impact on historical water levels. A detailed evaluation of the groundwater elevation fluctuations at the Site are included in the GW/SW Data Summary Report (Roux Associates, 2017c).

The data from this transducer was plotted over time to produce a hydrograph representative of typical minimum and maximum groundwater fluctuations, the seasonal changes in groundwater elevation for the upper hydrogeologic unit, and the historical yearly fluctuations in groundwater over the last twenty years at the Site, as shown in Appendix A7. The yellow bracket on the graph shows the time frame of the Phase I sampling period in 2016 and 2017. The graph indicates that the highest Site water levels tend to occur in May/June, and the lowest Site water levels are observed in October through December, consistent with the Phase I Site Characterization 2016 and 2017 sampling period.

Further, Appendix A8 presents the dates and elevations of the minimum and maximum groundwater elevations in CFMW-007 over the twenty-year period. The table indicates that the maximum and minimum elevations during the Phase I Site Characterization are similar to the twenty-year average maximum and minimum elevations.

As described in the GW/SW Data Summary Report (Roux Associates 2017c), groundwater elevations obtained from pressure transducers were plotted over time to produce hydrographs for the various well locations. Data from April 2016 to late November 2016 indicates that the highest Site water levels during this period were observed in late May/early June 2016 and the lowest water levels were observed in late October/early November 2016. The magnitude of groundwater elevation fluctuations was dependent on the location within the Site and the well screen depth. The largest fluctuations were observed in monitoring wells screened in the upper hydrogeologic unit and located near the landfills and Teakettle Mountain, including CFMW-007 (>40 feet) and CFMW-020 (>30 feet). Review of the elevation data compared to precipitation records suggest that the water table elevations may fluctuate significantly over short periods of time (>20 feet over one month) as a result of precipitation events and from contributions of losing streams. Smaller fluctuations were observed in wells located in the northern areas of the Site, including CFMW-001 (approximately 2 feet), and also wells screened below the upper hydrogeologic unit, including CFMW-044b (approximately 8 feet). The fluctuations in these wells are gradual and do not correlate with the short-term precipitation events.

Additionally, transducers were placed in nested monitoring wells throughout the Site in March 2017 to evaluate groundwater elevation fluctuations in locations around and downgradient of the landfills, and to evaluate differences in groundwater elevation fluctuations in the upper hydrogeologic unit and below the upper the hydrogeologic unit. The data suggested that the highest Site water levels were observed in late March/early April 2017 and the groundwater elevation levels trended downward through September 2017. Groundwater elevation changes were greater than 20 feet in monitoring well CFMW-019 (located on the southern boundary of the Wet Scrubber Sludge Pond) and groundwater elevation changes were greater than 50 feet in CFMW-016 (located on the eastern boundary of the Wet Scrubber Sludge Pond). Elevation fluctuations of greater than 50 feet were also observed at CFMW-007 (located on the western boundary of the West Landfill) during the same time (data was obtained from the Montana State Bureau of Mines website [MBMG, 2017]). The fluctuations in these upper hydrogeologic unit monitoring wells corresponded with increased seasonal precipitation and snow melt. Groundwater elevation data from wells screened below the

upper hydrogeologic unit did not show large fluctuations like the wells screened in the upper hydrogeologic unit. These fluctuations were gradual and do not correlate with the short-term precipitation events like the wells in the upper hydrogeologic unit (Roux Associates 2017c).

### 2.5.4 Seasonal Variability of Concentrations in Groundwater Samples

Groundwater elevation data obtained from CFMW-007 from April 2016 to July 2017 are graphically represented with the fluoride and cyanide concentrations in samples from monitoring wells located in the landfill area, as shown in Appendix A9 and A10, respectively. These graphs show that there were similar concentration ranges of cyanide and fluoride detections across the four rounds of sampling in the landfill area.

Concentrations of total cyanide and fluoride from the four groundwater sampling rounds were tabulated for comparison with groundwater elevations to further evaluate if Site-wide COPC and COPEC concentrations varied seasonally. For each monitoring well sampled during the Phase I Site Characterization, the minimum and maximum detected concentrations of total cyanide and fluoride were identified with their associated sampling round. Additionally, the minimum and maximum groundwater elevations for each monitoring well were identified. The comparison table is provided as Appendix A11.

As shown in Appendix A11, the maximum groundwater elevation in each well occurred during Round 4 (June 2017) with only one exception. In addition, Round 4 was when the greatest number of wells (but less than 50 percent of the wells) exhibited the minimum concentrations of total cyanide and fluoride.

Based on the results of the above evaluation for the data collected during the one-year period, the Phase I Site Characterization data provided a representative depiction of the temporal variation in groundwater conditions at the Site. Although the groundwater levels fluctuate seasonally, in general, cyanide and fluoride were detected in the same monitoring well locations during each round of sampling, and the primary source areas of cyanide and fluoride (i.e., the West Landfill, Wet Scrubber Sludge Pond, and Center Landfill) do not appear to change temporally. Iso-concentrations maps provided in the GW/SW Data Summary Report (Roux Associates, 2017c) indicate that the overall shape of the spatial distribution of total cyanide and fluoride detections were similar across the four rounds, and the maps mimic the groundwater flow directions from the primary source areas towards the Flathead River. The iso-concentration contours also indicate that the concentrations within the contoured area may vary seasonally, primarily in the areas immediately north and west of the Main Plant building.

Based on the results of the above evaluation for the data collected during the one-year period, the Phase I Site Characterization provided a representative depiction of the groundwater conditions at the Site. There is no readily apparent trend in concentration data with respect to temporal variability. However, given that only one year of sampling has been conducted, the temporal representativeness of the data would be improved with additional data collection during the Phase II Site Characterization.

# 3. PHASE II SITE CHARACTERIZATION OBJECTIVES

The objectives for the RI, as stated in the RI/FS Work Plan, are:

- Identify and characterize sources of COPCs;
- Determine the nature and extent of Site-related COPCs in soil, groundwater, surface water, sediment, and sediment porewater;
- Understand the transport and fate of COPCs in environmental media at the Site;
- Identify any complete or potentially complete exposure pathways (considering current and also potential future land use) and evaluate current and future human health and ecological risks posed by the COPCs present at the Site; and
- Support the development and evaluation of remedial alternatives for the Site.

In support of the Phase II Site Characterization objectives listed below, DQOs were developed using the USEPA DQO process (USEPA, 2006). The DQO process is designed to clarify the objectives of data collection and maximize efficiency during the data collection process. The DQO process is a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in the decision-making process are appropriate for its intended application. A summary of the step-by-step DQO process followed to develop the Scope of Work and objectives for the Phase II Site Characterization field activities is provided in Section 6.5.

The Phase II Site Characterization program has been designed to address any outstanding data gaps in order to conduct a risk assessment and complete the RI. Based on the current understanding of the Site conditions and the updated CSM following the completion of the Phase I Site Characterization, and the data gaps identified during preparation of the BHHRA WP and BERA WP, the following objectives were established for the Phase II Site Characterization:

- Refine the understanding of the nature and extent of COPCs around Site features investigated during the Phase I Site Characterization, and collect all data required for quantitative evaluation in the baseline risk assessment.
- Collect additional data to support the evaluation and refinement of COPCs which will occur during the development of the baseline risk assessments.
- Evaluate current conditions at RI areas/Site features and/or conditions within media that were not investigated during the Phase I Site Characterization, were identified as a data gap during the Phase I Site Characterization, or were discussed with EPA. Specific items to be investigated during Phase II Site Characterization include:
  - Topographic survey of the landfills;
  - Collection of an additional two rounds of surface water and groundwater quality data to evaluate the temporal variability in surface water and groundwater quality during the high-water and low-water season and to refine the understanding of surface water and groundwater conditions and temporal variability found during the Phase I Site Characterization;
  - Installation of additional water-table monitoring wells to refine the understanding of groundwater flow in the North-Central Undeveloped Area of the Site and in the Western Undeveloped Area of the Site;
  - Collection of sediment porewater for evaluation of COPEC bioavailability;

  - Assess conditions beneath the Main Plant building including utility tunnel area beneath the building; and
  - Collection of additional samples to assess the soil and groundwater quality downgradient of the Rectifier Yards and to confirm the findings of the Phase I Site Characterization.
- Address the data gaps identified in the BHHRA WP and BERA WP, including:
  - The collection of additional samples in areas of low sample density in order to calculate an exposure point concentration (EPC) that is representative of soil quality within each exposure are; specifically, within the Industrial Landfill Area, Eastern Undeveloped Area, North-Central Undeveloped Area, and Western Undeveloped Area.
  - The collection of additional soil, sediment, and surface water samples from offsite locations to characterize background COPC concentrations representative of regional conditions.
  - The collection of additional soil samples to characterize exposure in terrestrial exposure areas in order to evaluate and support ecological risk decision-making for these areas in the BERA.
  - The additional collection of soil, sediment, surface water, and porewater samples to assess COPEC bioavailability, and to develop adequate datasets to calculate statistically valid EPCs.
  - Additional spatial characterization of potential COPEC migration pathways from Site features, and characterization of areas limited to overland surface runoff and potentially historical atmospheric deposition.
  - Additional surficial and shallow soil vertical characterization of COPECs to sufficiently characterize exposure pathways.
  - The development of a statistically-robust background dataset in order to screen COPECs prior to further evaluation in the risk management step (Step 8) of the ERAGs process.
- Refine data to support identification and screening of remedial technologies as part of the FS.

The results of the Phase II Site Characterization will be used to refine the updated CSM/Conceptual Exposure Model (CEM) provided in the BHHRA WP and BERA WP (EHS Support, 2017a, b). As described in the RI/FS Work Plan (Roux Associates, 2015a), the CSM is continually updated as needed throughout the course of the RI based upon the evaluation of new data that is being collected and reviewed. The additional data collected as part of the Phase II will be evaluated to determine if any updates to the CSM are warranted. At the conclusion of the Phase II Site Characterization, the risk assessment will be completed in accordance with the procedures outlined in Section 6.0 of the RI/FS Work Plan (Roux Associates, 2015a) and in accordance with the BHHRA WP and BERA WP (EHS Support, 2017a, b).

# 4. PHASE II FIELD SAMPLING PLAN

The Phase II Site Characterization Scope of Work was developed based on the Phase II Site Characterization DQOs and the data requirements identified during preparation of the RI/FS Work Plan. The description of the basis for the sampling plan design is provided below, followed by a description of the sampling plan for the field activities planned for Phase II. The DQOs to support the field sampling plan design are provided in Section 6.5.

## 4.1 Field Sampling Plan Design

As further described in the DQOs outlined in Section 6.5.7, the Phase II Site Characterization locations and numbers of sampling points associated with each type of activity will be selected based upon a professional judgmental sample design. As described in USEPA guidance on sampling design (USEPA, 2002b), judgmental sampling design is appropriate when there is reliable historical and physical knowledge about the feature or condition under investigation; or, when the objective of the investigation is to screen an area(s) for the presence or absence of contamination at levels of concern, such as risk-based screening levels.

Judgmental sampling design conditions are generally applicable for the Phase II Site Characterization work. Specifically, with respect to judgmental sampling design, there is detailed knowledge about Site features based on the results of the Phase I Site Characterization, and the goals of the Phase II Site Characterization program that include use of risk-based screening levels to complete the screening of COPCs and COPECs for inclusion in subsequent risk assessment. As described in Section 6.5.3, EPCs for the BHHRA and BERA will typically be based on the upper confidence limit of the mean ($UCL_{mean}$) concentration for each COPC and COPEC. The calculation of statistically valid $UCL_{mean}$ typically requires a minimum of 8 to 10 observations, or more depending upon the variability of the population. Therefore, for each exposure area identified in the BHHRA WP and BERA WP, the sampling design proposed for the Phase II Site Characterization includes a minimum of 8 to 10 observations (sample locations), and most of the time more than 10, for each matrix evaluated in the exposure analysis. As further described in Section 6.5.7, statistical analysis of the Phase I soil data for select COPCs and COPECs was performed to inform the sample design process regarding the estimated minimum number of samples required within each exposure area to calculate $UCL_{mean}$ concentrations.

Although the sampling plan for delineation of known Site features is judgmental in its design and not fully random, the findings from Phase I Site Characterization activities were used to refine the Phase II sample locations to bias the sampling to areas where COPCs and COPECs are considered more likely to be present, which results in a conservative sampling design. Additionally, the judgmental design allows for placement of sampling locations to further delineate the extent of COPCs and COPECs horizontally and vertically as necessary based on the Phase I Site Characterization results.

Judgmental sampling design has also been used to develop the Scope of Work for investigation of hydrogeologic and groundwater quality conditions at the Site. The installation of new monitoring wells, as discussed in Section 4.6, were located based on the results of the Phase I Site Characterization to further define the extent of the groundwater contamination in the upper hydrogeologic unit, and to address groundwater flow and quality data gaps in certain areas of the Site. Per USEPA guidance, judgmental design is appropriate for groundwater sampling design considering the scale of the Site and the lack of adequate probabilistic investigation methods.

As discussed in the Phase I Data Summary Report (Roux Associates, 2017a), and as described in Section 4.5, twelve Decision Units (DUs) in the Operational Area of the Site require resampling. The resampling will utilize a stratified random sampling approach based on the USEPA guidance on sampling design (USEPA, 2002b) and the Interstate Technology & Regulatory Council (ITRC) Incremental Sampling Methodology (ITRC, 2012). The objective is to characterize soil quality conditions in the surface soil and shallow subsurface soil (0 to 0.5 ft-bls and 0.5 to 2.0 ft-bls, respectively) within the Operational Area of the Site, (Figure 2). Consistent with the sampling approach specified in Phase I SAP Modification #4 and utilized during the Phase I Site Characterization, the incremental sampling methodology was selected for this area to produce a more robust estimate of average soil conditions within individual grid cells uniformly distributed across the large area.

As discussed in Section 6.1 and Section 6.2 of the RI/FS Work Plan and consistent with the Phase I SAP (Roux Associates, 2015b), COPCs and COPECs will be evaluated during the Phase II Site Characterization based upon comparison of analytical results to human health and ecological screening levels drawn from the following sources as indicated for each media type. For screening levels based on regulatory sources, the most recent version of each screening level source will be used for comparison.

***Human Health Screening Levels***

***Soil***

- USEPA Residential Regional Screening Levels;
- USEPA Industrial Regional Screening Levels; and
- USEPA Protection of Groundwater Risk Based Soil Screening Levels.

***Surface Water, Sediment Porewater, and Groundwater***

- MDEQ Circular DEQ-7, Human Health Numeric Water Quality Standards;
- USEPA Drinking Water Maximum Contaminant Levels; and
- USEPA Tapwater RSLs.

***Sediment***

- USEPA Residential Regional Screening Levels; and
- USEPA Industrial Regional Screening Levels.

***Ecological Screening Levels***

***Soil***

- USEPA Ecological Soil Screening Levels;
- Los Alamos National Laboratory (LANL) ECORISK Database;
- Toxicological Benchmarks for Screening COPCs for Effects on Terrestrial Plants (Efroymson et al. 1997);
- Toxicological Benchmarks for Screening COPCs for Effects on Soil Invertebrates (Efroymson et al. 1997;
- Toxicological Benchmarks for Wildlife (Sample, B.E., 1996); and
- Region 5 RCRA Ecological Screening Levels.

***Surface Water, Sediment Porewater, and Groundwater***

- USEPA National Recommended Water Quality Criteria;
- MDEQ Circular DEQ-7;
- Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: (Suter and Tsao, 1996);
- USEPA Region 3 Freshwater Screening Benchmark; and
- Canadian Water Quality Guidelines, Summary Table.

***Sediment***

- Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems (MacDonald et al. 2000);
- USEPA Region 3 Freshwater Sediment Screening Benchmarks;
- Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella azteca* and the midge *Chironomus riparius;* (Ingersoll et al. 1996); and
- Region 5 RCRA Ecological Screening Levels.

Human health RSLs provided in the EPA Risk-Based Screening Tables will be based on target cancer risk of $1E^{-06}$ and target hazard quotient of 0.1. For the purposes of identifying COPCs, the lowest value, across all sources, should be selected as the screening level.

Concentrations of potential naturally occurring substances will also be compared to concentrations measured at background and upgradient sampling locations. A more detailed description of the background analysis is described in Section 4.11.

## 4.2 Phase II Site Characterization Activities

As discussed in Section 4.2 of the RI/FS Work Plan and summarized in Section 4.1 above, the RI is being conducted as an iterative approach and includes at least two phases of investigation work.

Based on the current understanding of the Site conditions and the updated CSM following the completion of the Phase I Site Characterization, and the data gaps identified during preparation of the BHHRA WP and BERA WP, the following tasks are planned to be conducted during the Phase II Site Characterization:

- Preparation of updated project operation plans, including an updated Health and Safety Plan (HASP);
- Pre-intrusive field activities, including Site reconnaissance of proposed Phase II sampling locations;
- Topographic survey of the landfills utilizing the Light Detection and Ranging (LiDAR) surveying method;
- Soil boring advancement and soil sampling;
- Monitoring well installation and development;
- Two rounds of water-level gauging;
- Two rounds of groundwater sampling of new and existing monitoring wells;
- Two rounds of surface water sampling at new and existing stations;
- Sediment sampling at new and existing stations;
- Sediment porewater sampling at new and existing stations; and

- Preparation and implementation of a Background Investigation SAP Addendum to characterize background concentrations of COPCs and COPECs in soil, sediment, and surface water.

The remainder of this Section describes the locations and sampling rationale for the Phase II Site Characterization field activities. A Site-wide summary of the proposed investigation locations are shown on Plates 1 and 2, and present the boundaries of the human health exposure areas and ecological exposure areas, respectively. The proposed soil sample locations are presented on Plate 3, the proposed surface water, sediment, and porewater sample locations are presented on Plate 4, and the proposed monitoring well and groundwater sample locations are presented on Plate 5.

Table 1 provides a summary of the samples defined for collection during the Phase II Site Characterization. The information in Table 1 includes: latitude and longitude collected via GPS and/or surveying at existing locations and determined from Geographic Information System (GIS) for proposed locations; and also sample information including the sample location type, sample media type, the closest Site feature to the sample, the rationale for each sample, and the proposed analyses for each sample. As indicated in the RI/FS Work Plan, it is anticipated the number of samples and/or locations of samples may be modified based upon the results of the pre-intrusive Site reconnaissance field activities. The scope of such modifications, if any, and the associated rationale, will be detailed in a SAP modification, and provided to USEPA for review prior to implementation.

## 4.3 Site Reconnaissance

A detailed Site reconnaissance will be performed prior to conducting other field investigation activities. The objectives of the Site reconnaissance are to:

- Field verify and GPS select proposed sampling locations;
- Refine sample locations that are proposed to delineate or to be biased towards areas of known or suspected areas of contamination; and
- Confirm accessibility and determine equipment requirements for access to proposed sampling locations.

The ground level field reconnaissance will consist of qualified scientists or engineers visually inspecting and photo-documenting the conditions of the proposed sampling locations and Site features. Key selected subcontractors (i.e., surveyor, drillers, risk assessors, etc.) may take part in selected aspects of the field reconnaissance to confirm equipment requirements for accessibility and to confirm the technical approach for their respective assignments.

Prior to beginning RI/FS field activities, planning meeting(s) will be conducted with CFAC's demolition contractor, Calbag Resources, LLC (Calbag), to ensure that the Calbag activities and the Phase II Site Characterization program are properly coordinated. The purpose of this planning will be to determine how best to sequence and/or adjust Phase II Site Characterization drilling activities in the vicinity of the ongoing Site decommissioning activities, to ensure that all of the Phase II Site Characterization objectives are met while also ensuring worker health and safety and allowing for continued progress of the Site decommissioning project.

## 4.4 Topographic Survey of Landfills

A topographic survey of the Site will be conducted by Roux Associates' subcontractor, Sands Surveying Inc. (Sands) of Kalispell, Montana, using LiDAR fly-over technology to document changes at the Site since the

last topographic survey conducted in 1997, as included in Roux Associates' RI/FS Work Plan (Roux Associates, 2015a). The topographic survey scope of work will include a ground control survey, data processing, and mapping showing roads, structures, visible utilities, water features with 1-foot contours. The survey will be utilized during the RI/FS to evaluate areas of runoff/overland flow, erosional features, anomalies related to differential settlement (if any) within the landfills, horizontal extent of disposal areas, and adequate slope for drainage.

## 4.5 Soil Borings and Soil Sampling

This section describes the Phase II Site Characterization soil boring and soil sampling program. The Phase II Site Characterization activities were designed to further delineate the horizontal and vertical nature and extent of COPCs and COPECs determined during Phase I, and to collect additional characterization data to refine soil quality conditions across the Site. Soil quality data collected during the Phase II Site Characterization will also be utilized during the risk assessments for final screening of COPCs and COPECs and to calculate representative EPCs. The remainder of this section describes the sampling location and procedure rationale.

The proposed Phase II soil boring locations are shown on Plate 3 and are summarized on Table 1. Proposed Phase II soil boring locations in each exposure area were selected based on a judgmental sampling design (USEPA, 2006) that targets the known sources and Site features, delineates COPCs and COPECs identified in the Phase I, and addresses the data gaps identified below. The number of proposed borings and spacing of proposed borings in the Phase II Site Characterization were selected with the goal of refining the characterization of the nature and extent of contamination within individual exposure areas, and to provide a robust dataset for representative EPCs to be calculated as part of the risk assessment.

The locations, depth interval, and analytical suite of Phase II soil borings are dependent on the sample rationale and exposure area, as presented in Table 1. A list of the analytical methods utilized for soil sample analysis is included in Section 4.13. A description of the soil boring investigations to be completed in Phase II and rationale for the work are provided below:

***Nature and Extent of COPCs in Site Features***

Select soil borings listed in Table 1 are proposed with the intent to refine the understanding of the nature and extent of contaminants identified during the Phase I Site Characterization. The proposed locations are typically within the boundaries of the Site feature being investigated, or along the perimeter of features to assess for impacts to the adjacent areas, and at depth intervals necessary to vertically characterize and/or delineate the soil conditions beneath the feature. Surface and shallow soil samples of landfill cover materials will also be collected from the landfills for which there are no design drawings or as-built drawings; specifically, the Sanitary Landfill, Center Landfill, Wet Scrubber Sludge Pond Landfill, and the Industrial Landfill.

Soil borings intended to characterize the nature and extent of contamination will be completed utilizing either hand augers or direct-push (e.g., Geoprobe™) techniques. Soil borings advanced with hand augers will be limited to borings that are proposed for completion at 2 ft-bls. In general, two soil samples will typically be collected for laboratory analysis from each soil boring advanced using hand augers, including: a discrete surface soil sample will be collected from the interval of 0-0.5 ft-bls; and a discrete shallow soil sample from the interval of 0.5 to 2 ft-bls. The Geoprobe™ will be utilized for borings deeper than 2 ft-bls with an anticipated maximum depth of 22 ft-bls. In general, three to six discrete soil samples will be collected for laboratory analyses from each soil boring advanced using the Geoprobe™ within unpaved areas depending on the proposed depth of the soil boring, including: a discrete surface soil sample will be collected from the interval of 0-0.5 ft-bls; a discrete shallow soil sample from the interval of 0.5 to 2 ft-bls; a discrete intermediate depth sample from a depth of 6 to 8 ft-bls; a discrete intermediate

depth sample from a depth of 10 to 12 ft-bls; a discrete deep sample from a depth of 15 to 17 ft-bls; and a discrete deeper sample from a depth of 20 to 22 ft-bls. Samples collected from 15-22 ft-bls are intended to delineate vertical contamination that was identified during the Phase I Site Characterization. In paved areas, the surficial sample will be omitted (due to pavement) and the shallow sample will be collected from the 2-ft depth interval immediately beneath the pavement materials.

***Site Boundary Soil Characterization***

The Phase I results identified detections of COPCs and COPECs, specifically PAHs, cyanide, fluoride, and selected metals in areas of the Site where former Site operations did not occur, and in the samples that are currently the greatest distance from the areas of Site operations. In an effort to vertically and horizontally delineate these COPCs and COPECs, a series of soil borings will be advanced along the extent of the western and eastern Site boundary, as defined in the RI/FS Work Plan (Roux Associates, 2015). Soil borings completed near the Site boundary will be advanced using hand augers and surficial (0-0.5 ft-bls) and shallow (0.5-2 ft-bls) soil samples will be collected.

***Characterization of Spatial Variability for Risk Assessment***

As identified in the risk assessment data gaps in Section 3.0, additional soil samples collected during the Phase II will also be utilized to support characterization of potential ecological and human health risk at the Site. Additional samples will be collected to increase the spatial density of sampling locations within exposure areas where limited sampling occurred during Phase I Site Characterization, or to characterize undeveloped areas of the Site where historical Site operations did not occur. Given that these areas were not developed as part of Site operations, potential COPC migration pathways to these areas are limited primarily to overland surface runoff and potentially localized historical atmospheric deposition. In addition, as described in Section 6.5.5, the variability in the existing data set for each exposure area was also evaluated using ProUCL to estimate the number of additional samples required to support the calculation of statistically valid EPCs. As a result of this analysis, additional samples were also added to some of the exposure areas that were more densely sampled during Phase I.

***Dioxins and Furans in Soil outside the Rectifier Yards***

The Phase I results identified localized detections of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in surficial and shallow soils collected in the Rectifier Yards. Surficial and shallow soil samples will be collected from eight soil borings outside the Rectifier Yards to delineate the extent of PCDDs/PCDFs and to determine if the PCDDs/PCDFs are confined to the rectifier yards. Soil samples results will be evaluated based on their TEQ levels. As described in Section 3.0, monitoring wells downgradient of the Rectifier Yards will also be sampled and evaluated for potential migration of COPCs from the Rectifier Yards.

***Operational Area Incremental Soil Sampling***

As discussed in the Phase I Data Summary Report (Roux Associates, 2017a), initially, the incremental soil samples collected from DUs 001 through 015 within the Operational Area during the Phase I Site Characterization were field processed by Roux Associates/Hydrometrics personnel. As documented in Phase I SAP Modification #4, field processing by Roux Associates/Hydrometrics was discontinued after sampling of DUs 001 through 015, and full composite samples were shipped to TestAmerica for laboratory controlled pre-processing and preparation in accordance with their Standard Operating Procedure (SOP) for Incremental Sampling Methodology (ISM) sampling. As part of this modification, three DUs (DU 002, 006, and 008) were re-sampled to allow for a comparison of the results from the two methods (field processing vs. laboratory processing), and for assessment of whether or not the initial field processing approach could have resulted in either a low or high bias relative to the laboratory processing methods, and in order to determine if re-sampling should potentially occur in the twelve DUs that were not re-sampled.

Due to the variability of the results in the assessment, it was determined that all twelve DUs (DU 001, 003, 004, 005, 007, 009, 010, 011, 012, 013, 014, 015) will be re-sampled utilizing the lab processing protocols in accordance with the ITRC ISM guidance as part of the Phase II Site Characterization.

As described in Section 4.1, a stratified random sampling approach will be utilized as per USEPA guidance on sampling design (USEPA, 2002b) and the ITRC Incremental Sampling Methodology (ITRC, 2012) to characterize soil quality conditions in the surface soil and shallow subsurface soil (0 to 0.5 ft-bls and 0.5 to 2.0 ft-bls, respectively). Each incremental soil sample will consist of 32 discrete grab samples distributed within the four quadrants of each grid (i.e., 8 samples per quadrant). The coordinates of the random locations will be established using GIS and a random number generator. Field personnel will utilize a hand-held GPS (with sub-meter accuracy) to navigate to each of the 32 sample locations within each grid for sample collection.

At each location, Cascade Drilling (Cascade), an experienced drilling subcontractor whom performed the Phase I Site Characterization drilling program, will advance a sampler using a Geoprobe™ direct push rig to a depth of 2 ft-bls. Consistent with the Phase I SAP Modification #4, soil samples will be collected using the "wedge" approach as defined in the ITRC February 2012 guidance document titled "Incremental Sampling Methodology" and discussed in the Roux SOP 5.12 titled Incremental Soil Sampling (ISS). A "wedge" of soil from the Geoprobe™ core at each of the 32 boring locations within a specific grid cell will be collected from the entire length of the targeted depth interval. Individual wedges, approximately 1-ounce (oz) by volume each, from the 32 locations will be combined to form an approximately 1-kilogram composite sample for the DU. Composite soil samples will be shipped to TestAmerica for processing prior to analysis in accordance with the laboratory ISS SOP included in Appendix B.

Section 5.3.5 of the ITRC Guidance for Incremental Sampling Methodology (ISM) states, "For sites with multiple similar DUs, "batch" type replicates may be a consideration; for example, three replicates in one DU could be used to provide an estimate of variability that is extrapolated to a number of similar DUs (similar to how labs use batch replicates for determining lab analysis precision)."

All of the DUs for the ISM sampling at the Site are located within the Operational Area and have a similar conceptual site model, including similar soil type, site use/history, and expected contaminant types. Based on the guidance, Roux proposes to collect three replicates from four DUs (ten percent of the DUs) during the Phase II. Based on the results of the sampling, an estimate of variability from replicate sampling will be extrapolated to the remaining DUs. The relative standard deviation (RSD) between replicates will be calculated to assess data precision and reproducibility (and, therefore, the confidence) in the data generated. The higher the RSD the less confidence there is that the data approximates a normal distribution and that the average contaminant concentration reported accurately represents the DUs. The approach and results of the extrapolation will be discussed in the Phase II Data Summary Report and will be revisited in the risk discussion as part of the risk assessment.

***PCB Delineation***

Discrete soil borings will be advanced within the Operational Area to better characterize the horizontal and vertical extent of the PCBs detected during the Phase I ISS sampling within DU-007, 013, 020, and 022. PCBs were detected at concentrations exceeding the USEPA Residential RSL for PCB Aroclor-1254 of 0.12 mg/kg in two of the incremental soil samples; surface soil sample CFISS-013 and shallow soil sample CFISS-020. Two soil borings will be advanced within each of the four grids along the dirt roads that traverse this area to assess whether there are any localized areas of higher concentrations. The sampling is biased towards the roads based upon historical anecdotal information from a former Site worker suggesting that oils were sprayed on the roads to mitigate the generation of dust by vehicles utilizing the roads. A surficial and shallow soil sample will be collected from each boring.

***Main Plant Building and Utility Tunnel Soil Borings***

Demolition of the Main Plant building was initiated by Calbag in 2015 and has continued through the first quarter of 2018. As of January 2018, the first four pot rooms and the West Rectifier Yard have been demolished and the pot room basements have been cleaned out. The demolition work will continue to proceed from west to east, until the remaining pot rooms are cleaned out and can be backfilled.

Soil borings are proposed to be advanced within the former footprint of the Main Plant building to characterize the soil to be left in place beneath the former pot room basements, and to investigate soil quality surrounding the Main Plant utility tunnel. There is potential that the Main Plant basements will be

backfilled prior to advancing the proposed soil borings. Due to the deep nature of the soil borings and the potential need to penetrate through the fill materials and the concrete basement floor, the borings will be advancing using Sonic-rotary drilling methods. At each proposed drilling basement location, soil borings will be advanced just beneath the former building foundation. Soil samples will then be collected from the 0-2 and 5-7-foot intervals below the former building foundation. A third sample will be collected 10-12 feet below the former foundation, or, if native soil is not observed in the 10-12-foot interval, the soil boring will be advanced until native soil is observed and a two-foot interval sample will be collected in the native soil.

A summary of the proposed soil samples in each exposure area is provided below:

| Interval | **0-2 Auger** | **0-2 Geoprobe** | **0-12 Geoprobe** | **0-12 Geoprobe** | **0-22 Geoprobe** | **0-12 Sonic** | **0-62 Sonic** | Total Samples |
|---|---|---|---|---|---|---|---|---|
| Samples | 2 | 2 | 3 | 4 | 6 | 3 | 3 | |
| Main Plant Area | 13 | 0 | 6 | 0 | 4 | 1 | 0 | 71 |
| Main Plant Building | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 42 |
| Eastern Undeveloped Area | 12 | 0 | 3 | 0 | 0 | 0 | 0 | 33 |
| Western Undeveloped Area | 13 | 0 | 3 | 0 | 0 | 4 | 0 | 47 |
| Central Landfill Area | 8 | 0 | 2 | 5 | 1 | 0 | 0 | 48 |
| Industrial Landfill | 5 | 0 | 3 | 0 | 0 | 2 | 0 | 25 |
| North Central Undeveloped Area | 7 | 0 | 10 | 0 | 0 | 0 | 0 | 44 |
| North Percolation Ponds | 6 | 0 | 0 | 0 | 5 | 0 | 0 | 42 |
| Operational Grid | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 40 |
| Landfill Samples | 12 | 6 | 0 | 0 | 0 | 0 | 0 | 36 |
| | 152 | 68 | 81 | 20 | 60 | 21 | 42 | **444** |

Cascade will also be utilized for the Phase II Site Characterization drilling program. All drilling activities will be overseen by the RI Manager and onsite engineers/scientists with experience in oversight of drilling programs.

Prior to drilling, Site plans and drawings will be evaluated and facility personnel consulted to identify whether subsurface utilities or obstructions may be present in the vicinity of the drilling locations. Within areas of the Site where subsurface borings or utilities may be present, the drilling locations will be pre-cleared by Cascade using non-mechanical methods (e.g., hand clearing, air knife, etc.) to a minimum of five ft-bls.

Consistent with the Phase I Site Characterization, the formation encountered during advancement of the entire soil boring will be described on borehole log forms in accordance with the Unified Soil Classification System (USCS). The core samples will be examined for evidence of potential impacts (i.e., staining, odor) and screened for the potential presence of VOCs using a Photoionization Detector (PID). Additional opportunistic soil samples may be collected and sent for laboratory analyses during soil boring activities based on visual observations and/or soil screening results encountered during drilling activities. Opportunistic samples may be collected if contaminants are evident at different depths including deeper or shallower than the proposed final depth, subsurface conditions indicate the presence of preferential pathways, or subsurface conditions prevent sampling at the pre-determined depths described above. If contamination is evident in the deepest proposed sample interval for the boring, drilling and sampling will proceed until observed contamination is no longer evident in the soil samples, until groundwater is encountered, or the limit of the equipment has been reached.

Select soil borings are proposed to be completed as monitoring wells as described in Section 4.6. Soil borings not completed as monitoring wells will be abandoned using grout or bentonite chips, with the top

three feet of each boring backfilled with soil cuttings. If visual impacts are observed during field screening of soils, the cuttings will be drummed for disposal and only clean material will be used for backfill.

## 4.6 Monitoring Well Installation

Eight soil borings are proposed to be completed as water-table monitoring wells. New monitoring wells will be used to supplement the Phase I Site Characterization and pre-existing monitoring well network at the Site. The proposed locations were selected to provide further evaluation of groundwater quality in areas that have not previously been monitored, and to further delineate the extent of COPCs and COPECs in groundwater. The additional wells will also help refine the understanding of Site groundwater flow.

The proposed monitoring wells to be installed during the Phase II Site Characterization are shown on Plate 5 and are summarized on Table 1. A summary of the rationale for the installation of Phase II monitoring wells is provided below:

- CFMW-066 and 067: Two wells screened in the upper hydrogeologic unit will be installed around the Industrial Landfill to assess groundwater quality around the landfill and to refine groundwater flow delineation in the North-Central Undeveloped Area.
- CFMW-057b, 065, 068, 069, 071: Five wells screened in the upper hydrogeologic unit will be installed in the Western Undeveloped Area. CFMW-057b will be installed as a nested well location adjacent to CFMW-057 and CFMW-057a to assess groundwater flow and quality in the upper hydrogeologic unit adjacent to Aluminum City; CFMW-065 will be installed to assess groundwater flow and quality in the western area of the Site, downgradient of the Industrial Landfill and the Northern Surface Water Feature; and CFMW-068, CFMW-069, and CFMW-071 will be installed to assess groundwater flow and quality in the western area of the Site between the Main Plant Area and Aluminum City.
- CFMW-070: One well screened in the upper hydrogeologic unit will be installed north of the Main Plant building within the Main Plant Area to assess groundwater quality and delineate potential sources to groundwater downgradient of the landfills.

The proposed locations may be modified based upon the results of Site reconnaissance and the initial phases of the drilling program.

The proposed Phase II Site Characterization monitoring wells will be installed below the groundwater table in the upper hydrogeologic unit. The screened interval of the wells will be determined by the RI field manager and the on-Site geologist/scientist performing oversight of the drilling activities based on field observations made during drilling and the understanding of groundwater fluctuations from the Phase I Site Characterization. Phase I Site Characterization wells installed in the upper hydrogeologic unit were screened 5 to 10 feet below the water table at time of drilling to account for seasonal water level fluctuations; newly installed wells screened in the upper hydrogeologic unit will be installed in a consistent fashion. Screen zones in the water table wells will consist of 10 feet of screen, with the top of screen located approximately 5 to 10 feet below the observed water table at the time of drilling to account for seasonal fluctuations in groundwater elevations. Although unlikely based on the results of the Phase I Site Characterization, if field observations suggest the well should be installed to bridge the water table due to the potential presence of light non-aqueous phase liquids (LNAPL) then the well will be installed with 15 feet of screen, including 5 feet above and 10 feet below the water table. Construction details for new monitoring wells will be provided in well logs in the Phase II Data Summary Report.

Monitoring wells will be constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and 2-inch diameter, 20-slot (0.020 inches) PVC screen flush-threaded onto the PVC casing. Surface completion of each well will consist of a protective stick-up enclosure and a locking J-plug and an exterior lockable metal cover. The location of each monitoring well will be logged with GPS technology with sub-meter accuracy. Following surface completion, all newly installed monitoring wells will be surveyed by Sands of Kalispell, Montana for horizontal (North American Datum [NAD] 83) and vertical (North American Vertical Datum [NAVD] 88) coordinates within the Montana State Plane Coordinate System (FIPS2500).

Newly-constructed monitoring wells will be developed and allowed a minimum of one-week to equilibrate with the surrounding formation prior to sampling. The development will be completed using a surge block and submersible pump. The surge block will be used inside the well to flush fine sediments from the sand filter. After the well is surged, a submersible pump will be lowered into the well and groundwater will be withdrawn. Temperature, pH, specific conductance, and turbidity readings will be monitored and pumping will proceed until the discharge water meets a field turbidity value to 10 formazin nephelometric units/nephelometric turbidity units (FNU/NTU) or less or until the field turbidity does not improve for a period of two hours during active development.

While drilling water table monitoring wells, soil samples will be collected from select monitoring wells from above the water table and within the screen of the saturated zone. Samples will be collected for geotechnical analysis including grain size, bulk density, total organic carbon, and moisture content analysis. These data will be used if needed to support the risk assessment and fate and transport evaluation as per the MDEQ guidance document titled “Technical Guidance General Field Data Needs for Fate and Transport Modeling” (MDEQ, 2008).

## 4.7 Long Term Elevation Monitoring with Pressure Transducers

Six (6) In-Situ Level Troll 700 pressure transducers were deployed in six existing monitoring wells at the Site in March 2017 as part of the Phase I Site Characterization. The pressure transducers were deployed to continuously collect groundwater elevation fluctuations in nested monitoring wells CFWM-016, 016a, 109, 019a, 053, 053a, around the West and Center Landfills, and near the Flathead River downgradient of the landfill area.

Groundwater elevation fluctuations around the landfills and in various areas of the Site will continue to be monitored utilizing pressure transducers during the Phase II Site Characterization. Roux will also continue to monitor the Montana State Bureau of Mines pressure transducer deployed in existing monitoring well CFMW 007/TW 3 (identified ID 87873 in the Montana Bureau of Mines and Geology [MBMG] website well database [MBMG, 2017]). In addition, pressure transducers will be placed in new Phase II monitoring wells CFMW-066, CFMW-065, and CFMW-069. The data obtained from these transducers will be utilized in conjunction with the existing pressure transducer network and the Site-wide gauging data to facilitate comprehensive understanding of Site-wide groundwater fluctuations.

## 4.8 Groundwater Gauging and Sampling

Groundwater levels will be measured across the monitoring well network once during high water season and once during low water season following installation of all Phase II monitoring wells to refine the existing understanding of Site-wide groundwater elevations and groundwater flow. Groundwater levels will be collected with an electronic water-level meter capable of measuring fluid elevation with an accuracy of 0.01 ft.

When conducting comprehensive gauging rounds, an effort will be made to collect all groundwater level measurements on the same day to provide a snapshot of the Site-wide conditions.

Groundwater samples will be collected from all newly-constructed monitoring wells, and all existing Site monitoring wells and former production wells that are deemed accessible and in good condition during Site reconnaissance and monitoring well gauging. Groundwater samples will be collected once during high water season (May/June 2018) and once during low water season (October/November 2018) following installation of all Phase II monitoring wells to characterize groundwater quality beneath the Site during varying seasonal conditions. To ensure that the groundwater sampling events occur during the high water and low water season for 2018, historic groundwater elevation data will be considered as discussed in Section 2.5.3. Additionally, groundwater elevation will be monitored using real-time data from the MBMG pressure transducer to confirm the timing of high water and low water seasons.

As described in Section 4.5, the Phase I Site Characterization results identified localized detections of PCDDs and PCDFs in soils collected in the Rectifier Yards. Since PCDDs, PCDFs, and PCBs were not analyzed in groundwater during the Phase I, the potential for PCDDs, PCDFs, and PCBs from the Rectifier Yards to impact Site groundwater was identified as a data gap, as described in Section 3.0. Groundwater samples from six monitoring wells downgradient of the Rectifier Yards will be sampled to determine if there is migration of these contaminants to groundwater.

Groundwater samples will be collected using the methods described in the USEPA guidance document titled "Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling" (USEPA, 2010). During purging, a water quality meter will be used to monitor water quality indicator parameters such as pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), temperature, and turbidity. The field parameters will be recorded on monitoring well sampling data forms and submitted with the Phase II Data Summary Report.

During both groundwater sampling events, groundwater samples will be analyzed for the analytical parameters presented in Table 8. All groundwater samples submitted for analysis of dissolved concentrations will be field filtered using a standard 0.45-micron filter.

## 4.9 Monitoring Well Slug Testing

Roux Associates will complete slug tests at new monitoring wells installed during the Phase II Site Characterization following the completion of groundwater sampling during the high-water season. The slug testing will be performed to evaluate hydraulic conductivity of the upper hydrogeologic unit at the new monitoring well locations. The hydraulic conductivity data from each tested well will be added to the overall Phase I Site Characterization dataset provided in the GW/SW Data Summary Report (Roux Associates, 2017c) and used for evaluation of groundwater flow beneath the Site.

Pneumatic slug tests will be conducted on the new 2-inch diameter wells where the entire length of screen of the monitoring well is submerged beneath the level of standing water in well. Mechanical slug tests will be conducted on any newly installed wells with partially submerged screens, although it is not anticipated during the high-water season when slug tests will likely be conducted.

Pneumatic slug tests will be conducted within the casing of each well using compressed air as the displacing (slug) volume. The water column within the well casing will be depressed by increasing the air pressure in the casing above the water column. When the water level is depressed to a predetermined level and the air

pressure stabilized within the test interval, the air pressure within the well casing will be rapidly released. The instantaneous release of air pressure from the well casing will initiate a pneumatic slug withdrawal test, which will be recorded using a pressure transducer and a data logger. All tests will be conducted in accordance with the procedures outlined in the SOP titled "Standard Operating Procedure 4.8 for Conducting a Pneumatic Slug Test."

Mechanical slug tests, if needed, will be conducted within the casing of each well using a solid cylinder (slug). Due to the fact that mechanical slug tests are being performed on water table wells, the testing will be limited to "slug-out" tests. As part of the "slug-out test", the water column within the well casing will be decreasing by rapidly removing the solid slug from the water column. All changes in water levels will be recorded using a pressure transducer and a data logger. All tests will be conducted in accordance with the procedures outlined in the SOP titled "Standard Operating Procedure 4.9 for Conducting a Mechanical Slug Test."

At each location, the test will be conducted with an approximate l-foot displacement. The test will be repeated at each well using 1-foot displacement to determine the reproducibility of the data. If water levels return to static or near static conditions within one hour, another test will be conducted using an approximate 2-foot displacement.

Data analysis to determine hydraulic conductivity values for each test will be performed using a combination of Excel, Aqtesolv or Geoprobe™ Slug Test Analysis software, and Win-Situ software. All data analysis procedures, including decision making processes, will be conducted in accordance with the procedures outlined in the SOP titled "Standard Operating Procedure 4.10 for "Analyzing Slug Test Data." Results of the slug testing analysis will be provided in the Phase II Data Summary Report.

## 4.10 Surface Water, Sediment, and Sediment Porewater Sampling

Surface water, sediment, and sediment porewater samples will be collected from surface water features present at the Site to evaluate the quality of these media. Surface water, sediment, and sediment porewater samples will be collected from within the following surface water features, if water is present in the feature at the time of sampling, including:

- North-East Percolation Pond
- North-West Percolation Pond
- South Percolation Ponds
- Backwater Seep Sampling Area
- Cedar Creek
- Cedar Creek Reservoir Overflow Ditch
- Flathead River
- Northern Surface Water Feature

The proposed surface water, sediment, and sediment porewater sample locations are shown on Plate 4 and summarized in Table 1. Within each feature, the order of sample collection will be from downstream to upstream, to minimize any potential for suspected sediment impacts from sampling activities on downstream sample locations. A list of the analytical methods utilized for surface water, sediment, and sediment porewater sample analysis is included in Section 4.13. A description of the proposed sampling for each media is described in the following sections.

### 4.10.1 Surface Water Sampling

Surface water samples are proposed to be collected at locations shown on Plate 4 and summarized in Table 1. To further assess the temporal variability of surface water quality at the Site, surface water samples will be collected once during high water season and once during low water season in 2018, as described in Section 2.5.1.

Surface water samples in the South Percolation Ponds and Backwater Seep Sampling Area will only be collected once during the high-water season (May/June 2018), since surface water samples were collected in the low water season (October/November 2017) as part of the Expedited Risk Assessment for the South Percolation Ponds.

Surface water samples will be collected by taking a grab sample directly from the water body using the sample collection container for each analysis. Samples will be collected at a depth of approximately 60 percent of the total water column depth and no greater than a maximum water depth of two feet. As part of sample collection activities within the surface water features, surface water will be field analyzed with a water quality meter to evaluate water quality parameters including temperature, conductivity, pH, DO, and ORP. The water quality meter will be placed directly in the surface water feature and will be monitored until stable readings are observed. The location of each sample will be logged with GPS technology with sub-meter accuracy. The readings and GPS location will be recorded on a field datasheet and included as part of the Phase II Data Summary Report.

Consistent with the Phase I Site Characterization, several new and existing surface water sample locations along the Flathead River are inaccessible by foot due to the presence of forested areas and limited bank/shoreline for traversing. Therefore, Roux Associates will collect these samples with the use of a boat provided by Roux Associates' subcontractor Kennedy/Jenks Consulting. A captain representative of Kennedy/Jenks Consulting will steer the boat through the river, and the inaccessible surface water samples will be collected from the boat by taking a grab sample directly from the waterbody using the sample collection container for each analysis.

During both surface water sampling events, surface water samples will be analyzed for a range of analytical parameters dependent on the exposure area, surface water feature, and purpose of the sample as presented in Table 1 and described in Section 4.13. All surface water samples submitted for analysis of dissolved concentrations will be field filtered using a standard 0.45-micron filter and collected using a peristaltic pump.

During both surface water sampling events, the discharge of Cedar Creek and Cedar Creek Reservoir Overflow Ditch will be measured utilizing a mechanical current-meter method in accordance with Roux SOP 6.7. The stream channel cross section will be divided into numerous vertical subsections. In each subsection, the area will be obtained by measuring the width and depth of the subsection, and the water velocity will be determined using a current flown meter. The discharge in each subsection will be computed by multiplying the subsection area by the measured velocity and the total discharge will be computed by summing the discharge of each subsection.

The temporary staff gauge installed within the Flathead River will continue to be monitored to measure river level conditions immediately adjacent to the Site. For the Flathead River, the instantaneous discharge measurement from USGS Station 12363000, located down river of the Site, will be recorded. River levels measured at the staff gauge will be used in conjunction with measured groundwater elevations to evaluate groundwater / surface water interactions.

### 4.10.2 Sediment Sampling

Sediment samples will be collected from the same locations as surface water samples, if water is present, immediately following the collection of surface water samples. The proposed sediment sample locations are shown on Plate 4 and summarized in Table 1.

Seasonal conditions and river stage will be taken into account when collecting sediment samples. It is anticipated that sediment sampling activities in the North Percolation Ponds and Northern Surface Water Feature will be performed in high water season because these surface water features tend to be dry or have very low flow during low water season, and because these features do not receive groundwater discharge based upon the bottom of the feature elevations. It is anticipated the sediment sampling activities in the Flathead River will be performed in late October/November 2018 when the river stage is at a low level and because the Flathead River is functioning as a gaining stream. Sediment in Cedar Creek will also be sampled during low-water season.

As discussed in Section 2.5, the total recoverable concentrations of inorganic and non-volatile organic COPECs in bulk sediment within aquatic and transitional habitats are not expected to vary seasonally. Only one round of additional sediment data will be collected within surface water features when the surface water features are expected to be wet. If any proposed sediment locations are determined not to contain unconsolidated materials that meet the definition of sediment as defined by USEPA as “suspended and bedded sediments” (USEPA, 2003), a surface soil sample will be collected in its absence.

Sediment samples are not proposed for collection from the Cedar Creek Drainage Overflow Ditch because all sediment locations attempted to be collected during the Phase I did not appear to be depositional areas. However, per USEPA’s request, the area upstream of the small dam within the Overflow Ditch will be inspected for sediment and sampled for sediment and sediment porewater, if present. Sediment samples will not be collected in the South Percolation Ponds or Backwater Seep Sampling Area because sediment was collected at these surface water features in October/November 2017 as part of the Expedited Risk Assessment for the South Percolation Ponds.

Sediment will be collected by grab sampling surface sediment from 0-0.5 ft immediately beneath the sediment-surface water interface, and placing in sampling jars for laboratory analysis. Gravel and larger sized grains will be removed from the sample by utilizing a size #10 sieve prior to packaging and shipment for laboratory analysis.

Sediment samples will be analyzed for a range of analytical parameters dependent on the exposure area, surface water feature, and purpose of the sample, and as presented in Table 1.

### 4.10.3 Sediment Porewater Sampling

Sediment porewater samples will be collected from the same locations as surface water samples and sediment samples, if water is present, immediately following the collection of the surface water sample and prior to collection of bulk sediment samples. The proposed sediment porewater sample locations are shown on Plate 4 and summarized in Table 1.

Concurrent with the sediment sampling activities, sediment porewater sampling in the Flathead River will be performed in late October/November 2018 when the river stage is at a low level and the Flathead River is

functioning as a gaining stream. Sediment porewater will also be sampled from Cedar Creek during the low-water season.

Sediment porewater will not be collected from the Cedar Creek Drainage Overflow Ditch because all locations attempted to be collected during the Phase I did not appear to be depositional areas, with the single exception of a potential porewater sediment sample within the weir if depositional material is observed, as discussed in Section 4.10.2. Although sediment samples are not proposed to be collected in the South Percolation Ponds or Backwater Seep Sampling Area, sediment porewater will be collected from these locations because sediment porewater was not evaluated during the Expedited Risk Assessment.

Where feasible, sediment porewater will be collected by utilizing a “PushPoint” or equivalent sampling tool inserted directly into the sediments. The PushPoint is a 6.4-millimeter-diameter stainless-steel tube with a machined point and 4-centimeter-long slotted-screen zone at the tip (Henry, 2001) designed to sample *in-situ* porewater without introducing surface water into the sample. The uppermost slot of the screen will be placed approximately 5-cm below the sediment surface, and a peristaltic pump will be used to draw water samples through the PushPoint sampler. Where feasible, porewater sampling will be conducted in accordance with the procedures outlined in the SOP titled "Standard Operating Procedure 4.11 for Collection of Porewater Samples," and the associated “PushPoint Sampler Operations Manual and Applications Guide.” It is possible that some conditions will dictate deviations from the procedures outlined in the SOP. For example, the bed of the Flathead River is composed of coarse grained (gravel to cobbles), which may limit the ability to insert the sampling probe or to use the flange to isolate the probe. Likewise, it is possible that extraction of sufficient pore water volumes with the PushPoint may be difficult or infeasible in some fine-grained deposits associated with the North Percolation Ponds and Northern Surface Water Feature. In such instances deviations from the SOP may be warranted. However, any deviations and alternative methods will require discussion and approval from the management team.

As discussed in Section 3.0, the total recoverable concentrations of inorganic and non-volatile organic COPECs in bulk sediment within aquatic and transitional habitats are not expected to vary seasonally in surface water features that are not connected to the groundwater system (i.e., Cedar Creek, North Percolation Ponds). Within the Flathead River which is subject to groundwater input, variable concentrations, if any, would be expected to be greatest during low-water season when potential COPEC inputs from groundwater are highest. As such, only one round of sediment porewater data will be collected within surface water features.

## 4.11 Background Investigation

A soil, sediment, and surface water sampling program will be conducted to characterize the naturally occurring background concentrations of COPCs and COPECs in areas outside the Site that are unaffected by historic Site operations or other readily identifiable anthropogenic sources of contamination.

Roux Associates will prepare a Background Investigation SAP Addendum to document sample location and rationale and sample methodology prior to sample collection. The Background Investigation SAP Addendum will identify and describe the reference areas where background samples, specify numbers of samples to be collected from each area, and explain the statistical methodology that will followed to compare site data to reference area data.

Background reference areas should have the similar physical, chemical, climatic, geological, and biological characteristics as the Site being investigated, but have not been affected by activities on the Site (USEPA,

2002c). For soil and sediment, background reference stations should be considered based on physical characteristics such as particle size distribution, organic matter content, hydrologic regime, and pH. For surface water, background reference stations should consider chemistry, depth, and flow.

Climatic characteristics such as moisture, temperature, and elevation; and biological characteristics such as organism abundance, species richness, and species diversity (USEPA, 1994) should be considered for all media. Surface water and sediment background reference areas should be located upgradient where locations have not been affected by Site activity.

The evaluation for background reference areas will be conducted prior to the submittal of the Background Investigation SAP Addendum. Background reference areas for surface water and sediment will likely include upgradient locations in Flathead River and Cedar Creek outside of the Site boundary. A total of 30 background soil samples, 20 surface water samples, and 20 sediment samples will be collected as part of the Background Investigation. Background surface water and sediment samples will be collected once during low water season in Cedar Creek and the Flathead River, consistent with the sample timing for the Phase II Site Characterization sampling.

Background reference stations will be presented on a figure in the Background Investigation SAP Addendum. Additional details regarding background sampling rationale and DQOs will also be provided in the Background Investigation SAP.

## 4.12 Fate and Transport Evaluation

As described in the RI/FS Work Plan Section 5.7, the collection of fate and transport soil parameters will continue during the Phase II Site Characterization to facilitate fate and transport evaluation. Field data recommended for chemical fate and transport modeling is described in Table 3 of the MDEQ guidance document titled “Technical Guidance General Field Data Needs for Fate and Transport Modeling” (MDEQ, 2008). Fate and transport analytical parameters, including grain size distribution (sieve and hydrometer), moisture content, total organic carbon, and bulk density, will be analyzed on selected soil samples during the Phase II Site Characterization soil sampling program to support future fate and transport assessment and modeling efforts, if necessary as part of the RI/FS. Samples to be analyzed for fate and transport analytical parameters are presented in Table 1. Laboratory analysis methods for fate and transport soil parameters are listed in Section 4.13.

Groundwater and surface water data relevant to fate and transport evaluation will also be collected, including field parameters such as pH, dissolved oxygen, temperature, and ORP, and analytical parameters listed in the nutrient and metal parameter list.

## 4.13 Laboratory Analytical Methods

Samples will be sent under chain-of-custody to TestAmerica Laboratories, Inc. in Edison, New Jersey, Pittsburgh, PA, and Burlington, Vermont, which were the laboratories utilized for the RI/FS Phase I Site Characterization. Samples will be analyzed for a range of analytical parameters dependent on the exposure area, related Site feature, and purpose of the sample as presented in Table 1 and described in Section 4.1. Select samples will be analyzed by TestAmerica via the following methods:

**Soil**

- Target Compound List (TCL) VOCs (excluding surface soil samples) via USEPA Method 8260B (utilizing Terra Core samplers);

- TCL Semivolatile Organic Compounds (SVOCs) via USEPA Method 8270 Low Level (LL);
- Target Analyte List (TAL) metals via USEPA Method 6020A / 7471B;
- Total cyanide via USEPA Method 9012B;
- Fluoride via USEPA Method 9056A;
- TCL PCBs via USEPA Method 8082;
- TCL Pesticides (surface samples only) via USEPA Method 8081;
- PCDD/PCDF via USEPA Method 8290A;
- Total Organic Carbon (TOC) via the Lloyd Kahn Method;
- Grain size distribution (sieve and hydrometer) via American Society for Testing and Materials (ASTM) Method D422;
- Moisture content via ASTM Method D2216-90;
- Bulk density via ASTM Method D-2937-04;
- Specific gravity via ASTM Method D854;
- Atterberg limits (liquid limit, plastic limit & plasticity index) via ASTM Method D4318;
- Porosity (as a calculation from specific gravity & density); and
- Flexible wall permeability via ASTM D5084, standard proctor via ASTM D689, and fixed wall permeability via ASTM D2434.

Select soil samples will also be analyzed for pH in the field, in accordance with SOP 5.14.

**Groundwater**

- TCL VOCs via USEPA Method 8260B;
- TCL SVOCs via USEPA Method 8270 LL;
- TCL total metals via USEPA methods 6020A / 7470A;
- TCL dissolved metals via USEPA methods 6020A / 7470A;
- Total cyanide via USEPA Method 335.4;
- Dissolved total cyanide via USEPA Method 335.4;
- Free cyanide via USEPA Method 9016;
- Dissolved free cyanide via USEPA Method 9016;
- General chemistry including fluoride via USEPA Method 300, alkalinity via USEPA Method 2320B, and total hardness via USEPA Method 2340C;
- Nutrients including chloride and sulfate via USEPA Method 300.0, nitrate and nitrite as N via USEPA Method 353.2, ammonia nitrogen via USEPA Method 350.1, sulfide via USEPA Method 4500S2F, and orthophosphate as P via USEPA Method 9056A;
- Total suspended solids (TSS) and total dissolved solids (TDS) via Standard Method 2540D/C;
- TCL PCBs via USEPA Method 8082; and
- PCDD/PCDF via USEPA Method 8290A.

**Surface Water**

- TCL total SVOCs via USEPA Method 8270 LL;

- Total TAL metals via USEPA Methods 6020A / 7470A;
- Dissolved TAL metals via USEPA Methods 6020A / 7470A;
- Total cyanide via USEPA Method 335.4;
- Free cyanide via USEPA Method 9016;
- General chemistry including fluoride via USEPA Method 300, alkalinity via USEPA Method 2320B, and total hardness via USEPA Method 2340C;
- Nutrients including total chloride and dissolved sulfate via USEPA Method 300.0, nitrate and nitrite as N via USEPA Method 353.2, ammonia nitrogen via USEPA Method 350.1, sulfide via USEPA Method 4500S2F, and orthophosphate as P via USEPA Method 9056A;
- TSS and TDS via Standard Method 2540D/C; and
- TOC and total dissolved carbon (DOC) via Lloyd Kahn Method.

**Sediment Porewater**

- TCL dissolved SVOCs via USEPA Method 8270 LL;
- Dissolved TAL metals via USEPA Methods 6020A / 7470A;
- Dissolved cyanide via USEPA Method 335.4;
- Dissolved free cyanide via USEPA Method 9016;
- General chemistry including dissolved fluoride via USEPA Method 300, dissolved alkalinity via USEPA Method 2320B, and total hardness via USEPA Method 2340C;
- Nutrients including total chloride and dissolved sulfate via USEPA Method 300.0, nitrate and nitrite as N via USEPA Method 353.2, ammonia nitrogen via USEPA Method 350.1, sulfide via USEPA Method 4500S2F, and orthophosphate as P via USEPA Method 9056A;
- TDS via Standard Method 2540D/C; and
- DOC via Lloyd Kahn Method.

**Sediment**

- TCL SVOCs via USEPA Method 8270 LL;
- TAL metals via USEPA Method 6020A / 7471B;
- Total cyanide via USEPA Method 9014;
- Fluoride via USEPA Method 9056A;
- TOC via the Lloyd Kahn Method;
- Grain size distribution (sieve and hydrometer) via ASTM Method D422; and
- Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM) via USEPA-821-R-100.

## 4.14 Investigation Derived Waste Management

Phase II Site Characterization Investigation Derived Waste (IDW) will be managed in accordance with the approved May 9, 2016 IDW Management Plan (MP) (Roux Associates, 2016b) utilized during the Phase I Site Characterization. The IDW MP was prepared to establish consistent methods to handle and manage all IDW, including:

- Impacted environmental media, and solid waste, both hazardous and non-hazardous (e.g., soil cuttings, contaminated debris or equipment, etc.);

- Liquid waste, both hazardous and non-hazardous (e.g., purge water, rinse water from decontamination, etc.);
- Sludge/sediment waste, both hazardous and non-hazardous (e.g., sediment that settles at the bottom of the frac tank, etc.); and
- Personal Protective Equipment (e.g., gloves, chemical-resistant coveralls, etc.).

IDW is expected to be generated during implementation of the field work activities described in this Phase II SAP. A description of the types of IDW expected at the Site and the associated field activity is provided below:

Pre-Intrusive Activities (Site Reconnaissance)

- PPE which potentially comes into contact with waste materials or contaminated media.

Drilling / Soil Sampling / Sediment Sampling / Well Installation

- Soil cuttings that are brought to the surface during drilling.
- Water generated during drilling and development of monitoring wells.
- Water generated by decontamination of drilling / sampling equipment.
- PPE which potentially come into contact with contaminated media.
- Sediment / sludge that may collect at bottom of liquid waste containers.

Groundwater Sampling / Surface Water Sampling / Porewater Sampling

- Purge water generated during sampling.
- Water generated by decontamination of sampling equipment.
- PPE which potentially comes into contact with contaminated media.

Other

- Impacted sampling disposables (i.e., filters, tubing, bladders, etc.).
- Ordinary trash (e.g., office and packaging materials, food and beverage containers, etc.).

Materials generated at the Site will be segregated based on the type of media and then characterized as hazardous or non-hazardous, as detailed in the IDW MP.

The equipment and supplies that may be required for implementation of the procedures outlined in this Work Plan include the following:

- Containers for storage and shipment of IDW
  - Four 25-yard roll-off containers for soil cuttings.
  - One 21,000-gallon frac tank for water.
  - 55-gallon drums.
- Material to cover/protect waste from exposure to weather conditions (e.g., poly sheeting, tarps, etc.).
- Equipment typically utilized during sampling (i.e., pumps, generators, water level indicators, safety monitoring equipment, etc.).
- Waterproof labels for hazardous /non-hazardous waste.

- Permanent marking pens.
- Plastic garbage bags, zip lock storage bags, rolls of plastic sheeting.
- PPE to protect against contact with IDW as required in the Site-specific HASP, including, but not limited to, steel-toed boots, chemical resistant gloves, and safety glasses.

Soil and water IDW will be managed by Cascade and Roux Associates throughout the Phase II Site Characterization. Each container will be sampled for waste characteristics prior to scheduling disposal, and results will be provided to USEPA and the state where the waste will be shipped (i.e. Washington Department of Ecology/Oregon DEQ) for notification purposes. IDW will be transported to CERLA-approved facilitates in accordance with the IDW MP. Soil IDW will be transported in roll-offs offsite by Cascade for disposal at Waste Management Graham Road Landfill in Medical Lake, Washington. Water IDW will be transported offsite in vacuum trucks by Cascade or disposal at Chemical Waste Management, Oregon. Waste shipments will be documented on non-hazardous waste manifests and will be included in the Phase II Data Summary Report.

# 5. FIELD SAMPLING PROCEDURES

This section discusses the SOPs and sample designation procedures that will guide the Phase II Site Characterization field activities.

## 5.1 Standard Operating Procedures

Roux Associates has developed a set of SOPs that are applicable for the proposed Phase II Site Characterization field sampling and data collection program. The SOPs were developed following USEPA and other applicable standard protocols. A list of relevant SOPs is provided below and copies of the SOPs are provided in Appendix B.

SOP 3.1 — Collection of Quality Control Samples for Water-Quality Data

SOP 3.2 — Field Record Keeping and Quality Assurance/Quality Control

SOP 3.3 — Sample Handling

SOP 4.2 — Measuring Water Levels Using an Electronic Sounding Device

SOP 4.3 — Purging a Well

SOP 4.4 — Sampling Ground-Water Monitoring Wells for Dissolved Constituents

SOP 4.5 — Surface-Water Sampling

SOP 4.6 — Filtration of Ground-Water and Surface-Water Samples for Dissolved Metals Analysis

SOP 4.7 — Measuring the Thickness of Separate-Phase Organic Liquids

SOP 4.8 — Conducting a Pneumatic Slug Test

SOP 4.9 — Conducting a Mechanical Slug Test

SOP 4.10 — Analyzing Slug Test Data

SOP 4.11 — Collection of Sediment Porewater Samples

SOP 5.1 — Collection of Soil Samples for Laboratory Analysis

SOP 5.2 — Collecting Stream-Bed, Pond, and Lagoon Sediment Samples

SOP 5.4 — Screening Soil Samples for Volatile Organic Vapors Using a Portable Photoionization Detector

SOP 5.5 — Soil Classification and Logging Procedures

SOP 5.12 — Incremental Soil Sampling

SOP 5.14 — Testing Soil pH in the Field Using a Portable pH Meter

SOP 6.4 — Measuring Water Quality Parameters

SOP 6.5 — Photo Documentation

SOP 6.6 — Collection of GPS Information

SOP 6.7 — Measuring Stream Discharge

SOP 9.1 — Decontamination of Field Equipment

SOP 10.3 — Soil Boring and/or Monitoring or Observation Well Drilling, Formation Sampling, and Borehole Abandonment in Unconsolidated Formations

SOP 10.4 — Construction, Development, and Abandonment of Monitoring or Observation Wells in Unconsolidated Formations

## 5.2 Sample Designation Procedures

Consistent with the Phase I Site Characterization sample designation procedures, all screening locations and analytical samples, including samples collected for QA/QC purposes, will be given a unique Site-specific sample identification number. The sample identification number will be used to track field-screening data and laboratory analytical results in the project database, as well as for presentation of the data in memoranda and reports. During the investigation, the sample numbers will be recorded in the field logbook and field datasheets, on the sample jars, and on the COC paperwork.

The Site-specific format will include the following structure:

1. Project Identification Code
   All samples collected during the RI will be labeled as "CF" to represent Columbia Falls Aluminum Company.
2. Sampling Location Type
   All samples will include an alpha identification code to identify the type of sample location:
   - SB = Soil Boring
   - MW = Monitoring Well
   - SWP = Surface Water Point
   - SDP = Sediment Point
   - PWP = Porewater Point
   - WC = Waste Characterization
   - ISS = Operational Area Incremental Soil Sample
3. Sample Location Number
   For new Phase II Site Characterization sampling locations, each unique sample location will receive a unique numerical ID. During the Phase I Site Characterization, numerical IDs started with "001" for each sample location type. The unique numerical ID will continue from the last numerical ID used during the Phase I for each sample location type (with the exception of porewater samples which are new, and will start with "001"). Existing locations will retain their historically used identification or the identification was that utilized during the Phase I.
4. Sample Media Type
   All samples will include an alpha identification code to identify the type of sample media being collected:
   - SO = Soil
   - GW = Groundwater
   - SW = Surface water
   - SD = Sediment
   - PW = Porewater
   - WCS = Waste Characterization Solids
   - WCL = Waste Characterization Liquids

5. Sample Interval

   Multiple samples may be collected within the same borehole location for vertical delineation purposes. The sample identification will include the depth interval in feet below land surface from which the unique sample was collected.

6. QA/QC Samples

   For samples collected for quality assurance / quality control purposes, the following alpha identification codes will be added to the sample ID:

   - MS = Matrix Spike
   - MSD = Matrix Spike Duplicate
   - FB = Field Blank
   - EB = Equipment Blank
   - TB = Trip Blank
   - DUP = Field Duplicate

Trip blanks and field duplicates will also be given unique identifiers indicating the type of sample and the sample date, but the analytical laboratory will be kept "blind" as to the location of field duplicate pairs to avoid introducing any bias to the analytical process.

The proposed samples and sample designations are provided on Table 1. Below are example sample designations for various types of hypothetical samples:

*An example designation for a soil sample collected from 10-12 ft-bls at soil boring location 065:*

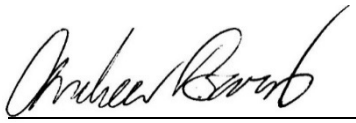
CFSB-065-SO-10-12

*An example designation for a groundwater sample collected from monitoring well 065:*

CFMW-065-GW

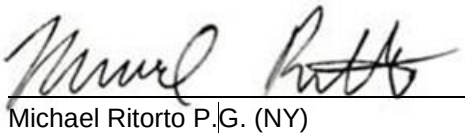
# PART 2 – COLUMBIA FALLS ALUMINUM COMPANY PHASE II REMEDIAL INVESTIGATION QUALITY ASSURANCE PROJECT PLAN

Prepared by Roux Associates
May 2018 - Revision #0



Andrew Baris P.G. (NY)
RI/FS Manager /
Principal Hydrogeologist /
Executive Vice President

May 3, 2018
Date



Michael Ritorto P.G. (NY)
RI Manager /
Principal Hydrogeologist /
Office Manager

May 3, 2018
Date



Laura Jensen
Project Hydrogeologist

May 3, 2018
Date



Jeffrey Wills
Senior Hydrogeologist /
Quality Assurance Manager

May 3, 2018
Date

# 6. GROUP A – PROJECT MANAGEMENT

This element group, comprising nine elements, addresses project administrative functions and project concerns, goals, and approaches to be followed. The first element (A1) is the title and approval sheet provided above. The second element (A2) is the table of contents provided at the beginning of the Phase II SAP. The remaining items included in this element are addressed below.

## 6.1 Element A3 – Distribution List

This Phase II SAP will be distributed to the following organizations/key project personnel associated with the RI/FS activities.

| Organization | Individual | Title | Copies |
|---|---|---|---|
| USEPA | Mike Cirian | EPA Project Manager | 3 hardcopies and 1 electronic |
| Montana DEQ | Richard Sloan | DEQ State Project Officer | 1 hardcopy and 1 electronic |
| Glencore | John Stroiazzo | Glencore Project Manager | Electronic Only |
| CFAC | Steve Wright | Project Coordinator | Electronic Only |
| Roux Associates | Andrew Baris | RI/FS Project Manager | Electronic Only |
| | Michael Ritorto | RI Manager | Electronic Only |
| | Jeffrey Wills | QA Officer | Electronic Only |
| | Annelise Muscietta | Project Field Manager | Electronic Only |
| | MaryBeth Lyons | Project Field Manager | Electronic Only |
| EHS Support, LLC | Gary Long | Ecological Risk Assessor | Electronic Only |
| | Tom Biksey | Human Health Risk Assessor | Electronic Only |
| TestAmerica Laboratories, Inc. | Melissa Haas | Laboratory Project Manager | Electronic Only |
| Laboratory Data Consultants | Christina Rink | Data Validation Project Manager | Electronic Only |

## 6.2 Element A4 – Project/Task Organization

A project organization for the RI/FS is shown in Figure 3. The project responsibilities of the various key project team members relevant to the Phase II Site Characterization are discussed below.

*RI/FS Project Manager – Andrew Baris, P.G.(NY), Principal Hydrogeologist, Roux Associates*

The RI/FS Project Manager has the responsibility to oversee the overall implementation and completion of the RI/FS Scope of Work. The Project Manager will manage the technical and administrative aspects of the project and will function as Roux Associates primary contact with CFAC and the regulatory agencies (USEPA and MDEQ). The RI/FS Project Manager will direct the activities of the RI Field Manager, FS Manager, and

other project staff, and will be supported by the QA Officer in the implementation of this QAPP. The RI/FS Project Manager is responsible for maintaining the official, approved QAPP.

*RI Manager – Michael Ritorto, P.G. (NY), Principal Hydrogeologist, Roux Associates*

The RI Manager will be the manager responsible for overseeing the implementation of the RI Scope of Work. The RI Manager will ensure that data collection is carried out according to the RI/FS Work Plan, and the various components of this Phase II SAP (FSP and QAPP). The RI Manager will also oversee any subcontractors for any task where subcontractors may be required (e.g., drilling, topographic survey, etc.). The RI Manager will be responsible for communicating updates on the status of the RI tasks to the RI/FS Project Manager.

*FS Manager – Charles McGuckin, P.E., Principal Engineer, Roux Associates*

The FS Manager is responsible for developing the Scope of Work and overseeing the various parts of the FS. The FS Manager will communicate with the RI/FS Project Manager and RI Manager during the design and implementation of the RI to collect data that can be used to support the FS.

*QA Officer – Jeffrey Wills, Senior Hydrogeologist, Roux Associates*

The QA Officer is a person independent of technical/data analysis responsibilities on the project that is designated to perform project QA/QC responsibilities. The QA Officer will assist as needed in ensuring compliance with this QAPP and the sampling protocols in the FSP. The QA Officer will be responsible for ensuring that sampling QA/QC audits are conducted to verify that data being collected during the RI meets the DQOs. The QA Officer will also be responsible for communicating with the analytical laboratory about potential QA/QC issues, if any, and managing the data validation subcontractors. The QA Officer will submit reports to the RI/FS Manager on QA activities and will verify that corrective measures are performed, if needed.

*Project Health and Safety Officer – Brian Hobbs, CIH, Corporate Health & Safety Officer, Roux Associates*

Health and safety will be a shared responsibility of all project personnel that visit the Site during the RI/FS activities. The overall health and safety management during field activities will be stewarded by the Project Health and Safety Officer. The Project Health and Safety Officer will be responsible for ensuring that all project personnel, including subcontractors, adhere to the requirements in the HASP.

*Project Field Managers – Annelise Muscietta, MaryBeth Lyons, Roux Associates*

The Project Field Managers will be responsible for performing the work in accordance with the Phase II SAP and performing the sampling described in the SOPs. The Project Field Managers will utilize Field Datasheets and field logbooks to record the work performed and document the samples collected, and will communicate daily progress to the RI Manager. The Project Field Managers will report directly to the RI Manager,

*Risk Assessors – Gary Long, Tom Biksey, EHS Support, LLC*

The Risk Assessors will be responsible for confirming that the Phase II Site characterization is being performed in accordance with the BHHRA WP and BERA WP. The Risk Assessors will communicate directly with the RI Manager and RI/FS Manager, and will report to the RI/FS Manager.

*Laboratory Project Manager – Melissa Haas, Project Manager, TestAmerica Laboratories, Inc.*

The Laboratory Project Manager will be responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Project Manager will ensure that all QA/QC protocols specified in this QAPP are followed and that an

acceptable laboratory report is prepared and submitted. The Laboratory Project Manager will report to Roux Associates' QA Officer and will also communicate directly, as needed, with the Data Validation Manager.

*Data Validation Manager – Christina Rink, Project Manager, Laboratory Data Consultants*

Roux Associates will coordinate data validation through a third-party Data Validator. The Data Validator will be responsible for validating analytical data received from the laboratory to ensure it meets the DQOs outlined in the QAPP and USEPA data validation guidelines. The Data Validator will provide a summary of the data validation results for inclusion in the summary reports.

## 6.3 Element A5 – Problem Definition/Background

This element discusses the basis for the RI/FS activities at the CFAC Site, provides pertinent background information, and discusses the intended uses of the information to be developed during implementation of the RI/FS.

### 6.3.1 Basis for the RI/FS

Roux Associates, Inc., has prepared a RI/FS Work Plan for the Site, as described in Section 2.0. The RI/FS is being conducted pursuant to the AOC dated November 30, 2015, between CFAC and the United States Environmental Protection Agency (USEPA) (CERCLA Docket No. 08-2016-0002).

The Site was operated as a primary aluminum reduction facility (commonly referred to as an aluminum smelter) from 1955 until 2009. Aluminum production at the Site was suspended in 2009 due to a downturn in aluminum market conditions, and CFAC announced the permanent closure of the facility in March 2015. Since that time, CFAC has initiated decommissioning and demolition activities and has commissioned the performance of an RI/FS. The purpose of the RI/FS is to characterize the nature and extent of risks associated with environmental conditions at the Site and to evaluate potential remedial options to address those risks. More specifically, the RI/FS is designed to achieve the following objectives:

1. Identify COPCs at the Site and their source(s);
2. Determine the nature and extent of Site-related COPCs in environmental media (soil, soil gas, groundwater, surface water, sediment, and sediment porewater) at the Site;
3. Understand the fate and transport of COPCs in environmental media at the Site;
4. Identify any exposure pathways (considering both current and potential future land use);
5. Evaluate current and potential future human health and ecological risks posed by the COPCs present at the Site; and
6. Conduct an evaluation of remedial alternatives for the Site, including treatability studies where necessary.

The main objectives of the Phase II are to generate the data needed to conduct a baseline risk assessment and complete the RI, and to generate the data for evaluation of remedial action options in the FS.

### 6.3.2 Background Information

A Site description, a summary of the results of the Phase I Site Characterization activities, and background information regarding the status of the RI/FS is provided in Section 2.0 of this SAP. A summary of the geology, hydrogeology, groundwater flow, and results of sampling activities completed at the Site to data is provided in the Phase I Data Summary Report (Roux Associates, 2017a) and the GW/SW Data Summary Report (Roux Associates, 2017c).

### 6.3.3 Intended Use of the Information

The information collected throughout the RI/FS will be utilized to achieve the objectives described in Section 6.3.1. Section 3.6 of the RI/FS Work Plan provides preliminary identification of potentially applicable or relevant and appropriate requirements (ARARs) and any other guidance and criteria "to be considered" (TBC) for the Site during the RI/FS.

Section 4.1 and Section 6.5.6.1 discusses screening criteria to which the Phase II Site Characterization data will be compared for identification and selection of COPCs. The data collected during the Phase II Site Characterization will be combined with the overall project dataset and will be utilized to complete the BHHRA and BERA. The variability of the entire dataset will be revisited in the risk assessment. The RI data will also be utilized to support the FS for the Site.

## 6.4 Element A6 – Project/Task Description

This element provides a description of the activities planned in the Phase II Site Characterization and a preliminary schedule for those tasks.

### 6.4.1 Phase II Remedial Investigation

As stated in the RI/FS Work Plan, the RI/FS Site Characterization Program was designed to be implemented in a phased approach and to consist of at least two phases of field work. The Phase I Site Characterization completed in 2017 focused on identification and characterization of source areas, and providing broad characterization of conditions across the Site (including at downgradient areas near potential human and ecological receptors).

The Phase II Site Characterization program has been designed to address any outstanding data that still needs to be collected in order to conduct a baseline risk assessment and complete the RI. Based on the current understanding of the Site conditions and updated CSM following the completion of the Phase I Site Characterization, and the data gaps identified during preparation of the BHHRA WP and BERA WP, the objectives referenced in Section 3.0 were generated for the Phase II Site Characterization.

To meet the objectives outlined in Section 3.0, the Phase II Site Characterization program will include pre-intrusive Site reconnaissance work, and investigation activities that will include sampling of soil, groundwater, surface water, sediment, and sediment porewater. Each of these tasks are described in greater detail in Section 4.0.

### 6.4.2 Phase II Remedial Investigation Preliminary Schedule

The schedule for implementation of the major RI/FS activities was provided in Section 10.3 of the RI/FS Work Plan. An updated project schedule outlining each phase of work has been provided to the USEPA routinely throughout the RI/FS in project progress reports. For this Phase II SAP, the project schedule was updated to include anticipated timing and duration of each Phase II Site Characterization task, as is included as Appendix C. Management of the schedule will be an important focus throughout the duration of the Phase II Site Characterization activities. The schedule will be periodically reviewed and updated as the work progresses. Many of the tasks in the RI/FS are independent; however, where possible, tasks will be conducted concurrently to facilitate progress. The schedule may require modification throughout the duration of the RI/FS based upon, among other factors, the regulatory review and approval process, the availability of specialized subcontractors for certain aspects the work, and/or adjustments to the Scope of Work.

## 6.5 Element A7 – Quality Objectives and Criteria for Measurement Data

The RI/FS Scope of Work was developed in a manner consistent with USEPA's "Guidance on Systematic Planning Using the Data Quality Objective Process" (USEPA, 2006). The DQO process is designed to clarify the objectives of data collection and maximize efficiency during data collection. It consists of a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in the decision-making process are appropriate for its intended application. The following steps were completed as part of the DQO process in general accordance with the USEPA guidance:

1. Define the Problem
2. Identify the Goals / Decisions of the Study
3. Identify Information Inputs
4. Define the Study Boundaries
5. Develop the Analytical Approach
6. Specify Performance or Acceptance Criteria
7. Develop the Plan for Obtaining Data

The remainder of this element summarizes the step-by-step DQO process. As noted previously, a separate Background Investigation SAP will be prepared to address the DQOs for the Background Investigation.

### 6.5.1 Step 1: Define the Problem

The RI/FS Work Plan and the results of the Phase I Site Characterization completed in 2017 provide the background information and relevant existing Site data to define the problem. The Phase I Site Characterization program was designed to identify and/or confirm source areas and broadly characterize the nature and extent of associated chemicals of concern across the Site and around Site features. The Phase I indicated that cyanide, fluoride, and PAHs are the primary COPCs and COPECs identified within the potential source areas and Site features. Other COPCs and COPECs, such as dioxin/furans, PCBs and some metals were also detected at concentrations that exceeded screening criteria in various areas of the Site. A summary of key findings from the Phase I Site Characterization regarding the nature and extent of COPCs and COPECs as it relates to the problem definition is provided in Section 2.1.1.

The results of the Phase I Site Characterization were used in the development of the baseline risk assessment work plans to perform a preliminary screening to identify the COPCs and COPECs which may pose a potential threat to human health and the environment. The Phase II Site Characterization is necessary to generate data to finalize the section of COPCs and COPECs and better define the extent and concentrations of the COPCs and COPECs that have resulted from former Site operations in order to complete the BHHRA and BERA. It is also necessary to refine the understanding of the potential ongoing sources of these COPCs and COPECs and potential COPC and COPECs migration and exposure pathways in order evaluate identify and potential remedial action alternatives in a feasibility study (FS).

### 6.5.2 Step 2: Identify the Goals / Decisions of the Study

The overall goal of the RI/FS is to determine:

- Where and to what extent remedial action is warranted to protect human and ecological receptors from contamination at the Site; and

- The remedial action alternative(s) that best satisfies the remedy selection criteria specified within the USEPA guidance and National Contingency Plan (NCP).

The Phase I Site Characterization focused on identification and characterization of source areas, identification of COPCs and COPECs, and providing broad characterization of conditions across the Site. In order to continue progress toward the above RI/FS goal, the Phase II Site Characterization has been designed to fill data gaps as necessary to complete the BHHRA, BERA, and FS. The objectives of the Phase II Site Characterization are presented in Section 3.0, and formed the basis for development of the following decision questions and statements.

- *Question 1*: Are there any additional COPCs and COPECs within each exposure area that should be retained for evaluation in the BHHRA and BERA, beyond those COPCs and COPECs identified in preliminary screening presented in the BHHRA WP and BERA WP?

  *Decision Statement:* Determine if any additional COPCs and COPECs are present in Site soil, groundwater, surface water, sediment, and sediment porewater at concentrations exceeding screening levels and that should therefore be identified as COPCs and COPECs.

- *Question 2*: What is the extent of COPCs and COPECs in Site soil, groundwater, surface water, sediment, and sediment porewater?

  *Estimation Statement:* Refine the estimation of the areal and vertical extent of COPC and COPECs affecting Site soil, groundwater, surface water, sediment, and sediment porewater by addressing the spatial and temporal data gaps identified in Section 3.0.

- *Question 3*: How are COPCs and COPECs in Site surface soil, subsurface soil, and groundwater moving throughout the Site and is there the possible movement of COPCs and COPECs off-Site?

  *Estimation Statement:* Evaluate the fate and transport of COPCs and COPECs throughout Site surface soil, subsurface soil, and groundwater. Parameters needed to inform this assessment include estimates of the depth to groundwater, hydraulic gradients, as well as measurements of soil and water quality characteristics (e.g., total organic carbon, soil particle size and bulk density, pH, oxidation potential, alkalinity), the types and concentrations of COPCs and COPECs across the Site and near downgradient Site boundaries, and the physiochemical properties of the COPCs and COPECs present.

- *Question 4*: What is the potential risk to human health or ecological receptors associated with exposure to COPCs and COPECs in soil, groundwater, surface water, sediment, and sediment porewater under current and reasonably anticipated future land use conditions?

  *Estimation Statement:* Collect adequate samples to enable the calculation of representative EPCs for COPCs and COPECs present within each exposure area for use in subsequent human health and ecological risk evaluations.

### 6.5.3 Step 3: Identify Information Inputs

An evaluation of current Site conditions based upon the findings from the Phase I Site Characterization and the SLERA is provided in Section 2.1. A description of the new data required to address each of the DQO questions and statements provided in Section 6.5.2 is summarized below.

- *Decision Statement: Determine if any additional COPCs and COPECs are present in Site soil, groundwater, surface water, sediment, and sediment porewater at concentrations exceeding screening levels and should be identified as COPCs and COPECs considering the comprehensive results of the Phase I and Phase II Site Characterization.*

  In order to make this determination, additional soil, groundwater, surface water, sediment, and sediment porewater samples will be collected within each exposure area from Site features as well as from potential receptor locations (i.e., Site-wide soils, groundwater, and surface water bodies). Temporal variability in the data will be considered when planning for groundwater and surface water sample collection in order to collect a representative range of COPC and COPECs data.

  The Phase II samples will be analyzed for a broad suite of analytical parameters as discussed in Section 4.13, and summarized in Table 1. The comprehensive results of the Phase I and Phase II sampling for each exposure area will be compared to the most recent sources of the screening criteria identified in Section 4.13 to determine if any additional constituents should be retained as COPCs and COPECs.

- *Estimation Statement: Refine the estimation of the areal and vertical extent of COPC and COPECs affecting Site soil, groundwater, surface water, sediment, and sediment porewater by addressing the spatial and temporal data gaps identified in Section 3.0.*

  In order to delineate the areal and vertical extent of COPCs and COPECs in the aforementioned media, samples will be collected at locations within, around, and downgradient of the various Site features, and at locations identified as sources during the Phase I. Soil samples will be collected to characterize the concentrations of COPCs and COPECs along the western and eastern site boundary, as well as to fill spatial gaps within the undeveloped areas of the Site, and beneath the Main Plant Building to better understand areal extent of COPCs and COPECs in soil.

  Soil borings will be added to further delineate PCBs where detected within the Operational Grid, and to assess for presence of dioxins/furans in soil outside the perimeter of the rectifier yards.

  Soil borings will be sampled to a depth of 22 ft or greater at select locations to better define the vertical extent of COPCs and COPECs in soil within the northern portion of the Main Plant Area, the southern portion of the Central Landfill Area, and the Northern Percolation Ponds.

  Within the groundwater system, installation of additional water table wells in the Western and North-Central Undeveloped Areas will better define the horizontal extent of COPCs and COPECs in the upper hydrogeologic unit. Within surface water features, additional upgradient and downgradient surface water, sediment, and porewater samples will be added to the sampling network to better delineate COPC and COPECs concentrations in those features.

- *Estimation Statement: Evaluate the fate and transport of COPCs and COPECs throughout Site surface soil, subsurface soil, and groundwater. Parameters needed to inform this assessment include estimates of the depth to groundwater, hydraulic gradients, as well as measurements of soil and water quality characteristics (e.g., total organic carbon, soil particle size and bulk density, pH, oxidation potential, alkalinity), the types and concentrations of COPCs and COPECs across the Site and near downgradient Site boundaries, and the physiochemical properties of the COPCs and COPECs present.*

  All of the above parameters were collected during the Phase I Site Characterization. Collection of these types of data will continue at the new / additional sampling locations for the Phase II Site Characterization, and with two comprehensive rounds of water levels, and groundwater / surface

water sampling, to further characterize temporal variations. The types of COPCs and COPECs will continue to be characterized across the Site and near the Site boundaries.

- *Estimation Statement: Collect adequate samples to enable the calculation of representative EPCs for COPCs and COPECs present within each exposure area for use in subsequent human health and ecological risk evaluations.*

  As described in the BHHRA WP, human health exposure areas within the Site were defined considering both the current and reasonable anticipated future land use for the various areas of the Site; and per the BERA WP, the ecological exposure areas were defined primarily based upon habitat and potential risks to small home range receptors (as described in Section 5.2.1 of the BERA WP). Potential exposure to ecological receptors will be based on a reasonable maximum exposure scenario using maximum EPC within each exposure area, as well as a refined exposure scenario based on the $UCL_{mean}$ EPCs within each exposure area. The evaluation of potential dietary exposure on a point-by-point basis will support an evaluation of areas where small home range receptors may be exposed to dietary doses exceeding toxicity reference values (TRVs). Given that the judgmental study design biases sampling to areas of known or suspected sources or pathways, the incorporation of maximum and point-by-point exposure scenarios will provide conservative estimates of potential exposures to small home range receptors via ingestion pathways. The boundaries of each exposure area were developed using professional judgement, considering Site characteristics, current and potential future receptors, and the distribution of COPCs identified in the Phase I Site Characterization.

  As part of the Phase II Site Characterization, additional sampling will be conducted in each exposure area to supplement the Phase I findings and to develop a sufficient data set for calculation of representative EPCs during the risk assessment. The EPCs will typically be based on the $UCL_{mean}$, although in some cases maximum or individual point concentrations may be used for EPCs per the risk assessment work plans. Calculation of statistically valid $UCL_{mean}$ concentrations typically requires a minimum of 8 to 10 observations, or more, depending upon the variability of the population. Therefore, exposure areas evaluated in the BHHRA and BERA will typically have a minimum of 8 to 10 observations for each matrix evaluated in the exposure analysis; and in most cases well more than 8 to 10 observations. Section 6.5.6.1 provides additional information regarding the uncertainty evaluation of the appropriate numbers of samples for estimating $UCL_{mean}$.

### 6.5.4 Step 4: Define the Study Boundaries

This section describes the spatial and temporal bounds of the Phase II Site Characterization.

**Spatial Bounds for Site Locations**

The Site boundary consists of approximately 1,340 acres of land bounded by Cedar Creek Reservoir to the north, Teakettle Mountain to the east, Flathead River to the south, and Cedar Creek to the west. The horizontal extent of the Site boundary is defined as shown on Figure 1. As described in Section 6.5.3, Site sample collection will occur at numerous locations within the Site boundary; and, soil samples will also be collected to characterize the concentrations of COPCs and COPECs along the western and eastern site boundary.

Soil sample depth intervals will range from surface soils (0-0.5 ft-bls) to deep subsurface intervals (62 ft-bls). Soil borings for the purpose of water table monitoring well installation will be advanced to beneath the water table in the upper hydrogeologic unit. All existing deep monitoring wells screened beneath the upper hydrogeologic unit will be re-sampled twice during the Phase II Site Characterization in an effort to confirm the Phase I finding that groundwater impacts are confined to the Upper Hydrogeologic Unit.

**Spatial Bound for Background/Reference Sampling**

Background / reference sampling for soil, surface water, and sediment will be collected outside of the Site boundary, and will be further described in the Background Investigation SAP. The locations will be selected such that Site-related impacts are not expected to occur in the reference locations. Surface water locations will likely be collected in Cedar Creek (or a creek with similar characteristics in the vicinity of the Site) and the Flathead River upgradient of the Site boundary.

**Temporal Bounds**

The Phase II field activities are anticipated to occur from early spring 2018 to fall 2018. The field activities will begin with the Site reconnaissance and installation of monitoring wells to ensure that groundwater and surface water sampling activities take place during the spring high water season. As discussed in Section 2.5, COPC and COPECs concentrations in surface water and groundwater may vary depending on seasonal fluctuations. Groundwater in the region is typically recharged from the surface water sources within the watershed including numerous reservoirs, ponds, streams, and lakes and additionally through infiltration of precipitation. During spring, the melting of winter snow and increased seasonal precipitation causes a high river stage in the Flathead River. This results in the Flathead River recharging groundwater and acting as a losing stream. In contrast, in the late summer, the dry weather results in a decrease in river stage so that the Flathead River becomes a gaining stream (Konizeski *et al*., 1968).

As described in Section 2.5, the findings from the evaluation of the Phase I Site Characterization data, the historical trends in surface water discharge in the Flathead River, and historical groundwater level fluctuations indicate that collecting surface water and groundwater samples during the 2018 low-water season and high-water season will supplement the Phase I data. One sediment and porewater sampling event will be conducted as part of the Phase II Site Characterization. Samples will be collected during 2018 spring high-water season from those features that have been observed to be dry in the summer (i.e., Northern Percolation Ponds, Cedar Creek Overflow, and Northern Surface Water Feature). Samples in the Flathead River will be collected during the 2018 low-water season, based on the Phase I data and regional published literature both showing the River is receiving groundwater input during this time period. The combined Phase I and Phase II dataset will be evaluated in the risk assessment.

### 6.5.5 Step 5: Develop the Analytical Approach

The activities described in Section 4.0 were developed to generate the types and quantity of data required to address the decision statement and estimation statements specified in Sections 6.5.2 and 6.5.3. Analytical data collected during the Phase II Site Characterization will be validated, compiled, and tabulated in the project database for comparison and statistical analysis. Laboratory MDLs will achieve both human health and ecological based screening values to the extent feasible, as shown in Tables 7 through 16. The analytical approach to address each decision and estimation statement is described below.

- *Decision Statement: Determine if concentrations in Site soil, groundwater, surface water, sediment, and sediment porewater are above screening levels, and if contaminants should be identified as COPCs and COPECs considering the results of the Phase I Site Characterization.*

  This determination will be made by comparison of maximum detected concentrations of each COPC and COPECs to human health and ecological screening levels for each media type, within each exposure area. The screening and final selection of COPCs and COPECs will be performed using the comprehensive data set from both the Phase I and Phase II Site Characterization programs. The screening level sources and the screening level process utilized for human health and ecological receptors will be as specified in the BHHRA WP and BERA WP, respectively.

- *Estimation Statement: Refine the estimation of the areal and vertical extent of COPC and COPECs affecting Site soil, groundwater, surface water, sediment, and sediment porewater by addressing the spatial and temporal data gaps identified in Section 3.0.*

  The analytical results from all sampling locations for all media will evaluated relative to the various human health and ecological screening levels to refine the delineation of COPCs and COPECs in each media investigated. These evaluations will be facilitated through the use of data presentation methods similar to those used for the Phase I Site Characterization; including: statistical summary data tables, thematic GIS maps, various contour maps, time-series graphs, and cross sections. The results for fate and transport analytical parameters will be evaluated and used in conjunction with aquifer transmissivity estimated from slug tests, hydraulic gradients, as well as measurements of soil and water quality characteristics (e.g., total organic carbon, soil particle size and bulk density, pH, oxidation potential, alkalinity). These data will be used if needed to support the risk assessment and fate and transport evaluation.

  In addition to the above, the results of the background investigation will be used to help better understand the extent of COPCs and COPECs resulting from site related contamination versus those that may be attributable in whole or in part to naturally occurring sources. The DQOs and scope of the background investigation, and the statistical methods that will be utilized in evaluating its results, will be outlined in a Background Investigation SAP to be submitted under separate cover.

- *Estimation Statement: Collect adequate samples to enable the calculation of representative EPCs for COPCs and COPECs present within each exposure area for use in subsequent human health and ecological risk evaluations.*

  EPCs will typically be based on the $UCL_{mean}$, although in some cases maximum or individual point concentrations may be used for EPCs per the risk assessment work plans. Exposure areas evaluated in the BHHRA and BERA will typically have a minimum of 8 to 10 observations for each matrix evaluated in the exposure analysis; and in most cases more than 8 to 10 observations.

  The $UCL_{mean}$ for the COPCs and COPECs, in various media and exposure areas, will be calculated using the most recent version of USEPA's ProUCL software, version 5.1.002 (5.1), and in accordance with the BHHRA WP and BERA WP. All aspects of data evaluation, data transformation, data identification, and the data treatment of outliers will be documented and included within the Exposure Assessment sections of the of BHHRA and BERA, along with the ProUCL output as an appendix to each report.

### 6.5.6 Step 6: Specify Performance or Acceptance Criteria

Performance or acceptance criteria is addressed by an assessment of potential decision error and uncertainty evaluation; as well as by the QA/QC aspects of the project.

#### 6.5.6.1 Decision Error Limits and Uncertainty Evaluation

As described below in Section 6.5.7, the sampling plan for the Phase II Site Characterization was developed primarily based upon judgmental sampling design, which is one of the accepted methods described in USEPA guidance on sampling design (USEPA, 2002b). A statistically rigorous analysis of decision error limits and uncertainty is generally not feasible (or valid) when implementing a judgmental sampling program. Notwithstanding this limitation, a discussion of the potential decision error and uncertainty is provided below relative to two of the key decision / estimation statements.

- *Decision Statement: Determine if concentrations in Site soil, groundwater, surface water, sediment, and sediment porewater are above screening levels, and if contaminants should be identified as COPCs and COPECs considering the results of the Phase I Site Characterization.*

  The potential Type 1 decision error to be avoided in this instance is that an analyte would be dismissed as a COPC and COPEC when it could be of potential risk. Given the design of Phase I

and Phase II sampling programs, the potential for this to occur is negligible. The Phase I and Phase II locations are generally biased to be within and around source areas, and at locations downgradient of these areas, where COPCs and COPECs would expect to be present at their highest concentrations. As part of Phase II, many more soil sampling locations have been added to increase the spatial density of samples within and around source areas where the highest COPC/COPEC concentrations should be present, as well as throughout the various undeveloped areas of the Site.

The analytical approach calls for using the maximum concentration of each analyte in each exposure area, from the combined Phase I and Phase II dataset, for comparison to the most conservative screening criteria. From a statistical perspective, this analytical approach is not amenable to analysis of decision error limits that is typically associated with hypothesis testing. However, the approach is overall a conservative approach (i.e., an absolute comparison of the maximum COPC concentration to the minimum screening criteria) that minimizes the potential for a Type 1 decision error (i.e., that an analyte would be dismissed as a COPC or COPEC when it could be of potential risk). Thus, this approach to COPC selection will result in data that are adequate for the risk assessment.

- *Estimation Statement: Collect adequate samples to enable the calculation of representative EPCs for COPCs and COPECs present within each exposure area for use in subsequent human health and ecological risk evaluations.*

  As previously described, EPCs will typically be based on the $UCL_{mean}$, although in some cases maximum or individual point concentrations may be used for EPCs per the risk assessment work plans. Estimating what constitutes an adequate number of samples for calculation of EPCs for COPCs and COPECs in environmental media within the various exposure areas requires consideration of the spatial and temporal representativeness of the sample dataset, and estimating minimum sample size requirements for calculating $UCL_{mean}$ concentrations. As discussed in Section 2.5, two additional comprehensive rounds of groundwater and surface water sampling (i.e., first during the high-water season and the second during low-water seasons) will be conducted to reduce uncertainty associated with temporal variations of COPC/COPEC concentrations within these media. Additional sampling points have also been proposed to improve the spatial representativeness of the sample datasets for surface water, sediment / sediment porewater, and ground water. With the additional proposed points, each aquatic exposure area will typically have a minimum of 8 to 10 locations, with multiple rounds of surface water sampling (typically six rounds of samples) at each location. With respect to groundwater, there are approximately 30 wells distributed throughout the cyanide and fluoride plumes, and additional wells outside the plumes, with multiple rounds of groundwater sampling (typically six rounds of samples) at each location.

  Due to variability within the soil data and the large size of the some of the terrestrial exposure areas, a statistical evaluation of the existing soil dataset for each exposure area was performed to approximate minimum sample size requirements for computation of the $UCL_{mean}$ concentration of indicator COPCs and COPECs; including cyanide, fluoride, benzo(a)pyrene, high and low molecular weight (HMW and LMW) PAHs, and select metals. A detailed description of the analytical approach is provided in Appendix D. A summary of the analysis is provided below.

  Minimum sample sizes were approximated based on the formula presented in USEPA (2006) and used in ProUCL v. 5.1 software (USEPA, 2015) to compute minimum sample sizes (*n*) needed to estimate the $95UCL_{mean.}$ The analysis considers the sample standard deviation for the existing soil dataset and a specified allowable error margin (Δ). The specified allowable error margin for each indicator COPC was the lesser of the ESV, as presented in the BERA WP, or the residential soil screening level, as presented in BHHRA WP.

  The results of the analysis indicate that the proposed Phase II soil sampling, when combined with the Phase I data, should provide an adequate dataset for calculating the $95UCL_{mean}$ concentration of the indicator COPCs. In most cases, the results indicate that the number of additional samples proposed for collection during Phase II will reduce uncertainty to less than one-half of the allowable error margin (Δ).

Greatest minimum sample sizes were estimated for benzo(a)pyrene and HMW PAHs in the North Percolation Pond. Extremely large approximated minimum sample sizes for these constituents are attributed to low Δ values relative to elevated sample standard deviations. The greater variability observed in these datasets may have resulted, in part, from non-random, judgmental sampling that was biased towards areas of known or suspected impacts in these areas. Given these limitations, there is limited practical use for minimum sample size estimates for benzo(a)pyrene and HMW PAHs in the North Percolation Pond.

Extremely large minimum sample sizes were also estimated for benzo(a)pyrene and HMW PAHs in the Central Landfills Area and Main Plant Area based on complete datasets. However, removal of outlying data points reduced sample standard deviations such that aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates based on modified datasets at Δ × 0.5 for most constituents and at Δ × 2 for all constituents evaluated within these exposure areas.

For exposure areas outside of site operational areas, aggregate Phase I and Phase II sample sizes satisfied minimum sample size requirements based on Δ × 0.5 in most cases, except for benzo(a)pyrene. Minimum sample size estimates for the Cedar Creek Overflow Ditch, South Percolation Pond Area, Flathead River Riparian Area, and undeveloped site areas (Eastern, Western, and North-Central) were low relative to site operational areas due to lower sample standard deviations for most constituents.

As previously stated, statistical considerations are only one element in designing a sampling program to achieve RI/FS objectives, including the DQO-based performance criteria for estimating $UCL_{mean}$ EPCs. The minimum sample size estimates presented in Appendix D do not consider exposure area size nor the number of samples necessary to characterize the nature and extent of soil constituents based on conceptual migration pathways from potential source areas. For these reasons, in many cases the numbers of samples proposed far exceeds the minimum number specified in Appendix D. This is especially the case in the large undeveloped areas of the Site where both USEPA and MDEQ requested greater sample densities across the areas to ensure adequate spatial representativeness.

The Appendix D statistical evaluation was performed solely as an exercise for the Phase II dataset and sample size adequacy, and the refined ESVs used in Appendix D have not yet been reviewed and approved by USEPA for use in the risk assessment. Refinement of ESVs for use in the risk assessment will need to be conducted as part of the risk assessment, and will be subject to USEPA review and approval.

#### 6.5.6.2 Quality Assurance / Quality Control

QA/QC measures will be implemented throughout the course of the Phase II Site Characterization as detailed within the QAPP portion of this SAP. These measures will minimize variability, mitigate the potential for false positive and/or false negative error, and increase the accuracy and defensibility of collected data. These measures include, but are not limited to, the following:

- Ensuring that that project personnel have the proper qualifications and training (Section 6.6);
- Establishing a process for management of project documents, data, and records (Section 6.7);
- Requirements for testing, inspection, maintenance and calibration of field and laboratory instrumentation (Section 7.6 and 7.7);
- Collection and analysis of field QC samples (Section 7.5.1);
- Analysis of laboratory QC samples (Section 7.5.2); and
- Assessment and oversight (Section 8.0).

The analytical results of sampling activities will be evaluated with respect the following data quality indicators: precision, accuracy, representativeness, completeness, sensitivity, and comparability. The field and

laboratory QC samples that will analyzed, including their frequency of collection/analysis and associated acceptance criteria (where applicable), are summarized in Tables 2 and 3.

The aforementioned data quality indicators are discussed in detail in the remainder of this section. Compliance with these criteria will be evaluated by the laboratory in accordance with laboratory SOPs and quality assurance procedures and any non-conformity identified shall be addressed in the lab reports. These criteria will also be evaluated during data verification and validation processes.

#### 6.5.6.3 Precision

Precision is defined as a measure of the reproducibility of individual measurements under a given set of conditions. Field precision is assessed through the collection and measurement of field duplicates. The variability between field duplicates reflects the combined variation in concentration between nearby samples and the variation due to measurement error.

Precision will be evaluated in terms of relative percent difference (RPD) between two replicate samples. RPD can be calculated using the following equation:

$$RPD = [(C1-C2) / ((C1+C2)/2)] \times 100$$

When: C1 = The larger of the two concentrations.

C2 = The smaller of the two concentrations.

Duplicate soil samples are typically expected to be more variable than results from duplicate water samples due to the physical and chemical heterogeneity of the soil matrix. As a result, a RPD of 50% was selected for soil and sediment field duplicate samples and a RPD of 30% for groundwater and surface water field duplicates to be used as advisory limits for analytes detected in both the original sample and its field duplicate. RPDs greater than these limits will be noted during the data validation process. The objectives for RPDs between the original samples and their field duplicates are shown in Table 3.

#### 6.5.6.4 Accuracy

Accuracy is a measure of the overall agreement of a measurement to a known value, which includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations. Accuracy in the field is assessed through the use of trip blanks and equipment blanks and through the adherence to all sample handling, preservation, and holding time requirements. The objective for trip blanks and equipment blanks is that no target compounds are present above the reporting limits (RLs).

Laboratory accuracy will be evaluated through the analysis of laboratory method blanks, and spiked samples/compounds such as matrix spike and matrix spike duplicates (MS/MSDs), laboratory control samples (LCSs), and surrogate compounds. Method blanks should not contain any target compounds above the RLs which are quantitation limits based on the low point of calibration. For spiked samples/compounds, the accuracy objectives, as measured by percent recoveries (%R) are the control limits provided in Table 3.

#### 6.5.6.5 Sensitivity

Sensitivity is the ability of a laboratory instrument or measurement technique to detect an analyte at certain levels of interest. Sensitivity of the analytical measurement techniques is demonstrated by laboratory MDLs

and Practical Quantification Limits (PQLs). MDLs represent the lowest reportable concentration of an individual compound that meets the analytical method qualitative identification criteria. PQLs refer to a minimum concentration of an analyte that can be measured within specified limits of precision and accuracy; they are generally 5-10 times the detection limit. MDLs and PQL are based on laboratory performance relative to established calibration standards. Compounds detected at concentrations below the PQL are qualified as "J" estimated value.

In order to evaluate the sampling results relative to analytical approach outlined in Section 6.5.5, PQLs will be at or below the most conservative human health or eco-toxicity based benchmark value, to the extent feasible. A summary of methods, analyte lists, MDLs, PQLs and Chemical Abstracts Service (CAS) Numbers provided by TestAmerica for each media is provided in Tables 7 through 16. These tables also included the desired PQLs for each analyte that has an established human health or eco-toxicity benchmark / criteria value. These values will be utilized to establish sensitivity requirements for TestAmerica.

Monitoring of instrument sensitivity is performed through the analysis of reagent blanks, near detection limit standards, and response factors. Documentation of laboratory instrument sensitivity can be provided by the laboratory upon request. Sample matrix cleanup (in laboratory) must occur when chemical interferences may be causing elevated reporting limits or inadequate contaminant identification or quantitation.

#### 6.5.6.6 Completeness

Data are considered complete when a prescribed percentage of the total intended measurements and samples are obtained. Analytical completeness is defined as the percentage of valid analytical results requested. Field completeness is a measure of the amount of valid measurement data collected for the project. The percent completeness can be calculated by the following equation:

$$\text{Completeness (percent)} = \frac{\text{(Valid Data Obtained)}}{\text{(Total Data Planned)}} \times 100$$

The target completeness objective for field measurements collected for this sampling program is 95 percent or more. The target completeness objective for laboratory analysis during the RI is a minimum of 90 percent of the planned collection of individual samples.

#### 6.5.6.7 Representativeness

Representativeness is a qualitative parameter, which is dependent upon the proper design of the sampling program and proper laboratory protocol. Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Representativeness of field measurements is dependent upon the proper design of the sampling program. In evaluating representativeness, it is important to understand the extent to which bias is incorporated by design into the sampling process. The Phase I RI sampling activities were designed to provide data that were representative of conditions at specific locations and times of sample collection, including temporal variability in groundwater and surface water over the four seasons. With respect to the Phase II Site Characterization, the additional sampling locations are based on the findings of the Phase I investigation activities. Additional data points have been added throughout the Site, and two additional comprehensive rounds of groundwater and surface water sampling (one during the high-water season, and one during low

water) will be conducted to ensure a representative data set for conducting the baseline risk assessment. The design of the Phase II Site Characterization sampling is described in Section 4.1 above. Representativeness of data collected during the Phase II Site Characterization will be verified by ensuring that the FSP and SOPs are followed throughout the RI activities.

#### 6.5.6.8 Comparability

Comparability is a qualitative objective, which expresses the confidence with which one data set can be compared with another. The objective for comparability is to ensure that results of analyses can be compared with analyses produced by other laboratories and other projects, and compared to the results of the Phase I Site Characterization.

The data from historical investigations was utilized in conducting the initial Site evaluation presented in the RI/FS Work Plan. However, the RI/FS is anticipated to generate data of sufficient quantity and quality such that reliance upon data from the prior investigations conducted in the 1980s and 1990s will not be necessary when conducting risk assessment and feasibility study.

Comparison to some more recent data sets may be informative and beneficial when evaluating sampling results and trends. The field sampling procedures and analytical methods utilized for the Phase I Site Characterization program, and that are proposed for the Phase II Site Characterization, are very similar to those used during the USEPA 2014 Site Reassessment as well as for the ongoing monitoring of residential wells. Therefore, the data collected from similar locations under similar conditions should be comparable. In addition, the analytical methods for cyanide and fluoride are consistent with those used to monitor Montana Pollutant Discharge Elimination System (MPDES) permit compliance. Therefore, seep, surface water and/or groundwater samples collected from similar locations under similar conditions should be comparable.

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the protocols described in the FSP and QAPP are followed and that proper sampling and analytical techniques are used. The sampling and analysis throughout the Phase II Site Characterization will be conducted in accordance with the SOPs and selected analytical methods. Therefore, these procedures and methods will provide comparable data.

### 6.5.7 Step 7: Develop the Plan for Obtaining Data

As described in Section 4.1, the locations and numbers of sampling points associated with each type of activity were typically selected based upon a judgmental sample design. As described in USEPA guidance on sampling design (USEPA, 2002b), judgmental sampling design is appropriate when there is reliable historical and physical knowledge about the feature or condition under investigation; or, when the objective of the investigation is to screen an area(s) for the presence or absence of contamination at levels of concern, such as risk-based screening levels. Both conditions are generally applicable for the current phase of work. First, based the Phase I program there is detailed knowledge about the environmental conditions at the various Site features, and there is also an understanding of where additional sampling locations are needed to delineate the extent of COPCs and COPECs in various media. Second, the program will include use of risk-based screening levels to identify and finalize selection of COPCs and COPECs for inclusion in subsequent risk assessment.

Although a judgmental sampling design has been utilized, the analytical approach for the baseline risk assessment will include calculation of EPCs based upon the $UCL_{mean}$ concentrations of COPCs and

COPECs. As described in Section 6.5.6.1, statistical analysis of the Phase I soil data for select COPCs and COPECs was performed to inform the sample design process regarding the estimated minimum number of samples required within each exposure area to calculate $UCL_{mean}$ concentrations. Based upon this analysis, the Phase II soil sampling proposed for each exposure area, when combined with the Phase I locations, will result in a dataset that exceeds the estimated minimum sample size requirements for most COPCs and COPECs. In all cases, there will be at least 8 to 10 soil sample locations per exposure area, and in most cases, many more than 10.

As part of the Phase II Site Characterization, samples have been added in areas of high COPC and COPEC concentrations that were identified during the Phase I to allow for further vertical delineation of COPCs and COPECs in these areas. Additional samples are being added at random locations throughout the large undeveloped areas to obtain better spatial representativeness across each area, and to characterize COPC and COPECs concentrations near the Site boundary. Although judgmental sampling designs have been used for both the Phase I and Phase II programs; review of Plate 3 shows with addition of the Phase II samples, that random samples have been placed throughout the Site in each exposure area. Increased sample densities exist in exposure areas where industrial activities took place, and areas of the higher sample density are biased towards areas where COPCs and COPECs are considered more likely to be present. As discussed in Section, this can bias high the $UCL_{mean}$ concentrations for some exposure areas, and will need to be considered and discussed in the uncertainty evaluation section of the risk assessment. Variability from the entire dataset will be revisited in the risk assessment.

Judgmental sampling design has also been used to develop the Scope of Work for investigation of hydrogeologic and groundwater quality, and the surface water and sediment quality at the Site. The installation of new monitoring wells, as discussed in Section 4.6, were located based on the results of the Phase I Site Characterization to further define the extent of the groundwater quality affects in the upper hydrogeologic unit, and to address groundwater flow and media quality data gaps in certain areas of the Site. Per USEPA guidance, judgmental design is appropriate for groundwater sampling design considering the scale of the Site and lack of adequate probabilistic investigation methods. Additional surface water, sediment and sediment pore water samples have been added to achieve at least 8 to 10 locations per surface water feature.

As discussed in Section 4.5, a stratified random sampling approach will be utilized as per USEPA guidance on sampling design (USEPA, 2002b) and the ITRC Incremental Sampling Methodology (ITRC, 2012) to characterize soil quality conditions in the surface soil and shallow subsurface soil (0 to 0.5 ft-bls and 0.5 to 2.0 ft-bls, respectively) within the Operational Area. Consistent with the sampling approach specified in Phase I SAP Modification #4 and utilized during the Phase I Site Characterization, the incremental sampling methodology was selected for this area to produce a more robust estimate of average soil conditions within individual grid cells uniformly distributed across the large area.

## 6.6 Element A8 – Special Training Requirements/Certifications

The RI Field Manager will ensure that all field team members have received project-specific training with respect to the various field sampling tasks and equipment operation and are knowledgeable in the applicable SOPs.

Prior to beginning field sampling activities, field planning meeting(s) will be conducted to discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required QC measures
- Health and safety requirements

It is the responsibility of each field team member to review and understand all applicable governing documents associated with this sampling program, including the FSP, QAPP and HASP.

All individuals involved in the collection, packaging, and shipment of samples must have OSHA 40-hour health and safety training, and respiratory protection training as required by 29 Code of Federal Regulations (CFR) 1910.134. Individuals involved in investigations at the asbestos landfills or other locations where asbestos is suspect must also have asbestos awareness training, as required by 29 CFR 1910.1001. All training documentation will be stored in the project files. It is the responsibility of the Health and Safety officer to ensure that all training documentation is up-to-date and on-file for each field team member.

Subcontractors will be utilized throughout the Phase II Site Characterization activities to complete various tasks. These tasks include drilling, land surveying, and operation of the boat for surface water sampling. The subcontractors will be required to hold licenses/certifications as applicable for their respective tasks.

All analytical laboratories participating in the analysis of samples for the Phase II Site Characterization are subject to national, local, and project-specific certifications and requirements. Each laboratory will meet Environmental Laboratory Accreditation standards as defined by the USEPA. Copies of all proficiency examinations and certifications are maintained by the laboratory coordinator within each laboratory. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies for methods and parameters that may also be of interest to the project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel.

## 6.7 Element A9 – Documentation and Records

The following sections provide an overview of the procedures and requirements for recordkeeping and reporting. Field logbooks and field datasheets will provide the means of recording the data collection activities during field activities. All field logbooks and data sheets will be scanned on a weekly basis to create a PDF files for electronic archiving with the central project file. An SOP for field recordkeeping is provided in this SAP. Some of the specific requirements with respect logbooks and field data are highlighted below. Additionally, reporting of data collected and responsibilities related to reporting are discussed below.

### 6.7.1 Field Logbooks

Field logbooks will be used to document field activities and observations. The field notes will be clear, with sufficient detail so that events can be reconstructed later if necessary. Field logbooks will document any field deviations from the RI/FS Work Plan and/or Phase II SAP, as well as the reasons for the changes. Requirements for logbook entries include the following:

- Field activity logbooks will be kept for each task.

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, is prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made will be noted as well as the time of the observation itself).
- Each consecutive day's first entry will be begun on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 a.m. for 9 a.m. and 2100 for 9 p.m.), will be recorded on each page.
- When field activity is complete, the logbook will be entered into the permanent project file.

In addition to the preceding requirements, the person recording the information will initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder will initial and date each entry. Logbook corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written next to the original entry. Corrections will be initialed and dated. Separate logbooks for each activity may be needed because several field activities may occur at once.

### 6.7.2 Field Datasheets

Field datasheets will be utilized when appropriate to achieve efficient and standardized recording of field measurements and observations. The type of field data sheet and the information recorded on it may vary by activity. At a minimum, field datasheets will be completed for each sample to document the unique sample identifier assigned, provide information on whether the sample is representative of a field sample or a field-based quality control sample (e.g., field blank, field duplicate), provide information regarding the sample media, sample date, sample location, sample GPS coordinates, and sampling team members for every sample. All datasheets must be entered into electronic format. Datasheets may also be used to document information such as habitat descriptions, sediment sample characteristics (e.g., color, texture, etc.), water level gauging data, surface water and groundwater sample field observations and measurements (e.g., pH, temperature, color, clarity, etc.). A reference date and activity will be entered into the logbook to refer to the field data sheets being generated. The field data sheets will be put into electronic format and become a permanent record within the project file.

### 6.7.3 Data Storage

In addition to data collected during field activities as listed in sections 6.7.2 and 6.7.3, other data that will need to be maintained throughout the RI/FS will include laboratory analytical data, photographs, project correspondence (i.e., letters and emails), and deliverable reports. In general, all project documents will be maintained in electronic format and stored in a project specific folder designated on the Roux Associates network. All electronic files will be backed up in accordance with Roux Associates IT Policy.

All data generated by the laboratories will be requested in electronic data deliverable (EDD) format. The laboratory data will be imported into the project database and managed in accordance with the data management procedures outlined in Section 7.10 of this QAPP.

One copy of all final documents submitted by Roux to a client or regulatory agency is maintained in a central digital repository. Archiving of the digital repository occurs at a minimum daily. All other project files for

completed projects will be retained for seven years from the date of completion of the project, unless a longer period is required by the client or USEPA. Project completion refers to completion of all work at the Site, not the completion of individual phases or tasks.

### 6.7.4 Reporting

A list of project deliverables is provided in Section 9.0 of the RI/FS Work Plan and in Progress Reports for the project. Reporting will be completed in hardcopy and electronic formats and submitted to the USEPA and MDEQ in accordance with the distribution list outlined in Section 6.1. The RI/FS Project Manager will be responsible to ensure all project deliverables are completed on-time and submitted in accordance with the procedures outlined in Section 6.1.

# 7. GROUP B – DATA GENERATION AND ACQUISITION

This element group, comprising ten elements, addresses data generation and data acquisition and management activities. Data generation and acquisition will be conducted using the same procedures utilized during the Phase I Site Characterization, unless otherwise noted.

## 7.1 Element B1 – Sampling Process Design

The Phase II Site Characterization sampling design is summarized in Section 4.1 of this SAP. All of the data planned to be collected in the Phase II Site Characterization will be considered critical to the process, and no secondary data is currently planned.

The Phase II Site Characterization is scheduled to begin in the 2nd Quarter of 2018. A general schedule for completion of each field task associated with Phase II Site Characterization will be provided to the USEPA Project Manager at least 30 days before the start of the field work activities. Because the Site is owned by CFAC, it is not anticipated that any of the onsite sampling locations will become inaccessible during the field activities. Off-site Background Investigation sample locations have yet to be determined, but access will be a consideration in the selection of the background sampling locations. If at any time the sampling locations described in the Phase II Scope of Work become inaccessible, CFAC will communicate with the USEPA Project Manager.

## 7.2 Element B2 – Sampling Methods

Details regarding sampling procedures are presented in Section 5.1 of this SAP, including a summary of the relevant SOPs that will be used to guide the Phase II Site Characterization sampling activities.

If problems arise or field conditions suggest a deviation from the SOPs is required, the RI Manager should be contacted. A plan to adequately address the situation should be developed and documented in the field notebook.

If problems occur related to sampling equipment malfunctions, the RI Manager should be contacted. The RI Manager will be responsible for verifying that corrective actions are completed, such as obtaining backup supplies and equipment to ensure that the field activities will continue until completion. Any equipment malfunctions should be noted in the field notebook with a description of the date, time, and problem. When replacement equipment arrives onsite, it should also be documented in the field notebook, including the source of the equipment and serial number.

## 7.3 Element B3 – Sample Handling and Custody

This element describes the management approaches that will be implemented to ensure that field samples retain their original physical form and chemical composition through collection to final disposal. Management approaches discussed below include sample designation, handling, and custody.

### 7.3.1 Sample Designation

All screening locations and analytical samples, including samples collected for QA/QC purposes, will be given a unique Site-specific sample identification number. The Site-specific sample designation is described in Section 5.2 of this SAP.

### 7.3.2 Sample Handling

The following sections summarize how sample custody will be managed during the course of the Phase II Site Characterization.

#### 7.3.2.1 Sample Labels

Each sample container will be affixed with a waterproof, adhesive label. The sample labels will contain the following information:

- Project name;
- Sample date;
- Sample time;
- Sample identification;
- Sampler's initials;
- Requested analysis; and
- Sample preservative.

Preprinted sample labels will typically be prepared prior to sampling tasks. Labels that are not preprinted, and those portions of the label that must be completed in the field (i.e., date, time, sampler's initials), will be completed using waterproof ink. The label will be covered with clear mailing tape in an effort to prevent it from falling off and to prevent potential water damage during transit.

#### 7.3.2.2 Sample Shipping and Hold Times

Most analytical methods require that samples be kept at an approximate temperature of four degrees Celsius (4°C). Samples requiring this type of preservation will be placed in coolers directly after collection and packed with ice. A temperature blank should be included in each sample cooler. Field personnel are responsible for the security and for maintaining the temperature of the samples before they are transferred to the analytical laboratory.

Sample bottles will be packed snugly with packing material in an effort to protect the containers from potential breakage during shipment. The samples, along with a completed chain of custody (COC), will be stored inside the coolers at the Site until they are sent to the laboratory for analysis. All samples will be shipped by overnight courier (e.g., Federal Express) to the laboratory for analysis. All containers shipped by courier to the laboratory will be sealed with a custody seal that has been signed and dated. Samples will be shipped or transported with sufficient time to meet all analytical holding standards. Tables 4 and 5 list container types and sizes, preservation, and holding times for the various analyses to be performed.

### 7.3.3 Sample Custody

The possession and proper transfer of samples and sample-related information must be documented from the time the samples are collected until the analyses have been completed and the data have been accepted. The objective of the sample custody system is to ensure that:

- Samples are uniquely identified and labeled;
- The correct samples are analyzed and are traceable to their records;
- Samples are protected from loss or damage;

- Alteration of samples (e.g., filtration, preservation) is documented;
- A forensic record of sample integrity is established; and
- Client confidentiality is maintained.

The COC form establishes the documentation and control necessary to identify and trace a sample from collection to final analysis. All field staff responsible for collecting and sending samples to the laboratory will receive a copy of a blank COC. The following sections summarize how sample custody will be managed during the course of RI.

#### 7.3.3.1 Field Chain of Custody Procedures

The field sampler(s) is responsible for the care and custody of the samples until they are transferred or properly dispatched. The field sampler(s) will complete the COC form immediately after collection in an effort to establish sample custody in the field before sample shipment. The following information will be included on the COC:

- Sample identification and sample container identification number, if applicable;
- Date and time the samples were collected;
- Matrix of the sample;
- The number of containers for each sample;
- Analysis requested and preservation codes;
- Name of sampler(s) and the person shipping the samples and documentation;
- Name, telephone number and email address of the RI Project Manager; and
- Signature of the sampler.

Any corrections to the COC will be made by putting a single strike through the incorrect entry and initialing and dating it. When the shipping container (i.e., cooler) is packed for shipping, personnel relinquishing the container will sign the COC. The COC will accompany the samples to the laboratory and a copy of the COC will be retained by the RI Field Manager and placed in the project file. The completed COC will be supplied by the laboratory with the standard data package.

The QA/QC Officer will be responsible for reviewing all sampling activities to verify whether proper custody procedures were followed during the field work. Any deviations in the custody procedures will be noted in the Phase II Data Summary Report.

#### 7.3.3.2 Transfer of Custody and Shipment Procedures

Samples will be sent to the laboratory for analysis with a signed COC. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the COC. This record documents transfer of custody of samples from the sampler to the laboratory. The original COC form will accompany the shipment, and a copy will be retained by the field manager to be placed in the project files. Photocopies of the original COC should be made before shipment, if possible, in an effort to ensure that clean copies can be made later.

Shipping coolers will be locked and secured with tape and custody seals for shipment to the laboratory. If the samples are sent by common carrier, a bill of lading (air bill) must be used. Receipts of bills of lading will

be retained in the project files. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside or on the outside of the sample container and the custody seals remain intact.

#### 7.3.3.3 Laboratory Chain of Custody Procedures

The laboratory project manager will verify that COC records are filled out upon receipt of the samples and will note questions or observations concerning sample integrity, if any. The name of the person receiving the samples and the date and time the samples were received by the laboratory should be noted on the COC.

The laboratory project manager will verify that sample-tracking records are maintained. These records will follow each sample through all stages of laboratory processing. The sample tracking records must show the date of sample extraction or preparation and the date of instrument analysis. These records will be used, in part, in an effort to determine compliance with holding time requirements. Laboratory custody procedures for sample receiving and log-in, sample storage, tracking during sample preparation and analysis, and storage of data are being conducted in accordance with the Phase I Site Characterization procedures and described in the Laboratory QAPP, provided in the Phase I SAP Addendum (Roux Associates, 2016a).

## 7.4 Element B4 – Analytical Methods

All field and laboratory analytical methods to be employed during implementation of the Phase II Site Characterization were chosen based on one or more of the following criteria:

- the ability to meet the DQOs for the project;
- the validity and reproducibility of the methods; and
- conformance of the methods to industry-standard or USEPA-published methods and practices.

The remainder of this Section describes the field and laboratory methods selected for the Phase II Site Characterization activities.

### 7.4.1 Field Analyses

Field instruments and equipment are those pieces of equipment used to gather or generate environmental data. The primary field instrumentation that is expected to be used during the Phase II Site Characterization includes:

- Multi-parameter meters to measure water quality parameters, including water temperature, specific conductance, dissolved oxygen concentration, pH, ORP, and turbidity;
- Designated pH meter to measure pH of water;
- Designated pH meter to measure pH of soil;
- Oil/water interface and water-level probes to measure fluid levels;
- Submersible groundwater pumps and/or bladder pumps for use during groundwater sampling activities;
- Velocity meter for surface water discharge measurement;
- PushPoint sampler to be used during sediment porewater sampling;
- Geroprobe™ slug testing equipment;
- PIDs for air monitoring, soil gas screening and soil screening;

- Multi-gas meter for air monitoring; and
- Handheld GPS for geo-referencing sampling locations.

A summary of the field instrumentation that is expected to be used during the Phase II Site Characterization is provided in Table 6.

### 7.4.2 Laboratory Analyses

The selected analyses for the Phase II Site Characterization sampling activities are described for each media in Section 4.0 and listed on Table 1.

The laboratory's SOPs specify equipment, method-specific performance criteria, and corrective actions for each method. A summary of methods, analyte lists, MDLs, PQLs and CAS Numbers provided by TestAmerica for each media is also provided in Tables 7 through 16. These tables also included the desired PQLs for each analyte that has an established human health or ecological risk-based screening criteria.

As part of the laboratory bid process in the Phase I Site Characterization, each of the analytical laboratories included in the bid process provided a summary of MDLs and PQLs that can be achieved by the respective laboratory under ideal circumstances. TestAmerica was able to meet more PQLs than each of the other laboratories evaluated, and as such, was chosen as the laboratory for the Phase I Site Characterization. TestAmerica will continue to be the primary laboratory for the Phase II Site Characterization based on these qualifications.

In those cases where TestAmerica cannot meet the desired PQL, it is because the screening level is extremely low (i.e., less than the detection limit of most laboratories) and often lower than USEPA screening criteria.

## 7.5 Element B5 – Quality Control

Overall data usability is influenced by variability (error) introduced into and/or inherent with both field (sampling) and laboratory (analytical) processes. The QC checks are tools with which to measure or estimate the overall effect of this variability on a sample collection effort. During implementation of the Phase II Site Characterization, a variety of QC checks will be performed by both field and laboratory staff to assess compliance with project DQOs and the SOPs for the various analytical methods. These QC checks are discussed below.

### 7.5.1 Field QC Checks

This section provides a description of field QC procedures. QC samples will be collected in the field to estimate precision and accuracy of the analytical results and to examine the sources of error introduced by the field practices. The results of the QC checks are used during data validation in an effort to evaluate the precision, accuracy, sensitivity, and representativeness of the overall sampling and analytical program. The following sections describe the QC checks that will be applied to the Phase II Site Characterization and their definition and purpose. The frequencies of field QC samples for the Phase II Site Characterization field activities are specified in Table 2.

#### 7.5.1.1 Field Duplicates

A field duplicate is a field sample that is collected at the same place and time as an original field sample. However, because of potential variation in field duplicate samples (even those from similar locations, especially for media such as soil, surface water, sediment, sediment porewater, etc.), it is not appropriate to assume that field duplicate pairs must necessarily have the same concentration values. Rather, field duplicates help to evaluate variability due to small-scale media heterogeneity, along with analytical precision. During the Phase II Site Characterization, duplicate samples will be collected at a minimum frequency of one per twenty samples and one per sample delivery group.

#### 7.5.1.2 Trip Blanks

Trip blanks are used to assess the potential for bias (inaccuracy) through the introduction of volatile contaminants into the sample or sample containers during transport, handling, and/or storage. Trip blanks determine if any cross-contamination between sample containers occurs from the proximity of sample containers to one another during transport or storage. Trip blanks consist of sample containers filled with analyte-free water that are preserved with hydrochloric acid (HCL) and prepared by the laboratory prior to the sampling event. The trip blanks are then transported to the field along with the containers used for sample collection and are kept with the samples throughout the sampling event, but are not exposed to the sampling process. Once sampling is complete, the trip blanks are then packaged for shipment with the other samples and sent for analysis. The trip blank sample containers are not opened before they reach the laboratory to be analyzed. There should be at least one trip blank included in each shipping container that contains samples for VOC analysis.

#### 7.5.1.3 Equipment Blanks

Equipment blanks (also referred to as decontamination rinsate blanks) are samples that are obtained by running de-ionized water through decontaminated sampling equipment as a check that the decontamination procedure has been adequately carried out and that there is no cross contamination of samples occurring due to the equipment itself. Equipment blanks must be analyzed for the same parameters as the associated samples. One equipment blank will be taken per day as needed when reusable sampling equipment is utilized.

#### 7.5.1.4 Temperature Blanks

Temperature blanks ensure that samples arrive to the laboratory at the correct preservation temperature. Temperature blanks typically consist of de-ionized water and will be included in each cooler when it is shipped to the laboratory. The laboratory sample custodian will record the temperature of the blank upon receipt of the samples.

#### 7.5.1.5 Matrix Spikes and Matrix Spike Duplicates

MS and MSD samples are designed to evaluate the effect of the sample matrix on analytical data, by measuring precision and accuracy from a known concentration of a target analyte that has been added to a particular sample matrix. MS/MSD samples are prepared by spiking environmental field samples with a standard solution containing known concentrations of representative target analytes. Percent recovery of each of the spiked compounds or analytes reflects the ability of the laboratory and method to accurately determine the quantity of the analyte in that particular sample (i.e., is a measure of accuracy in the specific sample matrix).

For the MSD samples, a second aliquot of the same field sample used for the MS is combined with the same quantity of the spiking compounds and is processed in an identical manner. The results for the MS/MSD pair provide a measure of the precision during laboratory analysis.

Additional sample volumes for MS/MSD QA/QC samples will be collected in the field at a minimum frequency of one per twenty samples. MS and MSD samples will be identified on the COC for the analytical laboratory.

#### 7.5.1.6 Field Blanks

A field blank is a sample of the same medium as field samples, but which does not contain any contaminant. Field blanks are normally collected for air and water samples, but not for soil or sediment. A field blank for surface water will be prepared by placing an appropriate volume of analyte-free reagent water (e.g., ASTM Type II) into a sample collection container. Field blanks must be analyzed for the same set of parameters as the surface water samples. Field blanks will be collected at a rate of 1 field blank per 20 field samples or 1 per sample batch, whichever is greater.

### 7.5.2 Laboratory QC Checks

The analytical laboratories have a QA/QC program in place to ensure the reliability and validity of the analysis performed at the laboratory. All analytical procedures are documented in writing in laboratory SOPs and each SOP includes the minimum requirements for the procedure. The internal QA/QC checks differ slightly for each individual procedure.

Laboratory QC check samples serve as checks on the laboratory sampling and measurement systems and assist in determining the data quality with regard to laboratory accuracy and precision. The number and type of laboratory QC check samples varies with the intended data use. Laboratory control samples fall into two basic categories: samples run through the entire sample allocation, preparation, and analysis method (method or matrix controls) and samples run through only the analysis method (analysis or instrument controls). In either case, control samples are samples of known or certified concentration that are introduced at either the pre-preparation or post-preparation step of the method and carried from that point on through the rest of the method as a routine sample.

Control samples are used in an effort to define either method (preparation plus instrument) or instrument accuracy. Method (preparation) performance check samples collectively measure the entire laboratory analytical data generation process, from sample allocation in the laboratory through the analysis and data reduction. Instrument (analysis) check samples measure the laboratory performance from the point where analysis begins, generally excluding any preparation/extraction effects, through the analysis and data reduction.

Laboratory analytical QC will be monitored through internal laboratory QC checks such as the analysis of blanks, matrix spikes, matrix spike duplicates, surrogate spike, laboratory control samples, and initial and continuing calibration checks. The frequency, acceptance criteria, and corrective action for these laboratory QC checks per analysis will be in accordance with method requirements and the individual laboratory QAPPs.

#### 7.5.2.1 Method and Analytical Blanks

Method blanks are generated within the laboratory during the processing of the field samples. These blanks are processed using the sample reagents and procedures at the same time as the samples being analyzed.

Contamination found in the method blank would indicate that similar contamination found in associated samples may have been introduced in the laboratory, and not actually be present in the samples.

Analytical blanks, such as initial calibration blanks and continuing calibration blanks are required by inorganic test methods. These blanks are laboratory reagent-grade water and acid solutions to match samples analyzed at the beginning, intervals during, and the end of an analytical sequence in an effort to assess contamination and instrument drift. The initial calibration blank is analyzed at the beginning of the analytical run following the calibration and initial calibration verification. The continuing calibration blank is analyzed prior to sample analyses, throughout the analytical run and at the end of the analytical sequence, or as stipulated in each analytical method.

#### 7.5.2.2 Surrogate Spikes

Surrogate spike analyses are used to determine target analyte recovery during sample preparation and analysis. A surrogate spike is prepared by adding a known amount of surrogate compound to an environmental sample before extraction. Surrogates are similar to matrix spikes and apply only to organic parameters. The surrogate compound is chosen to exhibit an analytical response similar to the response displayed by a target compound during sample analysis. The recovery of these surrogates aids the analysts in determining matrix effects on recovery of compounds in each sample and is a measure of accuracy. Surrogate spikes generally do not affect the routine sample results because the surrogate compounds are isotopically labeled. Surrogate spike analyses will be conducted in accordance with the referenced method protocols. Acceptance criteria and corrective action procedures for out-of-control surrogate spike results are listed in the laboratory QAPPs.

#### 7.5.2.3 Internal Standards

Internal standards are compounds of known concentrations that are added in a constant amount to samples, blanks, and calibration standards and are used to correct for the loss of analyte during sample preparation. The internal standard is a compound that is very similar, but not identical to the chemical species of interest in the samples, as the effects of sample preparation should, relative to the amount of each species, be the same for the signal from the internal standard as for the signal(s) from the species of interest in the ideal case. Acceptance criteria and corrective action procedures for out-of-control internal standard spike results are listed in the laboratory QAPPs.

## 7.6 Element B6 – Instrument/Equipment Testing, Inspection, and Maintenance

This section describes the instrument testing, inspection, and maintenance procedures.

### 7.6.1 Field Instruments

All measuring equipment must be calibrated and maintained on a periodic basis dependent on the manufacturer's maintenance schedule. The purpose of preventative maintenance is to address potential problems before they occur and to verify that equipment/measurement systems operate adequately when used to collect environmental data. Specific preventative maintenance procedures to be followed for the field equipment are those recommended by the manufacturer and those described in the applicable SOPs. Documentation of equipment maintenance shall be maintained by the field notebook.

Proper equipment cleaning and field decontamination procedures are necessary to prevent cross contamination of samples. Sampling equipment will be decontaminated prior to the start of activities and between sampling locations. Decontamination of equipment may involve the use of a laboratory grade, phosphate-free detergent such as Alconox or Liquinox. Equipment will be rinsed with tap water obtained from a local municipal supply or commercial source. Distilled, de-ionized water will be used as the final water rinse.

Field personnel performing the sample collection activities and handling of equipment will don a new pair of nitrile gloves prior to use of the equipment, between sampling and between decontamination procedures.

A summary of the maintenance requirements for field equipment used at the Site is provided in Table 6.

### 7.6.2 Laboratory Instruments

As part of their QA/QC program, the laboratory will conduct a routine preventative maintenance program in an effort to minimize the potential occurrence of instrument failure and other system malfunctions. These procedures will be documented by the laboratory and will be verified through laboratory audits conducted by the laboratory QA/QC Officer.

Appropriate documentation of all equipment/instrument maintenance shall be maintained by the laboratory personnel and shall include what was done, date, time (if appropriate), next scheduled maintenance, equipment status, anomalies, and personnel performing maintenance. This documentation shall be entered into specific maintenance log forms for laboratory maintenance activities as described in the laboratory QAPPs and SOPs.

## 7.7 Element B7 – Instrument/Equipment Calibration and Frequency

This section describes the instrument calibration procedures.

### 7.7.1 Field Instruments

Field instruments and equipment will be calibrated in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Calibration of field instruments will be performed at the intervals specified by the manufacturer, or more frequently as conditions dictate. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be removed from service until the problem is resolved. Any field equipment that fails to calibrate should be documented in the field notebook, including the date and reason for calibration failure. Additionally, when the field equipment problem is resolved it should also be documented in the field notebook.

Field instruments that are rented from third-party rental services should be calibrated prior to being delivered to the Site. Documentation of calibration should be provided by the rental service or onsite calibration will need to be performed. A summary of the calibration requirements for equipment used at the Site is provided in Table 6.

### 7.7.2 Laboratory Instruments

Calibration of laboratory equipment for analyses will be based upon approved written procedures in accordance with the requirements of the various analytical methods. Specific instrument calibration information should be provided in each laboratory QAPP.

Analytical instruments will be calibrated in accordance with the referenced analytical methods. Calibration standards are prepared in the laboratory by dissolving or mixing a known amount of nominally pure analyte in the appropriate matrix using volumetric containers. Calibration standards must be prepared from a standard source that is traceable to a certified primary reference material. All calibration standards must be prepared so that the types and concentration of the reagents used in the standard preparation are equivalent to the types and concentration of the reagents used in preparing the samples to be analyzed. Records of standard preparation and instrument calibration will be maintained by the laboratory.

Initial calibration and continuing calibration verification checks will be performed in an effort to determine that the instrument is capable of producing acceptable qualitative and quantitative data for the particular method being analyzed. Initial calibration is performed to demonstrate acceptable performance at the beginning of the analytical run and to verify the linearity of the instrument response within a specific concentration range. The continuing calibration is performed to ensure that the initial calibration is still valid for the instrument. Calibration protocols, including calibration frequencies, conditions, and acceptance criteria, are described in the laboratory QAPP.

## 7.8 Element B8 – Inspection/Acceptance of Supplies and Consumables

Certain supplies and consumables associated with the field sampling program are considered “critical”, (i.e., which may directly or indirectly affect the quality of the results). These include sample containers, tubing, and filters. The RI Field Manager will be responsible for ensuring that an adequate supply of the critical supplies and consumables is available and that consumables are certified clean. The employees conducting the field activities will be responsible for receiving all supplies / consumables and verifying that all materials are stored in a safe location until being used. The employees conducting the field work should communicate with the RI Manager if supplies need to be replaced or additional supplies need to be procured.

Sample containers will be provided by the laboratory, pre-cleaned and with appropriate preservative added. The laboratory has a control procedure in place to ensure cleanliness of sample containers, as described in its QAPP. In addition, there are other laboratory-related critical consumables such as reagent water and reference standards. The adequacy of these materials will be ensured and documented in accordance with the laboratory’s QAPP.

## 7.9 Element B9 – Non-Direct Measurements

This element is intended to address data obtained from existing sources rather than directly measured or generated during the Phase II Site Characterization.

Consistent with the Phase I Site Characterization, discharge of the Flathead River will be automatically measured at the closest USGS gauging station, which is located approximately three miles southwest of the Site near Columbia Falls (USGS Station #12363000). The USGS data will be used in conjunction with data collected from the temporary staff gauge installed within the Flathead River to continue evaluating the relationship of the Flathead River discharge immediately adjacent to the Site. River levels measured at the staff gauge will be used in conjunction with measured groundwater elevations to evaluate groundwater / surface water interactions.

Meteorological data may be used to evaluate the potential impacts of precipitation events. Meteorological data will be downloaded from the National Oceanic & Atmospheric Administration (NOAA) website for the

weather station located at Kalispell Glacier Park International Airport, located in Kalispell, Montana (Station ID# 244560).

Regional data from publicly available sources may be utilized during the preparation of the Background Investigation SAP Addendum. Outside data sources may be referenced for climatic and biological characteristics, as described in Section 4.11.

No other outside data sources are expected to be used during the Phase II Site Characterization.

## 7.10 Element B10 – Data Management

The Phase II Site Characterization will generate an extensive amount of information that needs to be added to the existing RI/FS dataset, and properly documented and managed in order to support risk assessment, remedy selection decisions and any legal or cost recovery actions. Therefore, data management procedures will be followed to ensure the quality, validity, and security of the data.

Roux Associates is the custodian of the project files and will maintain all relevant records, reports, logs, field notebooks, pictures, and subcontractor reports in a secured area and under custody of the RI Project Manager. Access will be restricted to project personnel, and the ability to view and/or add or change data will be granted to only those individuals identified and trained to perform those tasks. To the extent practical, data will be obtained and archived electronically. When electronic data collection is not practical, data will be archived in the project files. The non-electronic data will also be scanned for electronic archiving.

A variety of data will be generated during the Phase II Site Characterization field program, including photos, manual field measurements, data collected and logged automatically by field instruments, and results of chemical analyses. Management of these data will vary from type to type, as discussed below.

Photo Documentation

Field personnel are encouraged to use digital photography to document Site features or field activities. Photos will be collected and stored within the project file in accordance with Roux SOP 6.5.

Manual Field Measurements

Manual field measurements will be recorded in field logbooks or activity-specific field datasheets. Entries in the field logbooks will be photocopied as soon as practicable following each Site visits to ensure that a backup copy of the field measurements exists in the event the field logbook is lost, stolen, or destroyed. Photocopies of field logbooks will be kept in the project file. Field datasheets will also be returned to the office as soon as practicable following each Site visit. Field datasheets will be digitized and kept in the project file. Field datasheets are described in Section 6.7.2 and will be consistent with the format utilized during the Phase I Site Characterization.

Laboratory Results

The analytical laboratory will provide a summary report, EDDs, and a Contract Laboratory Program (CLP)-Level IV equivalent data package. The Level IV data package will contain data to perform a data validation to evaluate whether the data meets the performance and acceptance criteria as described in Section 6.5.

Level IV data packages will include the following:

- sample results;

- forms and checklists summarizing all QC measurement parameters specified in the method; and
- all associated raw data generated in support of the reported results.

Forms summarizing all QC measurement parameters specified in the method include:

- instrument tuning summary and associated sample summary;
- initial and continuing calibration data summaries;
- internal standard response and retention time summaries;
- laboratory control sample (LCS) data summaries;
- MS results;
- surrogate standard results; and
- laboratory duplicate summaries.

Raw data will include copies of all associated instrument printouts and laboratory notebook records that were generated during sample preparation and analysis.

Laboratory EDDs delivered to Roux Associates will be uploaded into Roux Associates' EQuIS™ project database described below.

Project Database

A project database was created as part of the Phase I Site Characterization to organize, analyze, and store project information and data. EQuIS™, a relational database system based on Microsoft Access, is the system utilized for the database. As part of the Phase II Site Characterization, EQuIS™ will continue to be used to:

- Provide a single centralized repository for field measurement data and laboratory analytical results (soil, soil gas, groundwater, surface water, sediment and);
- Provide a user-friendly interface for database queries and generation of data summary tables;
- Allow the data to be viewed and displayed in a GIS compatible format, along with other GIS data layers;
- Provide detailed information about sampling locations, sample types, sampling and analytical methods, results, and QA information;
- Provide simple comparisons to regulatory standards or risk-based screening levels, along with calculations of descriptive statistics; and
- Generate export files to spreadsheets, data analysis software, or other databases according to their requirements.

Laboratory analytical data will be added to the database using standardized formats and a QA program. The QA program checks the format and completeness of chemical data. Most data will be transferred directly from the laboratories via electronic files to eliminate the potential for error during keyboard data entry.

All data that is manual input into the database will be printed, 100% verified against the original source documents, and corrected if necessary within the EQuIS system. The hard copies will be initialed as they are checked during verification of electronic versions of the original source documents.

All validated results of sampling and tests and all other validated data received by CFAC will be made available to the USEPA via web access. The validated data will also be provided in progress reports. The RI/FS Manager has overall responsibility for the project database. The RI Manager will be responsible for ensuring that the project database is updated during the Phase II Site Characterization.

Roux Associates' Information Technology (IT) department will provide backup of the electronic database daily. Additionally, the need for any upgrades to the hardware or software required to manage the Phase II Site Characterization or RI/FS data will be determined jointly by Roux Associates' IT department and the RI/FS Manager. Any upgrades needed will be completed as necessary to facilitate the project.

# 8. GROUP C – ASSESSMENT AND OVERSIGHT

The two elements in this group detail the assessments and evaluations that will occur during implementation of the RI/FS to determine whether this QAPP is being implemented as approved, to increase confidence in the information obtained, and ultimately to determine whether the information may be used for its intended purpose.

## 8.1 Element C1 – Assessments and Response Actions

Four internal field audits will be conducted by the QA Officer or his/her designee during the Phase II Site Characterization. The major sampling activities to be audited include ISM sampling, porewater sampling, surface water sampling, groundwater sampling, and slug testing. The audits will focus mainly on measurement and sampling procedures, to ensure that representative data are being generated in the field. The audits will be timed to occur early implementation phase of each activity to allow for timely corrective action, if needed, prior to the generation of a significant amount of data. The field audits will ensure that data being collected during the Phase II Site Characterization meets the DQOs. All field audits should be provided to the RI/FS Manager and RI Manager via email for filing in the project records.

If any deviations are noted during the field audit, the QA Officer has full authority to stop work and discuss the deviation with the field personnel. The QA Officer will develop a corrective action plan that will be communicated with the field personnel and the RI/FS Manager, with clear consensus regarding the individual responsible to complete the action. The QA Officer should define a timely schedule and should verify all corrective actions are completed and documented in the project file. Laboratory calibration and checks are discussed in Section 7.5.2. Laboratory corrective actions generally address the need to bring data generating systems back into conformance after some trigger or other criteria have shown the system to be out of conformance. Generally, laboratory functional problems may occur during sample handling, sample preparation, laboratory analysis, and data review. The need for laboratory analysis corrective actions is based upon predetermined limits for accuracy, precision, and completeness. By conducting system and performance audits, the Laboratory QA Officer will determine if the data are acceptable and if corrective actions are necessary. The analytical laboratory will perform internal audits and corrective actions in accordance with its QAPP.

## 8.2 Element C2 – Reports to Management

As described above, at least four field QA audits are scheduled in addition to any laboratory audits that may be conducted. The field QA reports will be prepared by the QA Manager and submitted to the RI/FS Manager and RI Manager for storage in the project files. In addition, the QA Manager may prepare correspondence and submit to the RI/FS Manager, if needed, to document any corrective actions that may be required.

# 9. GROUP D – DATA VALIDATION AND USABILITY

The three elements in this group address the final project checks to determine whether the data developed conform to the stated objectives of the project and to estimate the effect of any deviations.

## 9.1 Element D1 – Data Review, Verification, and Validation

This element identifies the criteria for deciding to accept, reject, or qualify project information. Such decisions will be based on the data review, verification, and validation procedures described below in Section 9.2, which will determine whether the data meet the project DQOs.

Analytical data will need to achieve specific criteria in order to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels.

Performance and acceptance criteria, together with the appropriate level of QA practices, will guide the evaluation of existing data relative to the intended use. Section 6.5 of this QAPP provides specific details regarding the precision and accuracy control limits, and MDLs/ PQLs, for each of the target analytes and matrices, and the overall project goals for completeness and representativeness. Data which do not meet one or more performance criteria may still be acceptable for project use, although some degree of qualification may be required. Data grossly failing to meet one or more performance criteria will be rejected, unless substantial other evidence supports use with qualification. Error encountered as a result of sampling procedures will be limited to the extent practicable by following approved USEPA methods and applicable standard operating practices.

## 9.2 Element D2 – Verification and Validation Methods

Field data validation will initially be performed by the field personnel while collecting data/samples. The QA/QC of the field data is the responsibility of the RI Manager. Field data validation includes ensuring that data was properly collected and handled according to the sampling procedures described in this SAP and the SOPs. Decisions to repeat data collection and/or void data may be made by the RI Manager, if necessary, based upon the extent of the deficiencies and their importance in the overall context of the Phase II Site Characterization. The RI Manager may discuss the results of the field data verification and validation with the RI/FS Manager. The RI/FS Manager will ultimately decide if the data is unusable or if additional validation steps may be required. If data is deemed unusable, either the RI Manager or the RI/FS Manager will discuss with the project staff.

Validation of laboratory data will be performed in accordance with the following USEPA guidance:

- *National Functional Guidelines for Organic Data Review* (USEPA, 2017a);
- *National Functional Guidelines for Inorganic Data Review* (USEPA, 2017b); and
- *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA, 2009).

All laboratory data packages will be verified and validated using a Stage 4 validation to evaluate whether the data meets the performance and acceptance criteria. The Stage 4 validation will be performed on 100% of the laboratory data generated during the Phase II SAP to support risk assessment and remedy selection. As described in the guidance (USEPA, 2009), the Stage 4 verification and validation will include completeness

and compliance checks of sample receipt conditions, both sample-related and instrument-related QC results, recalculation checks, and the review of actual instrument outputs.

All data packages will be reviewed by a qualified, third-party data validator. The data validator will document findings by adding appropriate validation qualifiers (as necessary) to the sample results in the laboratory data packages based on the various verification and validation tasks. The following qualifiers will be applied to the data to identify data limitations identified during validation:

**J+** ..... (Estimated, High Bias): The compound or analyte was analyzed for and positively identified by the laboratory; however, the reported concentration is estimated, displaying high bias, due to non-conformances discovered during data validation.

**J-** ..... (Estimated, Low Bias): The compound or analyte was analyzed for and positively identified by the laboratory; however, the reported concentration is estimated, displaying low bias, due to non-conformances discovered during data validation.

**J** ..... (Estimated, Bias Indeterminate): The compound or analyte was analyzed for and positively identified by the laboratory; however, the reported concentration is estimated due to it being below the laboratory quantitation limit or due to non-conformances discovered during data validation. Bias is indeterminate.

**U** ..... (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however, the compound or analyte should be considered non-detect at the reported concentration due to the presence of contaminants detected in the associated blank(s).

**UJ** ..... (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however, the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

**R** ..... (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

**NA** ..... (Not Applicable): The non-conformances discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant a qualification of the data.

Additionally, flags classified as P (Protocol) or A (Advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

A summary of the data verification and validation processes will be included in a Data Summary Usability Report (DUSR). The verified and validated analytical data will be included in the Phase II Data Summary Report. The QA Officer is responsible for communicating with the data validator to ensure the data is validated. It is the ultimate responsibility of the RI/FS Manager to ensure that the entirety of the laboratory data collected during the Phase II Site Characterization is validated.

## 9.3 Element D3 – Reconciliation with User Requirements

Once all samples have been collected and analytical data has been generated, data will be evaluated to determine if DQOs were achieved. Only data generated in association with QC results meeting the stated acceptance criteria (i.e., data determined to be valid) will be considered usable for decision making purposes. Rejected data will be clearly indicated during validation and made unavailable for use. The Phase II Data Summary Report will include a qualitative and quantitative review of all QC samples and all deviations from the SAP described in this report, along with conclusions regarding the reliability of the data for their intended use.

Respectfully submitted,

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# TABLES

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2. Summary of Field Quality Control Samples
3. Summary of Laboratory Quality Control Measures by Analysis
4. Container Size, Preservation, and Shipping – Solid Samples
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7. Sampling Analyses and MDLs for Soil – Human Health
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16. Sampling Analyses and MDLs for Sediment Porewater – Ecological

| Notes Utilized Throughout Tables and Appendices | |
|---|---|
| **DEQ-7 Human Health Standards** | Montana Department of Environmental Quality- DEQ Circular 7 Human Health Standards |
| **EPA** | United States Environmental Protection Agency |
| **EPA Drinking MCL** | United States Environmental Protection Agency Risk Based Screening Level Drinking Water MCL |
| **EPA Tapwater RSL** | United States Environmental Protection Agency Risk Based Screening Level Tapwater RSL |
| **Industrial RSL** | United States Environmental Protection Agency Industrial Soil Regional Screening Level |
| **Rediential RSL** | United States Environmental Protection Agency Residnetial Soil Regional Screening Level |
| **Risk SSL** | United States Environmental Protection Agency Human Health Protection of Ground Water - Risk-based Soil Screening Level |
| **CFS** | Cubic Feet per Second |
| **DI** | Dissolved |
| **DRY** | Well is Dry |
| **DUP** | Duplicate sample |
| **ESV** | Ecological Screening Value |
| **ft-amsl** | Feet Above Mean Sea Level |
| **ft-bls** | Feet Below Land Surface |
| **ft-btoc** | Feet Below Top of Casing |
| **GWE** | Ground Water Elevation |
| **LOD** | Limit of Detection |
| **N/A** | No Information Available |
| **ND** | Non Detect |
| **RL** | Reporting Limit |
| **RPD** | Relative Percent Differnce |
| **T** | Total |
| **TEF Value** | Toxic equivalence factors |
| **UCL** | Upper Confidence Limit |
| **USGS** | United States Geologic Survey |
| **UTL** | Upper Tolerance Limit |
| **µg/L** | Micrograms per Liter |
| **g/cc** | Grams per cubic centimeter |
| **mg/kg** | Milligrams per kilogram |
| **pg/g** | Picogram per gram |
| **ppm** | Parts per million |
| **J-** | Estimated Low Bias |
| **J** | Estimated value |
| **J+** | Estimated High Bias |
| **R** | Result is Rejected |
| **U** | Indicates that analyte was not detected at the limit reported |
| **Notes Exclusively for Soil Ecological Screening Values** | |
| **A** | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. |
| **B** | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. |
| **C** | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. |
| **D** | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997) |
| **E** | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil Invertebrates (Efroymson et al. 1997) |
| **Background** | Essential nutrients calcium, magnesium, potassium and sodium were carried through as their maximum overall soil concentration exceeded their background concentrations. |
| USEPA Eco SSL state aluminum is only a COPEC if soil pH <5.5. Sitewide pH is approximately 7.2 | |
| **Notes Exclusively for Sediment Ecological Screening Values** | |
| **A** | USEPA Region 5 RCRA Ecological Screening Levels (USEPA 2003) |
| **B** | Ingersoll, et al. (1996); Threshold Effect Level (TEL) and Probable Effect Level (PEL) for total extraction of sediment (BT) samples from Hyalella azteca 28-day (HA28) tests. |
| **C** | MacDonald et al. (2000); consensus-based threshold effect concentration (TEC) and probable effect concentration (PEC). |
| **D** | USEPA Region 3 Freshwater Sediment Screening Benchmarks (USEPA 2006) |
| **E** | Derived based on the equilibrium partitioning (EqP) approach normalized to 1% TOC. |
| **F** | From Table 3-4 in EPA (2003); column titled "Coc, PAHi, FCVi (µg/goc)" normalized to 1% TOC and adjusted to ppm. |
| **Notes Exclusively for Groundwater, Surfacewater and Sediment Porwater Ecological Screening Values** | |
| **A** | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) |
| **B** | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) |
| **C** | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) |
| **D** | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs provided in Table 1. ORNL Population EC20s provided in Table 2. |
| **E** | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) |
| **F** | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] |

# Table 1. Summary of Proposed Phase II Sampling Locations
## Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT

| | | | | | | | | | | PROPOSED SOIL / SEDIMENT ANALYSES | | | | | | | | | | | | | | | | | | | | | | | | | | PROPOSED GROUNDWATER / SURFACE WATER ANALYSES / SEDIMENT POREWATER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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# Table 1. Summary of Proposed Phase II Sampling Locations
## Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT

| | | | | | | | | | PROPOSED SOIL / SEDIMENT ANALYSES | | | | | | | | |

# Table 1. Summary of Proposed Phase II Sampling Locations
## Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT

| | | | | | | | | | | | PROPOSED SOIL / SEDIMENT ANALYSES | | | | | | | | | | |

# Table 1. Summary of Proposed Phase II Sampling Locations
## Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT

| | | | | | | | | | | PROPOSED SOIL / SEDIMENT ANALYSES | | | | | | | | | | | | | | | | | | | | | | | | | | PROPOSED GROUNDWATER / SURFACE WATER ANALYSES / SEDIMENT POREWATER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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**Table 2. Summary of Field Quality Control Samples**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Field QC Sample Type | Sample Media | Minimum Collection Frequency | Analyses to be Performed | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| Trip Blank | Water Samples | 1 per cooler of samples for VOC analyses | VOC Analyses | Non-detect (<RL) for all target analytes | Qualify results of analyte(s) in samples associated with trip blank (same cooler) according to EPA data validation guidance |
| | Solid Samples | | VOC Analyses | Non-detect (<RL) for all target analytes | |
| Equipment Rinsate Blank | Groundwater Samples and Pore Water Samples | 1 per day | Metals, Cyanide, General Chemistry And Anion Analyses | Non-detect (<RL) for all target analytes | Qualify results of analyte(s) in samples associated with equipment rinsate blank (same day, same team) according to EPA data validation guidance |
| | Solid Samples | | VOC, SVOC, Pesticide, PCB, Metals And Cyanide, And Fluoride Analyses | Non-detect (<RL) for all target analytes | |
| Field Blank | Surface Water Samples | 1 per 20 field samples (5%) | Metals, Cyanide, General Chemistry And Anion Analyses | Non-detect (<RL) for all target analytes | Qualify results of analyte(s) in samples associated with field blank (surface water samples) according to EPA data validation guidance |
| Field Duplicate | Water Samples | 1 per 20 field samples (5%) | Metals, Cyanide, General Chemistry And Anion Analyses | ≤30% RPD for target analytes | Qualify results of analyte(s) in both parent and field duplicate samples |
| | Solid Samples | | VOC, SVOC, Pesticide, PCB, Metals, Cyanide, And Fluoride Analyses | ≤50% RPD for target analytes | |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 6020A**<br>**Metals by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)** | Initial calibration<br>(a blank and at least five calibration standards) | Each time the instrument is set up and after CCV failure | • Correlation coefficient (r) ≥0.995 | • Recalibrate instrument |
| | Initial calibration verification (ICV)<br>(independent source standard) | Immediately after initial calibration | • Percent recovery (%R) within 90% - 110% of true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | Every two hours, and at beginning and end of analytical sequence | • %R within 90% - 110% of true value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Interference check standard (ICS) | Beginning of sample analysis sequence | • Results within ±20% of true value | • Terminate analysis and recalibrate instrument |
| | Internal Standards (IS) | All samples analyzed during an analytical sequence, with the exception of the tuning solution | • Percent relative intensity (%RI) within 60% - 125% of the response in the calibration blank | • Reanalyze affected sample |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification;<br>CCB analyzed at the beginning of analytical sequence, after every CCV, and after last CCV | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| | Post-digestion spike | When MS recovery falls outside control limits and sample result is < 4x the spike added | • %R within ±25% of actual value<br>• (An aliquot of the remaining unspiked sample shall be spiked at 2x the indigenous level) | • Narrate all exceedances |
| | Serial dilution | 1 per preparation batch (≤20 samples) | • Percent difference (%D) ≤10% for sample concentrations >50x the MDLs | • Matrix interference effect should be suspected<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Methods 7470A/7471A**<br>**Mercury by Cold-Vapor Atomic Absorption** | Initial calibration<br>(a blank and at least five calibration standards) | Daily, and each time the instrument is set up | • Correlation coefficient (r) ≥0.995 | • Recalibrate instrument |
| | Initial calibration verification (ICV)<br>(independent source standard) | Immediately after initial calibration | • %R within 85% - 115% of true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | Every hour, and at beginning and end of analytical sequence | • %R within 85% - 115% of true value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification;<br><br>CCB analyzed at the beginning of analytical sequence, after every | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value,<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 8260B**<br>**Volatile Organic Compounds (VOCs) by Gas Chromatography/Mass Spectrometry (GC/MS)** | Instrument performance check (using 4-bromofluorobenzene (BFB) standard) | Every 12 hours | • Must meet ion abundance criteria established by method | • Retune instrument<br>• Repeat standard analysis |
| | Initial calibration (5 point minimum) | At beginning of each analytical sequence, or as necessary if CCV criteria are not met | • Relative response factors (RRFs) must meet criteria established by method (≥0.010 or ≥0.050 depending on compound);<br>• %RSD of the RRFs must meet criteria established by method (≤40% or ≤30% depending on compound) | • Recalibrate instrument |
| | Continuing calibration verification (CCV) | Every 12 hours | • RRFs must meet criteria established by method (≥0.010 or ≥0.050 depending on compound);<br>• %D between the average initial calibration RRF and CCV RRF must meet criteria established by method (≤40% or ≤30% depending on compound) | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Internal standards (IS) | All project samples, method blank, LCS, and MS/MSD | • Retention time (RT) for each IS within ±20 seconds of RT of IS in the associated CCV;<br>• IS area counts for all samples must not vary more than ±40% from the associated CCV | • Reanalyze sample<br>• If still not in compliance, re-extract/reanalyze sample<br>• Narrate all exceedances |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Re-extract/reanalyze affected samples as appropriate |
| | Surrogate spike | All project samples, method blank, LCS, and MS/MSD | • Recoveries of surrogates within control limits established by the selected laboratory | • Reanalyze sample<br>• Re-extract and reanalyze if recoveries of more than one surrogates outside control limits<br>• If still out, report both sets of data |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • Recoveries of target compounds in MS/MSD and RPDs between MS and MSD results within control limits established by the selected laboratory | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Re-extract/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • Recoveries of target compounds in LCS within control limits established by the selected laboratory | • Reanalyze LCS<br>• Re-extract/reanalyze LCS and affected samples |
| | Target Compound Identification | All project samples, method blank, LCS, and MS/MSD | • Relative retention times (RRTs) must be within ±0.06 RRT units of standard RRT;<br>• Mass spectra of the sample compound and a current laboratory-generated standard must match according to the criteria established by the method | • Reanalyze sample<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 8270D**<br>**Semi-Volatile Organic Compounds (SVOCs) by Gas Chromatography/Mass Spectrometry (GC/MS)** | Instrument performance check (decafluorotriphenylphosphine [DFTPP] standard) | Every 12 hours | • Must meet ion abundance criteria established by method | • Retune instrument<br>• Repeat standard analysis |
| | Initial calibration<br>5 point minimum) | At beginning of each analytical sequence, or as necessary if CCV criteria are not met | • Relative response factors (RRFs) must meet criteria established by method (≥0.010 or ≥0.050 depending on compound);<br>• %RSD of the RRFs must meet criteria established by method (≤40% or ≤20% depending on compound) | • Recalibrate instrument |
| | Continuing calibration verification (CCV) | Every 12 hours | • RRFs must meet criteria established by method (≥0.010 or ≥0.050 depending on compound);<br>• %D between the average initial calibration RRF and CCV RRF must meet criteria established by method (≤40% or ≤25% depending on compound) | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Internal standards (IS) | All project samples, method blank, LCS, and MS/MSD | • Retention time (RT) for each IS within ±30 seconds of RT of IS in the associated CCV;<br>• IS area counts for all samples must within 50% - 200% of the area counts in the associated CCV | • Reanalyze sample<br>• If still not in compliance, re-extract/reanalyze sample<br>• Narrate all exceedances |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Re-extract/reanalyze analytical batch as appropriate |
| | Surrogate spike | All project samples, method blank, LCS, and MS/MSD | • Recoveries of surrogates within control limits established by the selected laboratory | • Reanalyze sample<br>• Re-extract and reanalyze if recoveries of more than one surrogates are out<br>• If still out, report both sets of data<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • Recoveries of target compounds in MS/MSD and RPDs between MS and MSD results within control limits established by the selected laboratory | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Re-extract/reanalyze once if matrix is not a factor |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • Recoveries of target compounds in LCS within control limits established by the selected laboratory | • Reanalyze LCS<br>• Re-extract/reanalyze LCS and affected samples<br>• Narrate all exceedances |
| | Target Compound Identification | All project samples, method blank, LCS, and MS/MSD | • Relative retention times (RRTs) must be within ±0.06 RRT units of standard RRT;<br>• Mass spectra of the sample compound and a current laboratory-generated standard must match according to the criteria established by the method | • Reanalyze sample<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 335.4**<br>**Analysis of Total and Dissolved Cyanide in water by Colorimetric Method** | Initial calibration<br>(a blank and at least five calibration standards) | Daily, and each time the instrument is set up | • Correlation coefficient (r) ≥0.995 | • Recalibrate instrument |
| | Initial calibration verification (ICV)<br>(independent source standard) | Immediately after initial calibration | • %R within 85% - 115% of true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) | Every hour, and at beginning and end of analytical sequence | • %R within 85% - 115% of true value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification;<br>CCB analyzed at the beginning of analytical sequence, after every CCV, and after last CCV | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank<br>• Reprep/reanalyze analytical batch as appropriate |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value,<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 8082A**<br>**Polychlorinated biphenyls (PCBs) by Gas Chromatography** | Initial calibration | At beginning of each analytical sequence, or as necessary if CCV criteria are not met | • %RSD <20% for calibration factors (CFs) of the three to five major peaks of each Aroclor;<br>• Five-point calibration using Aroclors 1016 and 1260 to demonstrate linearity;<br>• The other seven Aroclors are calibrated at a single mid-point for pattern recognition | • Recalibrate instrument |
| | Continuing calibration verification (CCV) | Every 12 hours, and at beginning and end of analytical sequence | • % D ≤15% for CF of Aroclor peaks and surrogates compared with those from initial calibration;<br>• Absolute retention time (RT) of Aroclors and surrogates must be within the RF windows determined from initial calibration | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Target Compound Identification | All project samples, method blank, LCS, and MS/MSD | • RTs of surrogates and detected Aroclors must be within calculated RT windows;<br>• %D for detected Aroclor concentrations between the two GC columns must be within ±25% | • Reanalyze sample<br>• Narrate all exceedances |
| | Blanks:<br>Method blank (MB)<br>Instrument blank (IB) | MB: 1 per preparation batch (≤20 samples);<br>IB: immediately prior to each CCV, and at beginning and end of analytical sequence | • <RL | • Reanalyze blank<br>• Re-extract /reanalyze blank and associated samples |
| | Surrogate spike<br>(two surrogates: DCB and TCMX) | All project samples, method blank, LCS, and MS/MSD | • % R = 30% - 150% | • Reanalyze sample<br>• Re-extract and reanalyze sample once if matrix is not a factor<br>• If still out, report both sets of data |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| | Matrix spike (MS) and Matrix spike duplicate (MSD)<br>(spike Aroclors 1016 and 1260) | 1 per preparation batch (≤20 samples) | • %R for Aroclors 1016 and 1260: 29% -135%;<br>• RPDs between MS and MSD results:<br>≤15% for Aroclor 1016<br>≤20% for Aroclor 1260 | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Re-extract/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R for Aroclors 1016 and 1260: 50% - 150% | • Reanalyze LCS<br>• Re-extract/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 9012B**<br>**Analysis of Total Cyanide in soil** | Initial calibration | Each time the instrument is set up and after CCV failure | • Correlation coefficient (r) ≥0.995 | • Recalibrate instrument |
| | Initial calibration verification (ICV) (independent source standard) | Immediately after initial calibration | • Within ±10% of initial calibration curve | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | Every 10 samples, and at beginning and end of analytical sequence | • Within ±10% of initial calibration curve | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification;<br>CCB analyzed after 10 samples and at the end of analytical sequence | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < ½ RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±10% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±10% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 9016**<br>**Free Cyanide in Water and Soil by Microdiffusion** | Initial calibration | At beginning of each analytical sequence, or as necessary if CCV criteria are not met | • Within ±15% of the true value | • Recalibrate instrument |
| | Initial calibration verification (ICV) (independent source standard) | Immediately after initial calibration | • Within ±15% of the true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | Every 10 samples, and at beginning and end of analytical sequence | • Within ±15% of the true value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Interference check standard (ICS) | Beginning of sample analysis sequence | • Results within ±20% of true value | • Terminate analysis and recalibrate instrument |
| | Internal Standards (IS) | All samples analyzed during an analytical sequence, with the exception of the tuning solution | • Percent relative intensity (%RI) within 60% - 125% of the response in the calibration blank | • Reanalyze affected sample |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification;<br>CCB analyzed after 10 samples and at the end of analytical sequence | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| | | | | |
|---|---|---|---|---|
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 300.0/9056A**<br>**Inorganic Anions by Ion Chromatography (Fluoride, Chloride, Sulfate, and Orthophosphate)** | Initial calibration<br>(a blank and at least three concentration levels) | Must be verified each working day, or whenever the anion eluent is charged, and after 20 samples | • Calibration curve must be liner<br>• Response or retention time within ±10% of initial values | • Prepare new calibration curve |
| | Instrument performance check solution (IPC) (a mid-range check standard) | Immediately following daily calibration, after every tenth sample, and at the end of the sample run | • within ±10% of initial calibration | • Reanalyze IPC<br>• Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant IPC |
| | Laboratory reagent blank (LRB) | 1 per preparation batch (≤20 samples) | • < method detection limit (MDL) | • Reanalyze LRB<br>• Reprep/reanalyze analytical batch as appropriate |
| | Laboratory fortified blank (LFB) | 1 per preparation batch (≤20 samples) | • %R within 90% - 110% | • Reanalyze LFB<br>• Reprep/reanalyze LFB and affected samples<br>• Narrate all exceedances |
| | Laboratory fortified sample matrix (LFM) | A minimum of 10% of the routine samples | • %R within 90% - 110% | • If LFB recoveries are within acceptance criteria, matrix interference may be suspected |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 2340C**<br>**Analysis of Total Hardness by EDTA Titration in Water** | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 2320B**<br>**Analysis of Alkalinity in Water and Soil by Titration** | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 2540C/2540D**<br>**Total Dissolved Solids (TDS)/ Total Suspended Solids (TSS), Determination of Filterable Residue by Standard Method in Water** | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory duplicate | 1 per preparation batch (≤20 samples) | • RPD ≤20% between original and duplicate sample results that are ≥ 5x the RLs | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Lloyd Kahn Method**<br>**Analysis of Total Organic Carbon (TOC) in Solid Samples** | Initial calibration | Each time the instrument is set up and after CCV failure | • Within ±10% of true value | • Recalibrate instrument |
| | Initial calibration verification (ICV) (independent source standard) | Immediately after initial calibration | • Within ±10% of true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard ) | Every 10 samples and at end of analytical sequence | • Within ±10% of true value | • Terminate analysis, recalibrate instrument, and reanalyze previous 10 |
| | Calibration blanks -<br>Initial calibration blank (ICB), Continuing calibration blank (CCB) | Following each calibration verification | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze previous 10 samples |
| | Method blank | Every 20 samples | • < RL | • Reanalyze method blank.<br>• Reanalyze samples associated with method blank |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | Run daily or every 20 samples | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results<br>• %R and RPD criteria do not apply when sample concentration ≥4x the spike added | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | Daily or every 20 samples | • Middle range of the calibration curve | • Reanalyze LCS<br>• Analysis should not continue until LCS result is obtained |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 353.2**<br>**Nitrate-Nitrite as Nitrogen by Automated Colorimetry** | Initial calibration<br>(a blank and at least three concentration levels) | Daily, and each time the instrument is set up | • Calibration curve must be liner<br>• Response within ±10% of initial values | • Prepare new calibration curve |
| | Instrument performance check solution (IPC) (a mid-range check standard) | Immediately following daily calibration, after every tenth sample, and at the end of the sample run | • within ±10% of initial calibration | • Reanalyze IPC<br>• Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant IPC |
| | Laboratory reagent blank (LRB) | 1 per preparation batch (≤20 samples) | • < MDL | • Reanalyze LRB<br>• Reprep/reanalyze analytical batch as appropriate |
| | Laboratory fortified blank (LFB) | 1 per preparation batch (≤20 samples) | • %R within 90% - 110% | • Reanalyze LFB<br>• Reprep/reanalyze LFB and affected samples<br>• Narrate all exceedances |
| | Laboratory fortified sample matrix (LFM) | A minimum of 10% of the routine samples | • %R within 90% - 110% | • If LFB recoveries are within acceptance criteria, matrix interference may be suspected |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Method 350.1**<br>**Ammonia Nitrogen by Semi-Automated Colorimetry** | Initial calibration<br>(a blank and at least three concentration levels) | Daily, and each time the instrument is set up | • Calibration curve must be liner<br>• Response within ±10% of initial values | • Prepare new calibration curve |
| | Instrument performance check solution (IPC) (a mid-range check standard) | Immediately following daily calibration, after every tenth sample, and at the end of the sample run | • within ±10% of initial calibration | • Reanalyze IPC<br>• Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant IPC |
| | Laboratory reagent blank (LRB) | 1 per preparation batch (≤20 samples) | • < MDL | • Reanalyze LRB<br>• Reprep/reanalyze analytical batch as appropriate |
| | Laboratory fortified blank (LFB) | 1 per preparation batch (≤20 samples) | • %R within 90% - 110% | • Reanalyze LFB<br>• Reprep/reanalyze LFB and affected samples<br>• Narrate all exceedances |
| | Laboratory fortified sample matrix (LFM) | A minimum of 10% of the routine samples | • %R within 90% - 110% | • If LFB recoveries are within acceptance criteria, matrix interference may be suspected |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Polychlorinated dibenzo-p-dioxins (PCDD) / polychlorinated dibenzofurans (PCDF) via USEPA method 8290A** | Initial calibration | At beginning of each analytical sequence, or as necessary if CCV criteria are not met | • All native compounds must be within ±20% of expected value<br>• IDA (labeled) compounds must be within ±30% of expected value | • Recalibrate instrument |
| | Initial calibration verification (ICV) (independent source standard) | Immediately after initial calibration | • All native compounds must be within ±20% of expected value<br>• IDA (labeled) compounds must be within ±30% of expected value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | At the beginning of performance and after a 12-hour period | • All native compounds must be within ±20% of expected value<br>• IDA (labeled) compounds must be within ±30% of expected value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Method blank | 1 per process batch of similar matrix (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | At the request of Client | • RPD ≤20% between MS and MSD results<br>• | • Reprep/reanalyze once if matrix is not a factor<br>• Flag all exceedances |
| | Laboratory duplicate | At the request of Client | • RPD ≤25% between original and duplicate sample results | • Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per process batch of similar matrix (≤20 samples) | • Control analytes are above upper control limits and the and the associated samples are ND | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM) via USEPA-821-R-100** | Initial calibration verification (ICV) (independent source standard) | Daily prior to sample analysis | • Within ±15% of the true value | • Terminate analysis and recalibrate instrument |
| | Continuing calibration verification (CCV) (mid-level standard) | Every 10 samples, and at beginning and end of analytical sequence | • Within ±15% of the true value | • Terminate analysis, recalibrate instrument, and reanalyze samples back to the last compliant CCV |
| | Calibration blanks - Initial calibration blank (ICB), Continuing calibration blank (CCB) | ICB analyzed after initial calibration verification; CCB analyzed after 10 samples and at the end of analytical sequence | • < RL | • Reanalyze blank<br>• Clean system<br>• Reanalyze samples back to the last compliant blank |
| | Method blank | 1 per preparation batch (≤20 samples) | • < RL | • Reanalyze method blank.<br>• Reprep/reanalyze affected samples as appropriate |
| | Matrix spike (MS) and Matrix spike duplicate (MSD) | 1 per preparation batch (≤20 samples) | • %R within ±25% of actual value<br>• RPD ≤20% between MS and MSD results | • If LCS recoveries are within acceptance criteria, matrix interference may be suspected<br>• Reprep/reanalyze once if matrix is not a factor<br>• Narrate all exceedances |
| | Laboratory control sample (LCS) | 1 per preparation batch | • %R within ±15% of actual value | • Reanalyze LCS<br>• Reprep/reanalyze LCS and affected samples<br>• Narrate all exceedances |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Grain Size Distribution (sieve and hydrometer) via ASTM D422** | Initial calibration | At beginning of each day for oven and scale<br>Every 2 years for hydrometer<br>Every 6 months for sieves | • Oven temperature is within 105°C -115°C<br>• Check calibration of balance using at least 2 Class S weights that bracket the range of use | • Recalibrate instrument<br>• Record calibration in logbook |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Bulk Density via ASTM D-2937-04** | Initial calibration | At beginning of each day | • Oven temperature is within 105°C -115°C<br>• Check calibration of balance using at least 2 Class S weights that bracket the range of use | • Recalibrate instrument<br>• Record calibration in logbook |

**Table 3. Summary of Laboratory Quality Control Measures, by Analysis**
**Columbia Falls Aluminum Company, Columbia Falls, Montana**

| Analytical Method | QC Element | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|
| **Moisture Content via ASTM D2216-05** | Initial calibration | At beginning of each day | • Oven temperature is within 105°C -115°C<br>• Check calibration of balance using at least 2 Class S weights that bracket the range of use | • Recalibrate instrument<br>• Record calibration in logbook |

**Table 4. Container Size, Preservation, and Shipping – Solid Samples**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Container Description | Analyses | Method | Preservation and Handling | Extraction/Analysis Holding Times |
|---|---|---|---|---|
| 8-oz glass jar | Total Metals | EPA 6020A/7471B | Cool 4°C ± 2°C | 180 days |
| | Mercury | EPA 7471B | Cool 4°C ± 2°C | 28 days |
| | pH | EPA 9045D | Cool 4°C ± 2°C | As soon as possible |
| | Fluoride | EPA 9056A | Cool 4°C ± 2°C | 28 days |
| | Total Cyanide | EPA 9012B | Cool 4°C ± 2°C | 14 days |
| | Free Cyanide | EPA 9016 | Cool 4°C ± 2°C | 14 days |
| 4-oz glass jar | Semi-volatile Organic Compounds (SVOCs) Low Level | EPA 8270D Low Level | Cool 4°C ± 2°C | 14 days/40 days |
| 8-oz glass jar | Pesticides | EPA 8081B | Cool 4°C ± 2°C | 14 days/40 days |
| | Polychlorinated Biphenyls (PCBs) | EPA 8082A | Cool 4°C ± 2°C | 14 days/40 days |
| 3 x 40-mL glass vials with Teflon-lined screw cap (2 vials pre-preserved with NaHSO4 and 1 vial pre-preserved with methanol; sample with plastic syringe samplers) | Volatile Organic Compounds (VOCs) | EPA 8260B | Cool 4°C ± 2°C | 14 days |
| 16-oz glass jar | Grain Size Analysis (GSA) | ASTM D422 | Cool 4°C ± 2°C | No hold time |
| | Moisture content | ASTM D2216-05 | Cool 4°C ± 2°C | No hold time |
| | Bulk density | ASTM D-2937-04 | Cool 4°C ± 2°C | No hold time |
| 4-oz clear glass jar | Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM) | USEPA-821-R-100 | Cool 4°C ± 2°C | 28 days |
| 4-oz amber glass jar | Polychlorinated dibenzo-p-dioxins (PCDD)/ polychlorinated dibenzofurans (PCDF) | USEPA 8290A | Cool 4°C ± 2°C | 14 days |
| 4-oz amber glass jar with Teflon-lined screw cap | Total organic carbon (TOC) | Lloyd Kahn | Cool 4°C ± 2°C protect from sunlight and atmospheric oxygen | 28 days |

**Table 5. Container Size, Preservation, and Shipping – Aqueous Samples**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Container Description | Analyses | Method | Preservation and Handling | Extraction/Analysis Holding Times |
|---|---|---|---|---|
| 250-mL plastic (pre-preserved with HNO3) | Total Target Analyte List (TAL) Metals Dissolved TAL Metals | EPA 6020A | Cool 4°C ± 2°C HNO3, pH≤2 | 180 days |
| | Hardness | EPA 2340C | Cool 4°C ± 2°C HNO3, pH≤2 | 180 days |
| | Mercury | EPA 7470A | Cool 4°C ± 2°C HNO3, pH≤2 | 28 days |
| 250-mL plastic (pre-preserved with H2SO4) | Nitrite as N, Nitrate | EPA 353.2 | Cool 4°C ± 2°C H2SO4, pH≤2 | 28 days |
| | Ammonia | EPA 350.1 | Cool 4°C ± 2°C H2SO4, pH≤2 | 28 days |
| 250-mL plastic (pre-preserved with NaOH) | Dissolved and Free Cyanide | EPA 9016 | Cool 4°C ± 2°C NaOH, pH≥10 | 14 days |
| | Total Cyanide | EPA 335.4 | Cool 4°C ± 2°C NaOH, pH≥10 | 14 days |
| 250-mL plastic | Dissolved Alkalinity | EPA 2320B | Cool 4°C ± 2°C | 14 days |
| 2 x 1-L amber glass | Pesticides | EPA 8081B | Cool 4°C ± 2°C | 7 days |
| | Polychlorinated Biphenyls (PCBs) | EPA 8082A | Cool 4°C ± 2°C | 7 days |
| 2 x 250-mL amber glass | Semi-volatile Organic Compounds (SVOCs) Low Level | EPA 8270D Low Level | Cool 4°C ± 2°C | 7 days |
| 3 x 40 mL vials; no headspace (pre-preserved with HCl) | Volatile Organic Compounds (VOCs) | EPA 8260B | Cool 4°C ± 2°C HCl, pH<2 | 14 days |
| 1-L plastic | Total Suspended Solids (TSS) | SM 2540C | Cool 4°C ± 2°C | 7 days |
| 500-mL plastic | Total Dissolved Solids (TDS) | SM 2540D | Cool 4°C ± 2°C | 7 days |
| 250-mL amber glass (pre-preserved with H2SO4) | Dissolved Organic Carbon (DOC) | EPA 9060A | Cool 4°C ± 2°C H2SO4, pH≤2 | 28 days |
| 500-mL amber glass (pre-preserved with NaOH and Zn(O2CCH3)2 | Sulfide | SM 4500 | Cool 4°C ± 2°C Zn(O2CCH3)2, H2SO4, pH≤2 | 7 days |
| 1-L amber glass | Polychlorinated dibenzo-p-dioxins (PCDD)/ polychlorinated dibenzofurans (PCDF) | USEPA 8290A | Cool 4°C ± 2°C | 7 days |
| 125-mL plastic | Fluoride, Chloride, Sulfate | EPA 300.0 | Cool 4°C ± 2°C | 28 days |
| | Orthophosphate | EPA 9056A | Cool 4°C ± 2°C | 48 hours |

**Table 6. Equipment Calibration and Maintenance Requirements**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Equipment Type | Calibration Requirements | Maintenance Schedule |
|---|---|---|
| Photoionization Detector | Factory calibration per manufacturers recommendations. Field calibration daily prior to use with calibration gas. | Recharge or replace battery as needed. Regulary clean lamp window. Regulary replace filter. Visually inspect after each use to ensure equipment is in good working order. |
| Multi-Gas Meter | Factory calibration per manufacturers recommendations. Field calibration daily prior to use with calibration gas. | Recharge or replace battery as needed. Regulary clean lamp window. Regulary replace filter. Visually inspect after each use to ensure equipment is in good working order. |
| Electronic Water-Level Meter | Factory calibration per manufacturers recommendations. | Replace batteries as needed. Decon after each use. Visually inspect after each use to ensure equipment is in good working order. |
| Multi-parameter water quality meter | Factory calibration per manufacturers recommendations. Field calibration daily prior to use with multi-point calibration solution. | Replace batteries as needed. Clean probes as needed. Visually inspect after each use to ensure equipment is in good working order. |
| pH Meter (Water) | Factory calibration per manufacturers recommendations. Field calibration daily prior to use with multi-point calibration solution. | Replace batteries as needed. Clean probes as needed. Visually inspect after each use to ensure equipment is in good working order. |
| pH Meter (Soil) | Factory calibration per manufacturers recommendations. Field calibration daily prior to use with multi-point calibration solution. | Replace batteries as needed. Clean probes as needed. Visually inspect after each use to ensure equipment is in good working order. |
| Grundfos Pump | N/A | Maintain gaskets as needed. Clean pump intake as needed. Decon after each use. Visually inspect after each use to ensure equipment is in good working order. |
| Whale Pump | N/A | Maintain gaskets as needed. Clean pump intake as needed. Decon after each use. Visually inspect after each use to ensure equipment is in good working order. |
| Bladder Pump | N/A | Maintain gaskets as needed. Clean pump intake as needed. Replace bladder after each use. Decon after each use. Visually inspect after each use to ensure equipment is in good working order. |
| Pneumatic Slug Testing Manifold | N/A | Maintain gaskets as needed. Visually inspect after each use to ensure equipment is in good working order. |
| Bladder Pump Compressor | N/A | Visually inspect each day to ensure equipment is in good working order. |
| Peristaltic Pump | N/A | Replace masterflex tubing after each use. Visually inspect after each use to ensure equipment is in good working order. |
| Velocity Meter | N/A | Recharge or replace batteries as needed. Decon after each use. Visually inspect after each use to ensure equipment is in good working order. |
| GPS | Factory calibration per manufacturers recommendations. Reference point checks daily prior to use. | Recharge or replace battery as needed. Visually inspect each day to ensure equipment is in good working order. |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00179 | Corrosivity | T | 9045D | Ph Units | | | | | | | | | |
| GenChem | 16984-48-8 | Fluoride | DI | 9056A | mg/kg | 0.16 | 2.84 | 1.80465 | 1.7700 | 310 | 4700 | 12 | 12 | 4700 |
| GenChem | 16984-48-8 | Fluoride | T | 9056A | mg/kg | 0.18 | 9.02 | 0.87076 | 0.3900 | 310 | 4700 | 12 | 12 | 4700 |
| GenChem | STL00529 | In Place Density | T | D2937 | g/cc | | | | | | | | | |
| GenChem | STL00550 | Moisture Content | T | D2216-90 | Percent | | | | | | | | | |
| GenChem | STL00204 | pH | T | 9045D | Ph Units | | | | | | | | | |
| GenChem | STL00338 | Total Organic Carbon (1) | T | Lloyd Kahn | mg/kg | 69.8 | 127 | 82.70500 | 78.3000 | | | | | |
| Metals | 7429-90-5 | Aluminum | T | 6020A | mg/kg | 0.79 | 41.3 | 7.37911 | 7.2000 | 7700 | 110000 | 3000 | 3000 | 110000 |
| Metals | 7440-36-0 | Antimony | T | 6020A | mg/kg | 0.018 | 0.91 | 0.35472 | 0.3700 | 3.1 | 47 | 0.035 | 0.035 | 47 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | mg/kg | 0.033 | 0.99 | 0.38254 | 0.4000 | 0.68 | 3 | 0.0015 | 0.0015 | 3 |
| Metals | 7440-39-3 | Barium | T | 6020A | mg/kg | 0.28 | 4.4 | 0.62532 | 0.6250 | 1500 | 22000 | 16 | 16 | 22000 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | mg/kg | 0.014 | 0.28 | 0.10957 | 0.1100 | 16 | 230 | 1.9 | 1.9 | 230 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | mg/kg | 0.0047 | 0.69 | 0.28344 | 0.3000 | | | | | |
| Metals | 7440-70-2 | Calcium | T | 6020A | mg/kg | 26.7 | 82.1 | 36.57281 | 35.1000 | | | | | |
| Metals | 7440-47-3 | Chromium | T | 6020A | mg/kg | 0.077 | 1.7 | 0.67519 | 0.7000 | | | | | |
| Metals | 16065-83-1 | Chromium(III), Insoluble Salts | T | 6020A | mg/kg | 0.077 | 1.7 | 0.67519 | 0.7000 | 12000 | 180000 | 4000000 | 12000 | 4000000 |
| Metals | 18540-29-9 | Chromium(VI) | T | 6020A | mg/kg | 0.077 | 1.7 | 0.67519 | 0.7000 | 0.3 | 6.3 | 0.00067 | 0.00067 | 6.3 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | mg/kg | 0.0022 | 1.7 | 0.66092 | 0.7000 | 2.3 | 35 | 0.027 | 0.027 | 35 |
| Metals | 7440-50-8 | Copper | T | 6020A | mg/kg | 0.12 | 6.1 | 0.63044 | 0.6300 | 310 | 4700 | 2.8 | 2.8 | 4700 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | mg/kg | 0.4 | 0.56 | 0.43833 | 0.4200 | 2.3 | 15 | 0.0015 | 0.0015 | 15 |
| Metals | 57-12-5 | Cyanide, Total | T | 9012B | mg/kg | 0.014 | 0.8 | 0.02866 | 0.0180 | 2.3 | 15 | 0.0015 | 0.0015 | 15 |
| Metals | 7439-89-6 | Iron | T | 6020A | mg/kg | 4.1 | 57.2 | 22.54263 | 23.4000 | 5500 | 82000 | 35 | 35 | 82000 |
| Metals | 7439-92-1 | Lead | T | 6010C | mg/kg | 0.11 | 0.97 | 0.70432 | 0.8200 | 400 | 800 | | 400 | 800 |
| Metals | 7439-92-1 | Lead | T | 6020A | mg/kg | 0.058 | 0.49 | 0.19771 | 0.2000 | 400 | 800 | | 400 | 800 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | mg/kg | 5.1 | 79.3 | 31.79018 | 33.0000 | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | mg/kg | 0.15 | 3.5 | 1.37800 | 1.4000 | | | | | |
| Metals | 7439-97-6 | Mercury | T | 7471B | mg/kg | 0.01 | 0.039 | 0.01337 | 0.0130 | 1.1 | 4.6 | 0.0033 | 0.0033 | 4.6 |
| Metals | 7440-02-0 | Nickel | T | 6020A | mg/kg | 0.05 | 2.7 | 0.68064 | 0.7100 | 150 | 2200 | 2.6 | 2.6 | 2200 |
| Metals | 7440-09-7 | Potassium | T | 6020A | mg/kg | 6.3 | 75.1 | 30.44175 | 31.5000 | | | | | |
| Metals | 7782-49-2 | Selenium | T | 6020A | mg/kg | 0.051 | 0.85 | 0.33574 | 0.3500 | 39 | 580 | 0.052 | 0.052 | 580 |
| Metals | 7440-22-4 | Silver | T | 6020A | mg/kg | 0.0018 | 1.7 | 0.65238 | 0.6900 | 39 | 580 | 0.08 | 0.08 | 580 |
| Metals | 7440-23-5 | Sodium | T | 6020A | mg/kg | 11.1 | 84.8 | 36.41298 | 37.4000 | | | | | |
| Metals | 7440-28-0 | Thallium | T | 6020A | mg/kg | 0.024 | 0.34 | 0.13683 | 0.1400 | 0.078 | 1.2 | 0.0014 | 0.0014 | 1.2 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | mg/kg | 0.047 | 1.7 | 0.71559 | 0.7500 | 39 | 580 | 8.6 | 8.6 | 580 |
| Metals | 7440-66-6 | Zinc | T | 6020A | mg/kg | 0.64 | 6 | 2.37818 | 2.4000 | 2300 | 35000 | 37 | 37 | 35000 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | mg/kg | 0.00085 | 0.0023 | 0.00106 | 0.0010 | 0.19 | 2.5 | 0.0015 | 0.0015 | 2.5 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | mg/kg | 0.00093 | 0.0025 | 0.00117 | 0.0011 | 2 | 9.3 | 0.011 | 0.011 | 9.3 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | mg/kg | 0.00066 | 0.0018 | 0.00083 | 0.0008 | 1.9 | 8.5 | 0.077 | 0.077 | 8.5 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | mg/kg | 0.00078 | 0.0021 | 0.00098 | 0.0009 | 0.039 | 0.18 | 0.00015 | 0.00015 | 0.18 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | mg/kg | 0.00059 | 0.0016 | 0.00074 | 0.0007 | 0.086 | 0.36 | 0.000042 | 0.000042 | 0.36 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | mg/kg | 0.001 | 0.0028 | 0.00132 | 0.0012 | | | | | |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | mg/kg | 0.00063 | 0.0017 | 0.00078 | 0.0007 | 0.3 | 1.3 | 0.00015 | 0.00015 | 1.3 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | mg/kg | 0.0007 | 0.0019 | 0.00088 | 0.0008 | | | | | |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | mg/kg | 0.00084 | 0.0022 | 0.00105 | 0.0010 | 0.034 | 0.14 | 0.000071 | 0.000071 | 0.14 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | mg/kg | 0.00089 | 0.0024 | 0.00112 | 0.0011 | | | | | |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | mg/kg | 0.001 | 0.0027 | 0.00127 | 0.0012 | | | | | |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | mg/kg | 0.00075 | 0.002 | 0.00094 | 0.0009 | | | | | |
| Pesticides | 72-20-8 | Endrin | T | 8081B | mg/kg | 0.00082 | 0.0022 | 0.00102 | 0.0010 | 1.9 | 25 | 0.0092 | 0.0092 | 25 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | mg/kg | 0.0008 | 0.0021 | 0.00100 | 0.0009 | | | | | |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | mg/kg | 0.00089 | 0.0024 | 0.00112 | 0.0011 | | | | | |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | mg/kg | 0.00058 | 0.0015 | 0.00072 | 0.0007 | 0.57 | 2.5 | 0.00024 | 0.00024 | 2.5 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | mg/kg | 0.0014 | 0.0037 | 0.00175 | 0.0016 | | | | | |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | mg/kg | 0.00083 | 0.0022 | 0.00104 | 0.0010 | 0.13 | 0.63 | 0.00012 | 0.00012 | 0.63 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | mg/kg | 0.0013 | 0.0034 | 0.00158 | 0.0015 | 0.07 | 0.33 | 0.000028 | 0.000028 | 0.33 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | mg/kg | 0.0014 | 0.0036 | 0.00171 | 0.0016 | 32 | 410 | 0.2 | 0.2 | 410 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | mg/kg | 0.019 | 0.05 | 0.02354 | 0.0220 | 0.49 | 2.1 | 0.011 | 0.011 | 2.1 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | 0.41 | 5.1 | 0.013 | 0.013 | 5.1 |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | 0.2 | 0.83 | 0.00008 | 0.00008 | 0.83 |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | 0.17 | 0.72 | 0.00008 | 0.00008 | 0.72 |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | 0.23 | 0.95 | 0.0012 | 0.0012 | 0.95 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | 0.23 | 0.95 | 0.0012 | 0.0012 | 0.95 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | 0.12 | 0.97 | 0.002 | 0.002 | 0.97 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | 0.24 | 0.99 | 0.0055 | 0.0055 | 0.99 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | | | |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | 0.94 | | 0.94 | 0.94 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/kg | 0.027 | 10 | 0.11333 | 0.0310 | 4.7 | 20 | 0.00087 | 0.00087 | 20 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/kg | 0.023 | 9 | 0.09969 | 0.0270 | 2.3 | 35 | 0.00079 | 0.00079 | 35 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/kg | 0.084 | 32 | 0.35688 | 0.0980 | 5.3 | 24 | 0.000094 | 0.000094 | 24 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/kg | 0.013 | 5 | 0.05505 | 0.0150 | 310 | 4700 | 0.026 | 0.026 | 4700 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/kg | 0.03 | 11 | 0.12497 | 0.0350 | 190 | 2500 | 0.018 | 0.018 | 2500 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/kg | 0.031 | 12 | 0.13297 | 0.0370 | 630 | 8200 | 0.4 | 0.4 | 8200 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/kg | 0.0089 | 3.4 | 0.03791 | 0.0100 | 6.3 | 82 | 0.0012 | 0.0012 | 82 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/kg | 0.0074 | 2.9 | 0.03160 | 0.0087 | 19 | 250 | 0.0023 | 0.0023 | 250 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/kg | 0.069 | 27 | 0.29610 | 0.0810 | 130 | 1600 | 0.042 | 0.042 | 1600 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/kg | 0.24 | 91 | 1.01021 | 0.2800 | 13 | 160 | 0.0044 | 0.0044 | 160 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/kg | 0.012 | 4.8 | 0.05291 | 0.0150 | 1.7 | 7.4 | 0.00032 | 0.00032 | 7.4 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/kg | 0.017 | 6.4 | 0.07117 | 0.0200 | 0.36 | 1.5 | 0.000067 | 0.000067 | 1.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/kg | 0.0071 | 2.7 | 0.03019 | 0.0083 | 480 | 6000 | 0.39 | 0.39 | 6000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/kg | 0.008 | 3.1 | 0.03395 | 0.0093 | 39 | 580 | 0.0089 | 0.0089 | 580 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/kg | 0.0069 | 2.7 | 0.02969 | 0.0081 | 24 | 300 | 0.019 | 0.019 | 300 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/kg | 0.014 | 5.3 | 0.05829 | 0.0160 | 320 | 4100 | 0.075 | 0.075 | 4100 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/kg | 0.01 | 4 | 0.04401 | 0.0120 | 63 | 800 | 0.008 | 0.008 | 800 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/kg | 0.011 | 4.1 | 0.04492 | 0.0120 | | | | | |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | mg/kg | 0.0084 | 3.2 | 0.03560 | 0.0098 | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/kg | 0.035 | 13 | 0.14845 | 0.0410 | 1.2 | 5.1 | 0.00082 | 0.00082 | 5.1 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/kg | 0.0093 | 3.6 | 0.03955 | 0.0110 | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/kg | 0.084 | 32 | 0.35646 | 0.0980 | 0.51 | 6.6 | 0.00026 | 0.00026 | 6.6 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/kg | 0.0099 | 3.8 | 0.04190 | 0.0120 | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/kg | 0.014 | 5.2 | 0.05726 | 0.0160 | 630 | 8200 | 0.17 | 0.17 | 8200 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/kg | 0.0081 | 3.1 | 0.03423 | 0.0095 | 2.7 | 11 | 0.00016 | 0.00016 | 11 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/kg | 0.0094 | 3.6 | 0.03982 | 0.0110 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/kg | 0.012 | 4.6 | 0.05055 | 0.0140 | 25 | 110 | 0.0016 | 0.0016 | 110 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/kg | 0.15 | 58 | 0.64272 | 0.1800 | | | | | |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/kg | 0.0076 | 2.9 | 0.03228 | 0.0089 | 360 | 4500 | 0.55 | 0.55 | 4500 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/kg | 0.0081 | 3.1 | 0.03423 | 0.0095 | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/kg | 0.0069 | 2.6 | 0.02910 | 0.0080 | 780 | 12000 | 0.058 | 0.058 | 12000 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/kg | 0.03 | 11 | 0.12608 | 0.0350 | 1800 | 23000 | 5.8 | 5.8 | 23000 |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/kg | 0.014 | 5.4 | 0.05975 | 0.0160 | 2.4 | 10 | 0.0002 | 0.0002 | 10 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/kg | 0.024 | 9.2 | 0.10208 | 0.0280 | 170 | 820 | 0.0041 | 0.0041 | 820 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/kg | 0.026 | 10 | 0.11213 | 0.0310 | 1.1 | 21 | 0.011 | 0.011 | 21 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/kg | 0.0095 | 3.7 | 0.04084 | 0.0110 | 0.11 | 2.1 | 0.029 | 0.029 | 2.1 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/kg | 0.012 | 4.7 | 0.05262 | 0.0140 | 1.1 | 21 | 0.3 | 0.3 | 21 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/kg | 0.018 | 7 | 0.07755 | 0.0210 | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/kg | 0.014 | 5.3 | 0.05875 | 0.0160 | 1.6 | 210 | 2.9 | 1.6 | 210 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/kg | 0.0098 | 3.8 | 0.04169 | 0.0110 | 19 | 250 | 0.0013 | 0.0013 | 250 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/kg | 0.0074 | 2.9 | 0.03160 | 0.0087 | 0.23 | 1 | 0.0000036 | 0.0000036 | 1 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/kg | 0.012 | 4.7 | 0.05220 | 0.0140 | 39 | 160 | 1.3 | 1.3 | 160 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/kg | 0.0097 | 3.7 | 0.04124 | 0.0110 | 290 | 1200 | 0.24 | 0.24 | 1200 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/kg | 0.023 | 8.7 | 0.09613 | 0.0260 | 3100 | 40000 | 0.25 | 0.25 | 40000 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/kg | 0.0078 | 3 | 0.03321 | 0.0091 | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/kg | 0.0086 | 3.3 | 0.03652 | 0.0100 | 110 | 2100 | 9 | 9 | 2100 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/kg | 0.016 | 6.3 | 0.06997 | 0.0190 | 0.11 | 2.1 | 0.096 | 0.096 | 2.1 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/kg | 0.0095 | 3.7 | 0.04052 | 0.0110 | 7.3 | 100 | 0.015 | 0.015 | 100 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/kg | 0.0089 | 3.4 | 0.03791 | 0.0100 | 5100 | 66000 | 0.61 | 0.61 | 66000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/kg | 0.0091 | 3.5 | 0.03886 | 0.0110 | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/kg | 0.0094 | 3.6 | 0.03982 | 0.0110 | 630 | 8200 | 0.23 | 0.23 | 8200 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/kg | 0.016 | 6.1 | 0.06792 | 0.0190 | 63 | 820 | 5.7 | 5.7 | 820 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/kg | 0.0093 | 3.6 | 0.03987 | 0.0110 | 240 | 3000 | 8.9 | 8.9 | 3000 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/kg | 0.0069 | 2.6 | 0.02910 | 0.0080 | 240 | 3000 | 0.54 | 0.54 | 3000 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/kg | 0.013 | 4.9 | 0.05429 | 0.0150 | 0.21 | 0.96 | 0.00012 | 0.00012 | 0.96 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/kg | 0.0088 | 3.4 | 0.03765 | 0.0100 | 1.2 | 5.3 | 0.00027 | 0.00027 | 5.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/kg | 0.02 | 7.5 | 0.08321 | 0.0230 | 0.18 | 0.75 | 0.00013 | 0.00013 | 0.75 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/kg | 0.012 | 4.4 | 0.04892 | 0.0130 | 1.8 | 8 | 0.0002 | 0.0002 | 8 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/kg | 0.021 | 8 | 0.08958 | 0.0240 | 1.1 | 21 | 0.98 | 0.98 | 21 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/kg | 0.0068 | 2.6 | 0.02861 | 0.0079 | 570 | 2400 | 0.026 | 0.026 | 2400 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/kg | 0.008 | 3.1 | 0.03395 | 0.0093 | 3.8 | 17 | 0.00054 | 0.00054 | 17 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/kg | 0.0099 | 3.8 | 0.04190 | 0.0120 | 5.1 | 22 | 0.000092 | 0.000092 | 22 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/kg | 0.011 | 4.1 | 0.04492 | 0.0120 | 0.078 | 0.33 | 0.0000081 | 0.0000081 | 0.33 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/kg | 0.029 | 11 | 0.12130 | 0.0330 | 110 | 470 | 0.067 | 0.067 | 470 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/kg | 0.038 | 15 | 0.16259 | 0.0450 | 1 | 4 | 0.000057 | 0.000057 | 4 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/kg | 0.0084 | 3.2 | 0.03589 | 0.0098 | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/kg | 0.01 | 4 | 0.04369 | 0.0120 | 1900 | 25000 | 0.33 | 0.33 | 25000 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/kg | 0.014 | 5.5 | 0.06116 | 0.0170 | 180 | 2300 | 1.3 | 1.3 | 2300 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | mg/kg | 0.00016 | 0.022 | 0.00046 | 0.0004 | 810 | 3600 | 0.28 | 0.28 | 3600 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | mg/kg | 0.000074 | 0.015 | 0.00024 | 0.0002 | 0.6 | 2.7 | 0.00003 | 0.00003 | 2.7 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | mg/kg | 0.00019 | 0.027 | 0.00054 | 0.0004 | 670 | 2800 | 2.6 | 2.6 | 2800 |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | mg/kg | 0.00012 | 0.0064 | 0.00030 | 0.0003 | 0.15 | 0.63 | 0.000013 | 0.000013 | 0.63 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | mg/kg | 0.00015 | 0.019 | 0.00041 | 0.0003 | 3.6 | 16 | 0.00078 | 0.00078 | 16 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | mg/kg | 0.00018 | 0.027 | 0.00051 | 0.0004 | 23 | 100 | 0.01 | 0.01 | 100 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | mg/kg | 0.000048 | 0.028 | 0.00023 | 0.0001 | 6.3 | 93 | 0.0021 | 0.0021 | 93 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | mg/kg | 0.000082 | 0.022 | 0.00039 | 0.0003 | 5.8 | 26 | 0.0012 | 0.0012 | 26 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | mg/kg | 0.0002 | 0.018 | 0.00055 | 0.0004 | 0.0053 | 0.064 | 0.00000014 | 0.00000014 | 0.064 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | mg/kg | 0.000061 | 0.018 | 0.00022 | 0.0001 | 180 | 930 | 0.03 | 0.03 | 930 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | mg/kg | 0.000048 | 0.02 | 0.00021 | 0.0001 | 0.46 | 2 | 0.000048 | 0.000048 | 2 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | mg/kg | 0.000074 | 0.014 | 0.00025 | 0.0002 | 1.6 | 6.6 | 0.00027 | 0.00027 | 6.6 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | mg/kg | 0.000052 | 0.027 | 0.00024 | 0.0001 | | | | | |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | mg/kg | 0.000056 | 0.027 | 0.00024 | 0.0001 | 2.6 | 11 | 0.00046 | 0.00046 | 11 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | mg/kg | 0.00033 | 0.18 | 0.00155 | 0.0007 | 2700 | 19000 | 0.12 | 0.12 | 19000 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | mg/kg | 0.00041 | 0.058 | 0.00117 | 0.0009 | 20 | 130 | 0.00088 | 0.00088 | 130 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | mg/kg | 0.00059 | 0.051 | 0.00231 | 0.0021 | 3300 | 14000 | 0.14 | 0.14 | 14000 |
| VOC | 67-64-1 | Acetone | T | 8260B | mg/kg | 0.00046 | 0.086 | 0.00169 | 0.0010 | 6100 | 67000 | 0.29 | 0.29 | 67000 |
| VOC | 71-43-2 | Benzene | T | 8260B | mg/kg | 0.000087 | 0.015 | 0.00027 | 0.0002 | 1.2 | 5.1 | 0.00023 | 0.00023 | 5.1 |
| VOC | 75-25-2 | Bromoform | T | 8260B | mg/kg | 0.000056 | 0.014 | 0.00022 | 0.0001 | 19 | 86 | 0.00087 | 0.00087 | 86 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | mg/kg | 0.00014 | 0.014 | 0.00040 | 0.0003 | 0.68 | 3 | 0.00019 | 0.00019 | 3 |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | mg/kg | 0.00019 | 0.018 | 0.00049 | 0.0004 | 77 | 350 | 0.024 | 0.024 | 350 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | mg/kg | 0.00016 | 0.027 | 0.00052 | 0.0004 | 0.65 | 2.9 | 0.00018 | 0.00018 | 2.9 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | mg/kg | 0.000061 | 0.019 | 0.00022 | 0.0001 | 28 | 130 | 0.0053 | 0.0053 | 130 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | mg/kg | 0.000074 | 0.024 | 0.00028 | 0.0002 | 15 | 63 | 0.0021 | 0.0021 | 63 |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | mg/kg | 0.000065 | 0.018 | 0.00023 | 0.0001 | 8.3 | 39 | 0.00023 | 0.00023 | 39 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | mg/kg | 0.00015 | 0.03 | 0.00049 | 0.0003 | 1400 | 5700 | 0.59 | 0.59 | 5700 |
| VOC | 67-66-3 | Chloroform | T | 8260B | mg/kg | 0.000091 | 0.018 | 0.00030 | 0.0002 | 0.32 | 1.4 | 0.000061 | 0.000061 | 1.4 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | mg/kg | 0.00016 | 0.018 | 0.00046 | 0.0004 | 11 | 46 | 0.0049 | 0.0049 | 46 |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | mg/kg | 0.000095 | 0.021 | 0.00030 | 0.0002 | 16 | 230 | 0.0011 | 0.0011 | 230 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | mg/kg | 0.000065 | 0.013 | 0.00022 | 0.0001 | | | | | |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | mg/kg | 0.0002 | 0.021 | 0.00053 | 0.0004 | 650 | 2700 | 1.3 | 1.3 | 2700 |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | mg/kg | 0.00016 | 0.012 | 0.00042 | 0.0004 | 0.29 | 1.3 | 0.000036 | 0.000036 | 1.3 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | mg/kg | 0.00014 | 0.011 | 0.00037 | 0.0003 | 8.7 | 37 | 0.03 | 0.03 | 37 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | mg/kg | 0.000078 | 0.024 | 0.00028 | 0.0002 | 5.8 | 25 | 0.0017 | 0.0017 | 25 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | mg/kg | 0.000052 | 0.015 | 0.00019 | 0.0001 | 0.036 | 0.16 | 0.0000021 | 0.0000021 | 0.16 |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | mg/kg | 0.000074 | 0.026 | 0.00027 | 0.0002 | 190 | 990 | 0.074 | 0.074 | 990 |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | mg/kg | 0.00039 | 0.047 | 0.00142 | 0.0009 | 7800 | 120000 | 0.41 | 0.41 | 120000 |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | mg/kg | 0.000074 | 0.01 | 0.00021 | 0.0002 | 47 | 210 | 0.0032 | 0.0032 | 210 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | mg/kg | 0.00014 | 0.018 | 0.00055 | 0.0005 | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | mg/kg | 0.00014 | 0.017 | 0.00038 | 0.0003 | 35 | 320 | 0.0027 | 0.0027 | 320 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | mg/kg | 0.000048 | 0.022 | 0.00021 | 0.0001 | 56 | 240 | | 56 | 240 |
| VOC | 95-47-6 | o-Xylene | T | 8260B | mg/kg | 0.000069 | 0.026 | 0.00026 | 0.0002 | 65 | 280 | 0.019 | 0.019 | 280 |
| VOC | 100-42-5 | Styrene | T | 8260B | mg/kg | 0.000065 | 0.014 | 0.00021 | 0.0001 | 600 | 3500 | 0.13 | 0.13 | 3500 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | mg/kg | 0.00012 | 0.029 | 0.00039 | 0.0003 | 8.1 | 39 | 0.0018 | 0.0018 | 39 |
| VOC | 108-88-3 | Toluene | T | 8260B | mg/kg | 0.000082 | 0.02 | 0.00032 | 0.0002 | 490 | 4700 | 0.076 | 0.076 | 4700 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | mg/kg | 0.00017 | 0.014 | 0.00044 | 0.0004 | 160 | 2300 | 0.011 | 0.011 | 2300 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | mg/kg | 0.000043 | 0.015 | 0.00018 | 0.0001 | | | | | |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | mg/kg | 0.00011 | 0.018 | 0.00033 | 0.0002 | 0.41 | 1.9 | 0.0001 | 0.0001 | 1.9 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | mg/kg | 0.00015 | 0.012 | 0.00040 | 0.0003 | 2300 | 35000 | 0.33 | 0.33 | 35000 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | mg/kg | 0.00017 | 0.016 | 0.00048 | 0.0004 | 0.059 | 1.7 | 0.0000065 | 0.0000065 | 1.7 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/Kg | 0.0330 | 0.00140 | | | 4.7 | 20 | 0.00087 | 0.00087 | 20 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/Kg | 0.0330 | 0.00144 | | | 2.3 | 35 | 0.00079 | 0.00079 | 35 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/Kg | 0.0667 | 0.0104 | | | 5.3 | 24 | 0.000094 | 0.000094 | 24 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/Kg | 0.00670 | 0.00247 | | | 310 | 4700 | 0.026 | 0.026 | 4700 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.0139 | | | 190 | 2500 | 0.018 | 0.018 | 2500 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00238 | | | 630 | 8200 | 0.4 | 0.4 | 8200 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00183 | | | 6.3 | 82 | 0.0012 | 0.0012 | 82 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/Kg | 0.00670 | 0.00257 | | | 19 | 250 | 0.0023 | 0.0023 | 250 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00207 | | | 130 | 1600 | 0.042 | 0.042 | 1600 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/Kg | 0.330 | 0.0897 | | | 13 | 160 | 0.0044 | 0.0044 | 160 |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00166 | | | 1.7 | 7.4 | 0.00032 | 0.00032 | 7.4 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00206 | | | 0.36 | 1.5 | 0.000067 | 0.000067 | 1.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00153 | | | 480 | 6000 | 0.39 | 0.39 | 6000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00155 | | | 39 | 580 | 0.0089 | 0.0089 | 580 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00160 | | | 24 | 300 | 0.019 | 0.019 | 300 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00956 | | | 320 | 4100 | 0.075 | 0.075 | 4100 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.0152 | | | 63 | 800 | 0.008 | 0.008 | 800 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/Kg | 0.0330 | 0.00191 | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/Kg | 0.0330 | 0.0311 | | | 1.2 | 5.1 | 0.00082 | 0.00082 | 5.1 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00848 | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/Kg | 0.170 | 0.0575 | | | 0.51 | 6.6 | 0.00026 | 0.00026 | 6.6 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00233 | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00157 | | | 630 | 8200 | 0.17 | 0.17 | 8200 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/Kg | 0.0330 | 0.00111 | | | 2.7 | 11 | 0.00016 | 0.00016 | 11 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00202 | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00162 | | | 25 | 110 | 0.0016 | 0.0016 | 110 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/Kg | 0.170 | 0.0234 | | | | | | | |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/Kg | 0.00670 | 0.00192 | | | 360 | 4500 | 0.55 | 0.55 | 4500 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/Kg | 0.00670 | 0.00146 | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/Kg | 0.0670 | 0.00181 | | | 780 | 12000 | 0.058 | 0.058 | 12000 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00173 | | | 1800 | 23000 | 5.8 | 5.8 | 23000 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/Kg | 0.0670 | 0.0146 | | | 2.4 | 10 | 0.0002 | 0.0002 | 10 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/Kg | 0.0670 | 0.00414 | | | 170 | 820 | 0.0041 | 0.0041 | 820 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00126 | | | 1.1 | 21 | 0.011 | 0.011 | 21 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00145 | | | 0.11 | 2.1 | 0.029 | 0.029 | 2.1 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00164 | | | 1.1 | 21 | 0.3 | 0.3 | 21 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/Kg | 0.00670 | 0.00144 | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00200 | | | 1.6 | 210 | 2.9 | 1.6 | 210 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/Kg | 0.0330 | 0.00159 | | | 19 | 250 | 0.0013 | 0.0013 | 250 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/Kg | 0.00670 | 0.00121 | | | 0.23 | 1 | 0.0000036 | 0.0000036 | 1 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/Kg | 0.330 | 0.0355 | | | 39 | 160 | 1.3 | 1.3 | 160 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0229 | | | 290 | 1200 | 0.24 | 0.24 | 1200 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/Kg | 0.170 | 0.0217 | | | 3100 | 40000 | 0.25 | 0.25 | 40000 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/Kg | 0.00670 | 0.00156 | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 110 | 2100 | 9 | 9 | 2100 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00149 | | | 0.11 | 2.1 | 0.096 | 0.096 | 2.1 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/Kg | 0.0330 | 0.00146 | | | 7.3 | 100 | 0.015 | 0.015 | 100 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0100 | | | 5100 | 66000 | 0.61 | 0.61 | 66000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.00121 | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0146 | | | 630 | 8200 | 0.23 | 0.23 | 8200 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0194 | | | 63 | 820 | 5.7 | 5.7 | 820 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00176 | | | 240 | 3000 | 8.9 | 8.9 | 3000 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 240 | 3000 | 0.54 | 0.54 | 3000 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/Kg | 0.00670 | 0.00239 | | | 0.21 | 0.96 | 0.00012 | 0.00012 | 0.96 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/Kg | 0.00670 | 0.00195 | | | 1.2 | 5.3 | 0.00027 | 0.00027 | 5.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 0.18 | 0.75 | 0.00013 | 0.00013 | 0.75 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/Kg | 0.0330 | 0.00172 | | | 1.8 | 8 | 0.0002 | 0.0002 | 8 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00135 | | | 1.1 | 21 | 0.98 | 0.98 | 21 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 570 | 2400 | 0.026 | 0.026 | 2400 |

**Table 7. Sampling Analyses and MDLs for Soil – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00130 | | | 3.8 | 17 | 0.00054 | 0.00054 | 17 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/Kg | 0.0667 | 0.0122 | | | 5.1 | 22 | 0.000092 | 0.000092 | 22 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/Kg | 0.00670 | 0.00226 | | | 0.078 | 0.33 | 0.0000081 | 0.0000081 | 0.33 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/Kg | 0.0330 | 0.0111 | | | 110 | 470 | 0.067 | 0.067 | 470 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/Kg | 0.170 | 0.0536 | | | 1 | 4 | 0.000057 | 0.000057 | 4 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/Kg | 0.00670 | 0.00179 | | | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/Kg | 0.0330 | 0.0101 | | | 1900 | 25000 | 0.33 | 0.33 | 25000 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00158 | | | 180 | 2300 | 1.3 | 1.3 | 2300 |

**Table 8. Sampling Analyses and MDLs for Soil – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997) | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil Invertebrates (Efroymson et al. 1997) | EPA Region 5 Ecological Screening Levels | Minimum ESV | Maximum ESV |
| | | | | | | | | | | Plants | Soil Invertebrates | Mammals | Birds | Mammals | Birds | Plants | Soil Invertebrates | Mammals | Birds | Plants | Soil Invertebrates | | | |
| | | | | | | | | | | A | A | A | A | B | B | C | C | C | C | D | E | F | | |
| GenChem | STL00179 | Corrosivity | T | 9045D | Ph Units | | | | | | | | | | | | | | | | | | | |
| GenChem | 16984-48-8 | Fluoride | DI | 9056A | mg/kg | 0.16 | 2.84 | 1.80465 | 1.7700 | | | 580 | 150 | 149.4 | 6.5 | | | | | | | | 6.5 | 580 |
| GenChem | 16984-48-8 | Fluoride | T | 9056A | mg/kg | 0.18 | 9.02 | 0.87076 | 0.3900 | | | 580 | 150 | 149.4 | 6.5 | | | | | | | | 6.5 | 580 |
| GenChem | STL00529 | In Place Density | T | D2937 | g/cc | | | | | | | | | | | | | | | | | | | |
| GenChem | STL00550 | Moisture Content | T | D2216-90 | Percent | | | | | | | | | | | | | | | | | | | |
| GenChem | STL00204 | pH | T | 9045D | Ph Units | | | | | | | | | | | | | | | | | | | |
| GenChem | STL00338 | Total Organic Carbon (1) | T | Lloyd Kahn | mg/kg | 69.8 | 127 | 82.70500 | 78.3000 | | | | | | | | | | | | | | | |
| Metals | 7429-90-5 | Aluminum | T | 6020A | mg/kg | 0.79 | 41.3 | 7.37911 | 7.2000 | | | | | | | | | | | 50 | | | 50 | 50 |
| Metals | 7440-36-0 | Antimony | T | 6020A | mg/kg | 0.018 | 0.91 | 0.35472 | 0.3700 | 11 | 78 | 2.4 | | 0.248 | | | 78 | 0.27 | | 5 | | 0.142 | 0.142 | 78 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | mg/kg | 0.033 | 0.99 | 0.38254 | 0.4000 | 18 | 6.8 | 15 | 18 | 0.25 | 3 | 18 | | 46 | 43 | 10 | 60 | 5.7 | 0.25 | 60 |
| Metals | 7440-39-3 | Barium | T | 6020A | mg/kg | 0.28 | 4.4 | 0.62532 | 0.6250 | 110 | 330 | 1300 | 820 | 20 | 17.2 | | 330 | 2000 | | 500 | | 1.04 | 1.04 | 2000 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | mg/kg | 0.014 | 0.28 | 0.10957 | 0.1100 | 2.5 | 40 | 18 | | 2.42 | | | 40 | 21 | | 10 | | 1.06 | 1.06 | 40 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | mg/kg | 0.0047 | 0.69 | 0.28344 | 0.3000 | 32 | 140 | 0.27 | 0.29 | 3.533 | 1.2 | 32 | 140 | 0.36 | 0.77 | 4 | 20 | 0.00222 | 0.00222 | 140 |
| Metals | 7440-70-2 | Calcium | T | 6020A | mg/kg | 26.7 | 82.1 | 36.57281 | 35.1000 | | | | | | | | | | | | | | | |
| Metals | 7440-47-3 | Chromium | T | 6020A | mg/kg | 0.077 | 1.7 | 0.67519 | 0.7000 | 0.35 | 0.34 | 45 | 28 | 12.01 | 0.83 | | | | | 1 | 0.35 | 0.4 | 0.34 | 45 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | mg/kg | 0.0022 | 1.7 | 0.66092 | 0.7000 | 13 | | 160 | 96 | | | 13 | | 230 | 120 | 20 | | 0.14 | 0.14 | 230 |
| Metals | 7440-50-8 | Copper | T | 6020A | mg/kg | 0.12 | 6.1 | 0.63044 | 0.6300 | 70 | 80 | 38 | 15 | 55.7 | 38.9 | 70 | 80 | 49 | 28 | 100 | 50 | 5.4 | 5.4 | 100 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | mg/kg | 0.4 | 0.56 | 0.43833 | 0.4200 | | | 310 | 0.1 | 236.5 | | | | | | | | 1.33 | 0.1 | 310 |
| Metals | 57-12-5 | Cyanide, Total | T | 9012B | mg/kg | 0.014 | 0.8 | 0.02866 | 0.0180 | | | 310 | 0.1 | 236.5 | | | | | | | | 1.33 | 0.1 | 310 |
| Metals | 7439-89-6 | Iron | T | 6020A | mg/kg | 4.1 | 57.2 | 22.54263 | 23.4000 | | | | | | | | | | | | | | | |
| Metals | 7439-92-1 | Lead | T | 6010C | mg/kg | 0.11 | 0.97 | 0.70432 | 0.8200 | 120 | 1700 | 72 | 14 | 29.3 | 0.94 | 120 | 1700 | 56 | 11 | 50 | 500 | 0.0537 | 0.0537 | 1700 |
| Metals | 7439-92-1 | Lead | T | 6020A | mg/kg | 0.058 | 0.49 | 0.19771 | 0.2000 | 120 | 1700 | 72 | 14 | 29.3 | 0.94 | 120 | 1700 | 56 | 11 | 50 | 500 | 0.0537 | 0.0537 | 1700 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | mg/kg | 5.1 | 79.3 | 31.79018 | 33.0000 | | | | | | | | | | | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | mg/kg | 0.15 | 3.5 | 1.37800 | 1.4000 | 220 | 450 | 1400 | 1400 | 322 | 825 | 220 | 450 | 4000 | 4300 | 500 | | | 220 | 4300 |
| Metals | 7439-97-6 | Mercury | T | 7471B | mg/kg | 0.01 | 0.039 | 0.01337 | 0.0130 | 34 | 0.05 | 1.7 | 0.013 | 0.079 | 0.005 | | | | | 0.3 | 0.1 | 0.1 | 0.005 | 34 |
| Metals | 7440-02-0 | Nickel | T | 6020A | mg/kg | 0.05 | 2.7 | 0.68064 | 0.7100 | 38 | 280 | 9.7 | 21 | 146.52 | 64.08 | 38 | 280 | 130 | 210 | 30 | 200 | 13.6 | 9.7 | 280 |
| Metals | 7440-09-7 | Potassium | T | 6020A | mg/kg | 6.3 | 75.1 | 30.44175 | 31.5000 | | | | | | | | | | | | | | | |
| Metals | 7782-49-2 | Selenium | T | 6020A | mg/kg | 0.051 | 0.85 | 0.33574 | 0.3500 | 0.52 | 4.1 | 0.66 | 0.75 | 0.733 | 0.331 | 0.52 | 4.1 | 0.63 | 1.2 | 1 | 70 | 0.0276 | 0.0276 | 70 |
| Metals | 7440-22-4 | Silver | T | 6020A | mg/kg | 0.0018 | 1.7 | 0.65238 | 0.6900 | 560 | | 14 | 2.6 | | | 560 | | 14 | 4.2 | 2 | | 4.04 | 2 | 560 |
| Metals | 7440-23-5 | Sodium | T | 6020A | mg/kg | 11.1 | 84.8 | 36.41298 | 37.4000 | | | | | | | | | | | | | | | |
| Metals | 7440-28-0 | Thallium | T | 6020A | mg/kg | 0.024 | 0.34 | 0.13683 | 0.1400 | 0.05 | | 0.22 | 6.3 | 0.027 | | | | | | 1 | | 0.0569 | 0.027 | 6.3 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | mg/kg | 0.047 | 1.7 | 0.71559 | 0.7500 | 60 | | 140 | 6.7 | 0.714 | 9.439 | | | 280 | 7.8 | 2 | | 1.59 | 0.714 | 280 |
| Metals | 7440-66-6 | Zinc | T | 6020A | mg/kg | 0.64 | 6 | 2.37818 | 2.4000 | 160 | 120 | 98 | 48 | 586.1 | 12 | 160 | 120 | 79 | 46 | 50 | 200 | 6.62 | 6.62 | 586.1 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | mg/kg | 0.00085 | 0.0023 | 0.00106 | 0.0010 | | | 4.1 | 0.0063 | | | | | 0.021 | 0.093 | | | 0.00488 | 0.00488 | 4.1 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | mg/kg | 0.00093 | 0.0025 | 0.00117 | 0.0011 | | | 3.7 | 0.11 | | | | | 0.021 | 0.093 | | | 0.596 | 0.021 | 3.7 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | mg/kg | 0.00066 | 0.0018 | 0.00083 | 0.0008 | 4.1 | | 0.044 | 0.36 | | | | | 0.021 | 0.093 | | | 0.0035 | 0.0035 | 4.1 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | mg/kg | 0.00078 | 0.0021 | 0.00098 | 0.0009 | | | 0.037 | | 0.733 | | | | | | | | 0.00332 | 0.00332 | 0.733 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | mg/kg | 0.00059 | 0.0016 | 0.00074 | 0.0007 | | | 58 | | 0.1 | 0.46 | | | | | | | 0.0994 | 0.0994 | 58 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | mg/kg | 0.001 | 0.0028 | 0.00132 | 0.0012 | 2.2 | | 0.27 | 0.28 | | | | | | | | | | 0.27 | 2.2 |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | mg/kg | 0.00063 | 0.0017 | 0.00078 | 0.0007 | | | 0.27 | 14 | 1.47 | 0.46 | | | | | | | 0.00398 | 0.00398 | 14 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | mg/kg | 0.0007 | 0.0019 | 0.00088 | 0.0008 | | | | | 0.1 | 0.46 | | | | | | | 9.94 | 0.1 | 9.94 |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | mg/kg | 0.00084 | 0.0022 | 0.00105 | 0.0010 | 10 | | 0.0045 | 0.012 | 0.073 | 0.064 | | | 0.0049 | 0.022 | | | 0.00238 | 0.00238 | 10 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | mg/kg | 0.00089 | 0.0024 | 0.00112 | 0.0011 | | | 0.64 | 15 | | | | | | | | | 0.119 | 0.119 | 15 |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | mg/kg | 0.001 | 0.0027 | 0.00127 | 0.0012 | | | 0.64 | 15 | | | | | | | | | 0.119 | 0.119 | 15 |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | mg/kg | 0.00075 | 0.002 | 0.00094 | 0.0009 | | | 0.64 | 15 | | | | | | | | | 0.0358 | 0.0358 | 15 |
| Pesticides | 72-20-8 | Endrin | T | 8081B | mg/kg | 0.00082 | 0.0022 | 0.00102 | 0.0010 | 0.0034 | | 0.023 | 0.0014 | 0.182 | 0.008 | | | | | | | 0.0101 | 0.0014 | 0.182 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | mg/kg | 0.0008 | 0.0021 | 0.00100 | 0.0009 | | | | | | | | | | | | | 0.0105 | 0.0105 | 0.0105 |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | mg/kg | 0.00089 | 0.0024 | 0.00112 | 0.0011 | | | | | | | | | | | | | | | |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | mg/kg | 0.00058 | 0.0015 | 0.00072 | 0.0007 | 0.1 | | 0.0094 | 0.21 | 29.3 | 1.66 | | | | | | | 0.005 | 0.005 | 29.3 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | mg/kg | 0.0014 | 0.0037 | 0.00175 | 0.0016 | 2.2 | | 2.2 | 2.3 | | | | | | | | | | 2.2 | 2.3 |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | mg/kg | 0.00083 | 0.0022 | 0.00104 | 0.0010 | 0.4 | | 0.059 | 0.3 | 0.476 | | | | | | | | 0.152 | 0.059 | 0.476 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | mg/kg | 0.0013 | 0.0034 | 0.00158 | 0.0015 | | | | | | | | | | | | | 0.152 | 0.152 | 0.152 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | mg/kg | 0.0014 | 0.0036 | 0.00171 | 0.0016 | | | 5 | 18 | 14.7 | | | | | | | | | 5 | 18 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | mg/kg | 0.019 | 0.05 | 0.02354 | 0.0220 | | | 5.9 | 4.1 | 29.3 | | | | | | | | 0.119 | 0.119 | 29.3 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | | | 1 | | 6.52 | | | | | | | | | 1 | 6.52 |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | | | | | | | | | | | | | | | |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | | | | | | | | | | | | | | | |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | | | 0.38 | 0.041 | 0.329 | 0.339 | | | | | | | | 0.041 | 0.38 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | mg/kg | 0.000089 | 0.023 | 0.01008 | 0.0097 | | | 0.0072 | 0.041 | 0.071 | | | | | | | | | 0.0072 | 0.071 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | 160 | | 0.44 | 0.041 | 0.111 | 0.149 | | | | | | | | 0.041 | 160 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | 10 | 0.88 | | | | | | | | | | 0.88 | 10 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | | | | | | | | | | | | | |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | | | | | | | | | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | mg/kg | 0.000092 | 0.024 | 0.01039 | 0.0100 | | | | | | | | | | | 40 | | | 40 | 40 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/kg | 0.027 | 10 | 0.11333 | 0.0310 | | | | | | | | | | | 60 | | | 60 | 60 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/kg | 0.023 | 9 | 0.09969 | 0.0270 | | | | | | | | | | | | | 2.02 | 2.02 | 2.02 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/kg | 0.084 | 32 | 0.35688 | 0.0980 | | | | | 1.83 | | | | | | | | 2.05 | 1.83 | 2.05 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/kg | 0.013 | 5 | 0.05505 | 0.0150 | | | | | | | | | | | | | 19.9 | 19.9 | 19.9 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/kg | 0.03 | 11 | 0.12497 | 0.0350 | | | | | | | | | | | | | | | |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/kg | 0.031 | 12 | 0.13297 | 0.0370 | | | | | | | | | | | 4 | 9 | 14.1 | 4 | 14.1 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/kg | 0.0089 | 3.4 | 0.03791 | 0.0100 | | | | | | | | | | | | 10 | 9.94 | 9.94 | 10 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/kg | 0.0074 | 2.9 | 0.03160 | 0.0087 | | | | | | | | | | | | | 87.5 | 87.5 | 87.5 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/kg | 0.069 | 27 | 0.29610 | 0.0810 | | | | | | | | | | | | | 0.01 | 0.01 | 0.01 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/kg | 0.24 | 91 | 1.01021 | 0.2800 | | | | | | | | | | | 20 | | 0.0609 | 0.0609 | 20 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/kg | 0.012 | 4.8 | 0.05291 | 0.0150 | 6 | 18 | 13 | | | | | | | | | | 1.28 | 1.28 | 18 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/kg | 0.017 | 6.4 | 0.07117 | 0.0200 | | 30 | 4.1 | 52 | | | | | | | | | 0.0328 | 0.0328 | 52 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/kg | 0.0071 | 2.7 | 0.03019 | 0.0083 | | | | | | | | | | | | | 0.0122 | 0.0122 | 0.0122 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/kg | 0.008 | 3.1 | 0.03395 | 0.0093 | | | 0.54 | 0.39 | | | | | | | | | 0.243 | 0.243 | 0.54 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/kg | 0.0069 | 2.7 | 0.02969 | 0.0081 | | | 16 | | | | | | | | | | 3.24 | 3.24 | 16 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/kg | 0.014 | 5.3 | 0.05829 | 0.0160 | 0.67 | | 590 | | | | | | | | | | | 0.67 | 590 |

**Table 8. Sampling Analyses and MDLs for Soil – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997) | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil Invertebrates (Efroymson et al. 1997) | EPA Region 5 Ecological Screening Levels | Minimum ESV | Maximum ESV |
| | | | | | | | | | | Plants | Soil Invertebrates | Mammals | Birds | Mammals | Birds | Plants | Soil Invertebrates | Mammals | Birds | Plants | Soil Invertebrates | | | |
| | | | | | | | | | | A | A | A | A | B | B | C | C | C | C | D | E | F | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/kg | 0.01 | 4 | 0.04401 | 0.0120 | | | 5.4 | | | | | | | | | | | 5.4 | 5.4 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/kg | 0.011 | 4.1 | 0.04492 | 0.0120 | | | | | | | | | | | | | 1.6 | 1.6 | 1.6 |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | mg/kg | 0.0084 | 3.2 | 0.03560 | 0.0098 | | | | | | | | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/kg | 0.035 | 13 | 0.14845 | 0.0410 | | | | | | | | | | | | | 0.646 | 0.646 | 0.646 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/kg | 0.0093 | 3.6 | 0.03955 | 0.0110 | | | | | | | | | | | | | 3.16 | 3.16 | 3.16 |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/kg | 0.084 | 32 | 0.35646 | 0.0980 | | | | | | | | | | | | | 0.144 | 0.144 | 0.144 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/kg | 0.0099 | 3.8 | 0.04190 | 0.0120 | | | | | | | | | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/kg | 0.014 | 5.2 | 0.05726 | 0.0160 | | | | | | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/kg | 0.0081 | 3.1 | 0.03423 | 0.0095 | 1 | 1.8 | | | | | | | | | | | | 1 | 1.8 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/kg | 0.0094 | 3.6 | 0.03982 | 0.0110 | | | | | | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/kg | 0.012 | 4.6 | 0.05055 | 0.0140 | | | | | | | | | | | | | 21.9 | 21.9 | 21.9 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/kg | 0.15 | 58 | 0.64272 | 0.1800 | | | | | | | | | | | | 7 | | 7 | 7 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/kg | 0.0076 | 2.9 | 0.03228 | 0.0089 | 0.25 | | 120 | | | | | | | | 20 | | 682 | 0.25 | 682 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/kg | 0.0081 | 3.1 | 0.03423 | 0.0095 | | | 120 | | | | | | | | | | 682 | 120 | 682 |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/kg | 0.0069 | 2.6 | 0.02910 | 0.0080 | | | | | | | | | | | | | 300 | 300 | 300 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/kg | 0.03 | 11 | 0.12608 | 0.0350 | 6.8 | | 210 | | | | | | | | | | 1480 | 6.8 | 1480 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/kg | 0.014 | 5.4 | 0.05975 | 0.0160 | | | | | | | | | | | | | | | |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/kg | 0.024 | 9.2 | 0.10208 | 0.0280 | | | | | | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/kg | 0.026 | 10 | 0.11213 | 0.0310 | 18 | | 3 | 0.8 | | | | | | | | | 5.21 | 0.8 | 18 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/kg | 0.0095 | 3.7 | 0.04084 | 0.0110 | | | 53 | | 1.98 | | | | | | | | 1.52 | 1.52 | 53 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/kg | 0.012 | 4.7 | 0.05262 | 0.0140 | 18 | | 38 | | | | | | | | | | 59.8 | 18 | 59.8 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/kg | 0.018 | 7 | 0.07755 | 0.0210 | | | 24 | | | | | | | | | | 119 | 24 | 119 |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/kg | 0.014 | 5.3 | 0.05875 | 0.0160 | | | 62 | | | | | | | | | | 148 | 62 | 148 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/kg | 0.0098 | 3.8 | 0.04169 | 0.0110 | | | | | | | | | | | | | 0.302 | 0.302 | 0.302 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/kg | 0.0074 | 2.9 | 0.03160 | 0.0087 | | | | | | | | | | | | | 23.7 | 23.7 | 23.7 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/kg | 0.012 | 4.7 | 0.05220 | 0.0140 | | | 0.59 | 0.02 | 36 | 0.91 | | | | | | | 0.925 | 0.02 | 36 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/kg | 0.0097 | 3.7 | 0.04124 | 0.0110 | | | 90 | | | | | | | | | | 0.239 | 0.239 | 90 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/kg | 0.023 | 8.7 | 0.09613 | 0.0260 | | | | | | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/kg | 0.0078 | 3 | 0.03321 | 0.0091 | | | 80 | | | | | | | | | | | 80 | 80 |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/kg | 0.0086 | 3.3 | 0.03652 | 0.0100 | | | 2.4 | | | | | | | | | | 4.73 | 2.4 | 4.73 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/kg | 0.016 | 6.3 | 0.06997 | 0.0190 | | | 12 | | | | | | | | | | | 12 | 12 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/kg | 0.0095 | 3.7 | 0.04052 | 0.0110 | 6.1 | | | | | | | | | | | | | 6.1 | 6.1 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/kg | 0.0089 | 3.4 | 0.03791 | 0.0100 | 100 | | 3600 | | 9084 | | | | | | 100 | | | 100 | 9084 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/kg | 0.0091 | 3.5 | 0.03886 | 0.0110 | | 10 | 38 | | | | | | | | | 200 | 734 | 10 | 734 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/kg | 0.0094 | 3.6 | 0.03982 | 0.0110 | 160 | | 180 | 0.011 | 1090 | 0.09 | | | | | 200 | | | 0.011 | 1090 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/kg | 0.016 | 6.1 | 0.06792 | 0.0190 | | | 0.91 | | | | | | | | | | | 0.91 | 0.91 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/kg | 0.0093 | 3.6 | 0.03987 | 0.0110 | | 10 | 22 | | | | | | | | | | 122 | 10 | 122 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/kg | 0.0069 | 2.6 | 0.02910 | 0.0080 | | 3.7 | 250 | | | | | | | | | 30 | 122 | 3.7 | 250 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/kg | 0.013 | 4.9 | 0.05429 | 0.0150 | 10 | 10 | 0.2 | 0.079 | | | | | | | | | 0.199 | 0.079 | 10 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/kg | 0.0088 | 3.4 | 0.03765 | 0.0100 | | | | | | | | | | | | | 0.0398 | 0.0398 | 0.0398 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/kg | 0.02 | 7.5 | 0.08321 | 0.0230 | | | | | | | | | | | 10 | | 0.755 | 0.755 | 10 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/kg | 0.012 | 4.4 | 0.04892 | 0.0130 | | | | | | | | | | | | | 0.596 | 0.596 | 0.596 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/kg | 0.021 | 8 | 0.08958 | 0.0240 | | | 62 | | | | | | | | | | 109 | 62 | 109 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/kg | 0.0068 | 2.6 | 0.02861 | 0.0079 | | | | | | | | | | | | | 139 | 139 | 139 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/kg | 0.008 | 3.1 | 0.03395 | 0.0093 | 1 | | 9.7 | 3.4 | | | | | | | | | 0.0994 | 0.0994 | 9.7 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/kg | 0.0099 | 3.8 | 0.04190 | 0.0120 | | 2.2 | 4.9 | | | | | | | | | 40 | 1.31 | 1.31 | 40 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/kg | 0.011 | 4.1 | 0.04492 | 0.0120 | | | | | | | | | | | | | 0.544 | 0.544 | 0.544 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/kg | 0.029 | 11 | 0.12130 | 0.0330 | | | | | | | | | | | | 20 | 0.545 | 0.545 | 20 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/kg | 0.038 | 15 | 0.16259 | 0.0450 | 5 | 31 | 0.81 | 0.36 | 0.879 | | 5 | 31 | 2.8 | 2.1 | 3 | 6 | 0.119 | 0.119 | 31 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/kg | 0.0084 | 3.2 | 0.03589 | 0.0098 | | 5.5 | 10 | | | | | | | | | | 45.7 | 5.5 | 45.7 |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/kg | 0.01 | 4 | 0.04369 | 0.0120 | 0.79 | 1.8 | 38 | | | | | | | | 70 | 30 | 120 | 0.79 | 120 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/kg | 0.014 | 5.5 | 0.06116 | 0.0170 | | 10 | 22 | 34 | | | | | | | | | 78.5 | 10 | 78.5 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | mg/kg | 0.00016 | 0.022 | 0.00046 | 0.0004 | | | 260 | | 2060 | | | | | | | | 29.8 | 29.8 | 2060 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | mg/kg | 0.000074 | 0.015 | 0.00024 | 0.0002 | | | | | | | | | | | | | 225 | 225 | 225 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | mg/kg | 0.00019 | 0.027 | 0.00054 | 0.0004 | | | | | | | | | | | | | | | |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | mg/kg | 0.00012 | 0.0064 | 0.00030 | 0.0003 | | | | | | | | | | | | | 28.6 | 28.6 | 28.6 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | mg/kg | 0.00015 | 0.019 | 0.00041 | 0.0003 | | | 210 | | | | | | | | | | 20.1 | 20.1 | 210 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | mg/kg | 0.00018 | 0.027 | 0.00051 | 0.0004 | | | 11 | | | | | | | | | | 8.28 | 8.28 | 11 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | mg/kg | 0.000048 | 0.028 | 0.00023 | 0.0001 | | | | | | | | | | | | 20 | 11.1 | 11.1 | 20 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | mg/kg | 0.000082 | 0.022 | 0.00039 | 0.0003 | | 1.2 | 0.27 | | | | | | | | | 20 | 11.1 | 0.27 | 20 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | mg/kg | 0.0002 | 0.018 | 0.00055 | 0.0004 | | | | | | | | | | | | | 0.0352 | 0.0352 | 0.0352 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | mg/kg | 0.000061 | 0.018 | 0.00022 | 0.0001 | | | 0.92 | | | | | | | | | | | 0.92 | 0.92 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | mg/kg | 0.000048 | 0.02 | 0.00021 | 0.0001 | | | 27 | 0.85 | 14.2 | 14.2 | | | | | | | 21.2 | 0.85 | 27 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | mg/kg | 0.000074 | 0.014 | 0.00025 | 0.0002 | | | | | | | | | | | | 700 | 32.7 | 32.7 | 700 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | mg/kg | 0.000052 | 0.027 | 0.00024 | 0.0001 | | | 0.73 | | | | | | | | | | | 0.73 | 0.73 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | mg/kg | 0.000056 | 0.027 | 0.00024 | 0.0001 | | 1.2 | 0.88 | | | | | | | | | 20 | | 0.88 | 20 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | mg/kg | 0.00033 | 0.18 | 0.00155 | 0.0007 | | | 360 | | | | | | | | | | | 360 | 360 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | mg/kg | 0.00041 | 0.058 | 0.00117 | 0.0009 | | | 5.4 | 0.36 | | | | | | | | | 12.6 | 0.36 | 12.6 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | mg/kg | 0.00059 | 0.051 | 0.00231 | 0.0021 | | | 9.8 | | 91.6 | | | | | | | | 443 | 9.8 | 443 |
| VOC | 67-64-1 | Acetone | T | 8260B | mg/kg | 0.00046 | 0.086 | 0.00169 | 0.0010 | | | 1.2 | 7.5 | 36.6 | | | | | | | | 2.5 | 1.2 | 36.6 |
| VOC | 71-43-2 | Benzene | T | 8260B | mg/kg | 0.000087 | 0.015 | 0.00027 | 0.0002 | | | 24 | | 52 | | | | | | | | 0.255 | 0.255 | 52 |
| VOC | 75-25-2 | Bromoform | T | 8260B | mg/kg | 0.000056 | 0.014 | 0.00022 | 0.0001 | | | | | | | | | | | | | 15.9 | 15.9 | 15.9 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | mg/kg | 0.00014 | 0.014 | 0.00040 | 0.0003 | | | | | | | | | | | | | | | |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | mg/kg | 0.00019 | 0.018 | 0.00049 | 0.0004 | | | 0.82 | | | | | | | | | | 0.0941 | 0.0941 | 0.82 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | mg/kg | 0.00016 | 0.027 | 0.00052 | 0.0004 | | | | | 58.6 | | | | | | | | 2.98 | 2.98 | 58.6 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | mg/kg | 0.000061 | 0.019 | 0.00022 | 0.0001 | | 2.4 | 43 | | | | | | | | | 40 | 13.1 | 2.4 | 43 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | mg/kg | 0.000074 | 0.024 | 0.00028 | 0.0002 | | | | | | | | | | | | | | | |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | mg/kg | 0.000065 | 0.018 | 0.00023 | 0.0001 | | | | | | | | | | | | | 2.05 | 2.05 | 2.05 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | mg/kg | 0.00015 | 0.03 | 0.00049 | 0.0003 | | | | | | | | | | | | | | | |
| VOC | 67-66-3 | Chloroform | T | 8260B | mg/kg | 0.000091 | 0.018 | 0.00030 | 0.0002 | | | 8 | | 55 | | | | | | | | 1.19 | 1.19 | 55 |

**Table 8. Sampling Analyses and MDLs for Soil – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997) | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil Invertebrates (Efroymson et al. 1997) | EPA Region 5 Ecological Screening Levels | Minimum ESV | Maximum ESV |
| | | | | | | | | | | Plants | Soil Invertebrates | Mammals | Birds | Mammals | Birds | Plants | Soil Invertebrates | Mammals | Birds | Plants | Soil Invertebrates | | | |
| | | | | | | | | | | A | A | A | A | B | B | C | C | C | C | D | E | F | | |
| VOC | 74-87-3 | Chloromethane | T | 8260B | mg/kg | 0.00016 | 0.018 | 0.00046 | 0.0004 | | | | | | | | | | | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | mg/kg | 0.000095 | 0.021 | 0.00030 | 0.0002 | | | 23 | | 89.6 | | | | | | | | | 23 | 89.6 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | mg/kg | 0.000065 | 0.013 | 0.00022 | 0.0001 | | | | | | | | | | | | | 0.398 | 0.398 | 0.398 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | mg/kg | 0.0002 | 0.021 | 0.00053 | 0.0004 | | | | | | | | | | | | | | | |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | mg/kg | 0.00016 | 0.012 | 0.00042 | 0.0004 | | | | | | | | | | | | | 0.54 | 0.54 | 0.54 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | mg/kg | 0.00014 | 0.011 | 0.00037 | 0.0003 | | | | | | | | | | | | | 39.5 | 39.5 | 39.5 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | mg/kg | 0.000078 | 0.024 | 0.00028 | 0.0002 | | | | | | | | | | | | | 5.16 | 5.16 | 5.16 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | mg/kg | 0.000052 | 0.015 | 0.00019 | 0.0001 | | | | | | | | | | | | | 1.23 | 1.23 | 1.23 |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | mg/kg | 0.000074 | 0.026 | 0.00027 | 0.0002 | | | | | | | | | | | | | | | |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | mg/kg | 0.00039 | 0.047 | 0.00142 | 0.0009 | | | | | | | | | | | | | | | |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | mg/kg | 0.000074 | 0.01 | 0.00021 | 0.0002 | | | | | | | | | | | | | | | |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | mg/kg | 0.00014 | 0.018 | 0.00055 | 0.0005 | | | | | | | | | | | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | mg/kg | 0.00014 | 0.017 | 0.00038 | 0.0003 | 1600 | | 2.6 | | 21.4 | | | | | | | | 4.05 | 2.6 | 1600 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | mg/kg | 0.000048 | 0.022 | 0.00021 | 0.0001 | | | | | | | | | | | | | | | |
| VOC | 95-47-6 | o-Xylene | T | 8260B | mg/kg | 0.000069 | 0.026 | 0.00026 | 0.0002 | | | | | | | | | | | | | | | |
| VOC | 100-42-5 | Styrene | T | 8260B | mg/kg | 0.000065 | 0.014 | 0.00021 | 0.0001 | 3.2 | 1.2 | | | | | | | | | 300 | | 4.69 | 1.2 | 300 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | mg/kg | 0.00012 | 0.029 | 0.00039 | 0.0003 | 10 | | 0.18 | | | | | | | | | | 9.92 | 0.18 | 10 |
| VOC | 108-88-3 | Toluene | T | 8260B | mg/kg | 0.000082 | 0.02 | 0.00032 | 0.0002 | 200 | | 23 | | 51.5 | | | | | | 200 | | 5.45 | 5.45 | 200 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | mg/kg | 0.00017 | 0.014 | 0.00044 | 0.0004 | | | 23 | | 89.6 | | | | | | | | | 23 | 89.6 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | mg/kg | 0.000043 | 0.015 | 0.00018 | 0.0001 | | | | | | | | | | | | | 0.398 | 0.398 | 0.398 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | mg/kg | 0.00011 | 0.018 | 0.00033 | 0.0002 | | | 42 | | 1.387 | | | | | | | | | 1.387 | 42 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | mg/kg | 0.00015 | 0.012 | 0.00040 | 0.0003 | | | 52 | | | | | | | | | | 16.4 | 16.4 | 52 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | mg/kg | 0.00017 | 0.016 | 0.00048 | 0.0004 | | | 0.12 | | 0.623 | | | | | | | | 0.646 | 0.12 | 0.646 |
| | | *New Phase II Analyses* | | | | RL | MDL | LOD | | | | | | | | | | | | | | | | |
| = | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/kg | 0.0330 | 0.00140 | | | | | | | | | | | | | 60 | | | 60 | 60 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/Kg | 0.0330 | 0.00144 | | | | | | | | | | | | | | | 2.02 | 2.02 | 2.02 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/Kg | 0.0667 | 0.0104 | | | | | | | 1.83 | | | | | | | | 2.05 | 1.83 | 2.05 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/Kg | 0.00670 | 0.00247 | | | | | | | | | | | | | | | 19.9 | 19.9 | 19.9 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.0139 | | | | | | | | | | | | | | | | | |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00238 | | | | | | | | | | | | | 4 | 9 | 14.1 | 4 | 14.1 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00183 | | | | | | | | | | | | | | 10 | 9.94 | 9.94 | 10 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/Kg | 0.00670 | 0.00257 | | | | | | | | | | | | | | | 87.5 | 87.5 | 87.5 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00207 | | | | | | | | | | | | | | | 0.01 | 0.01 | 0.01 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/Kg | 0.330 | 0.0897 | | | | | | | | | | | | | 20 | | 0.0609 | 0.0609 | 20 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00166 | | | 6 | 18 | 13 | | | | | | | | | | 1.28 | 1.28 | 18 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00206 | | | | 30 | 4.1 | 52 | | | | | | | | | 0.0328 | 0.0328 | 52 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00153 | | | | | | | | | | | | | | | 0.0122 | 0.0122 | 0.0122 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00155 | | | | | 0.54 | 0.39 | | | | | | | | | 0.243 | 0.243 | 0.54 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00160 | | | | | 16 | | | | | | | | | | 3.24 | 3.24 | 16 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00956 | | | 0.67 | | 590 | | | | | | | | | | | 0.67 | 590 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.0152 | | | | | 5.4 | | | | | | | | | | | 5.4 | 5.4 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/Kg | 0.0330 | 0.00191 | | | | | | | | | | | | | | | 1.6 | 1.6 | 1.6 |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/Kg | 0.0330 | 0.0311 | | | | | | | | | | | | | | | 0.646 | 0.646 | 0.646 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00848 | | | | | | | | | | | | | | | 3.16 | 3.16 | 3.16 |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/Kg | 0.170 | 0.0575 | | | | | | | | | | | | | | | 0.144 | 0.144 | 0.144 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00233 | | | | | | | | | | | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00157 | | | | | | | | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/Kg | 0.0330 | 0.00111 | | | 1 | 1.8 | | | | | | | | | | | | 1 | 1.8 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00202 | | | | | | | | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00162 | | | | | | | | | | | | | | | 21.9 | 21.9 | 21.9 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/Kg | 0.170 | 0.0234 | | | | | | | | | | | | | | 7 | | 7 | 7 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/Kg | 0.00670 | 0.00192 | | | 0.25 | | 120 | | | | | | | | 20 | | 682 | 0.25 | 682 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/Kg | 0.00670 | 0.00146 | | | | | 120 | | | | | | | | | | 682 | 120 | 682 |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/Kg | 0.0670 | 0.00181 | | | | | | | | | | | | | | | 300 | 300 | 300 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00173 | | | 6.8 | | 210 | | | | | | | | | | 1480 | 6.8 | 1480 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/Kg | 0.0670 | 0.0146 | | | | | | | | | | | | | | | | | |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/Kg | 0.0670 | 0.00414 | | | | | | | | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00126 | | | 18 | | 3 | 0.8 | | | | | | | | | 5.21 | 0.8 | 18 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00145 | | | | | 53 | | 1.98 | | | | | | | | 1.52 | 1.52 | 53 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00164 | | | 18 | | 38 | | | | | | | | | | 59.8 | 18 | 59.8 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/Kg | 0.00670 | 0.00144 | | | | | 24 | | | | | | | | | | 119 | 24 | 119 |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00200 | | | | | 62 | | | | | | | | | | 148 | 62 | 148 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/Kg | 0.0330 | 0.00159 | | | | | | | | | | | | | | | 0.302 | 0.302 | 0.302 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/Kg | 0.00670 | 0.00121 | | | | | | | | | | | | | | | 23.7 | 23.7 | 23.7 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/Kg | 0.330 | 0.0355 | | | | | 0.59 | 0.02 | 36 | 0.91 | | | | | | | 0.925 | 0.02 | 36 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0229 | | | | | 90 | | | | | | | | | | 0.239 | 0.239 | 90 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/Kg | 0.170 | 0.0217 | | | | | | | | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/Kg | 0.00670 | 0.00156 | | | | | 80 | | | | | | | | | | | 80 | 80 |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | | | 2.4 | | | | | | | | | | 4.73 | 2.4 | 4.73 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00149 | | | | | 12 | | | | | | | | | | | 12 | 12 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/Kg | 0.0330 | 0.00146 | | | 6.1 | | | | | | | | | | | | | 6.1 | 6.1 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0100 | | | 100 | | 3600 | | 9084 | | | | | | 100 | | | 100 | 9084 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.00121 | | | | 10 | 38 | | | | | | | | | 200 | 734 | 10 | 734 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0146 | | | 160 | | 180 | 0.011 | 1090 | 0.09 | | | | | 200 | | | 0.011 | 1090 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0194 | | | | | 0.91 | | | | | | | | | | | 0.91 | 0.91 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00176 | | | | 10 | 22 | | | | | | | | | | 122 | 10 | 122 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | | 3.7 | 250 | | | | | | | | | 30 | 122 | 3.7 | 250 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/Kg | 0.00670 | 0.00239 | | | 10 | 10 | 0.2 | 0.079 | | | | | | | | | 0.199 | 0.079 | 10 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/Kg | 0.00670 | 0.00195 | | | | | | | | | | | | | | | 0.0398 | 0.0398 | 0.0398 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | | | | | | | | | | | 10 | | 0.755 | 0.755 | 10 |

**Table 8. Sampling Analyses and MDLs for Soil – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Los Alamos National Laboratory (LANL) (2012) Minimum across evaluated species in source. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Minimum across species of birds and mammals presented in Sample et al. (1996), Appendix D. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/) Minimum across species evaluated in source. | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997) | Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil Invertebrates (Efroymson et al. 1997) | EPA Region 5 Ecological Screening Levels | Minimum ESV | Maximum ESV |
| | | | | | | | | | | Plants | Soil Invertebrates | Mammals | Birds | Mammals | Birds | Plants | Soil Invertebrates | Mammals | Birds | Plants | Soil Invertebrates | | | |
| | | | | | | | | | | A | A | A | A | B | B | C | C | C | C | D | E | F | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/Kg | 0.0330 | 0.00172 | | | | | | | | | | | | | | | 0.596 | 0.596 | 0.596 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00135 | | | | | 62 | | | | | | | | | | 109 | 62 | 109 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | | | | | | | | | | | | | 139 | 139 | 139 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00130 | | | 1 | | 9.7 | 3.4 | | | | | | | | | 0.0994 | 0.0994 | 9.7 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/Kg | 0.0667 | 0.0122 | | | | 2.2 | 4.9 | | | | | | | | | 40 | 1.31 | 1.31 | 40 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/Kg | 0.00670 | 0.00226 | | | | | | | | | | | | | | | 0.544 | 0.544 | 0.544 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/Kg | 0.0330 | 0.0111 | | | | | | | | | | | | | | 20 | 0.545 | 0.545 | 20 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/Kg | 0.170 | 0.0536 | | | 5 | 31 | 0.81 | 0.36 | 0.879 | | 5 | 31 | 2.8 | 2.1 | 3 | 6 | 0.119 | 0.119 | 31 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/Kg | 0.00670 | 0.00179 | | | | 5.5 | 10 | | | | | | | | | | 45.7 | 5.5 | 45.7 |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/Kg | 0.0330 | 0.0101 | | | 0.79 | 1.8 | 38 | | | | | | | | 70 | 30 | 120 | 0.79 | 120 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00158 | | | | 10 | 22 | 34 | | | | | | | | | 78.5 | 10 | 78.5 |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00000 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 1440 | 93.80913 | 72.00 | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 1550 | 87.02893 | 31.00 | | | | | |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 1200 | 95.23810 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 15 | 1200 | 82.12810 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 250000 | 10413.2231 | 5000.00 | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 5000 | 366.80498 | 100.00 | 10000 | 10000 | | 10000 | 10000 |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 84 | 46.57399 | 48.00 | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 12700 | 363.04959 | 127.00 | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 500 | 24.95868 | 10.00 | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 0.82 | 20 | 1.95380 | 1.00 | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 9.1 | 18.2 | 18.12479 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20000 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.31 | 0.62 | 0.61744 | 0.62 | 6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62000 | 0.62 | 6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.32 | 0.64 | 0.63736 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64000 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 0.61 | 12.2 | 1.36744 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20000 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.12 | 0.24 | 0.23901 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.36 | 0.71 | 0.70711 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71000 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 30.3 | 605 | 62.50041 | 60.50 | | | | | |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50000 | 60.50 | | | | | |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 0.66 | 1.3 | 1.29471 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 0.65 | 1.3 | 1.29463 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 0.68 | 1.4 | 1.39405 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40000 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 7.7 | 1.62157 | 1.50 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 77 | 3.23789 | 1.50 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 40 | 5.04762 | 2.00 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 80 | 5.38843 | 2.00 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 21.2 | 42.4 | 42.22479 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40000 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.19 | 0.38 | 0.37843 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38000 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 31.8 | 63.6 | 63.33719 | 63.60 | | | | | |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60000 | 63.60 | | | | | |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 1.2 | 2.5 | 2.48926 | 2.50 | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50000 | 2.50 | | | | | |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | 2 | 2 | 0.063 | 0.063 | 2 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | 2 | 2 | 0.063 | 0.063 | 2 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 0.68 | 1.4 | 1.39405 | 1.40 | 100 | | | 100 | 100 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40000 | 1.40 | 100 | | | 100 | 100 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 45.7 | 91.4 | 91.02231 | 91.40 | | | | | |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40000 | 91.40 | | | | | |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.37 | 0.73 | 0.72702 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73000 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 0.64 | 1.3 | 1.29455 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 34.5 | 690 | 73.84711 | 69.00 | | | | | |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 345 | 75.03175 | 69.00 | | | | | |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.13 | 0.26 | 0.25893 | 0.26 | 2 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | 2 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 0.95 | 1.9 | 1.89215 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90000 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 3.5 | 7 | 6.97107 | 7.00 | 2000 | | 600 | 600 | 2000 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00000 | 7.00 | 2000 | | 600 | 600 | 2000 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.68 | 0.63747 | 0.63 | | | 0.083 | 0.083 | 0.083 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.47 | 0.43519 | 0.43 | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.4 | 3.13734 | 3.10 | | | 0.46 | 0.46 | 0.46 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 1 | 0.94063 | 0.93 | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | 24 | 24 | 24 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.53 | 0.49532 | 0.49 | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.58 | 0.53551 | 0.53 | 30 | | 1.2 | 1.2 | 30 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.68 | 0.63747 | 0.63 | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.99 | 0.92057 | 0.91 | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.6 | 2.42215 | 2.40 | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.66 | 0.61734 | 0.61 | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.8 | 0.74835 | 0.74 | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.4 | 1.30443 | 1.30 | | | | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.64 | 0.59620 | 0.59 | | | | | |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.89 | 0.82905 | 0.82 | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2.2 | 2.02722 | 2.00 | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1.1 | 1.02215 | 1.00 | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.83 | 0.76854 | 0.76 | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.79 | 0.73791 | 0.73 | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 1 | 0.96994 | 0.96 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.52 | 0.48532 | 0.48 | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 5.1 | 4.73291 | 4.70 | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.62 | 0.57614 | 0.57 | 2100 | | 180 | 180 | 2100 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.84 | 0.77905 | 0.77 | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.93 | 0.87025 | 0.86 | | | 190 | 190 | 190 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.6 | 0.55614 | 0.55 | 0.5 | | | 0.5 | 0.5 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.17 | 0.16222 | 0.16 | 0.05 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.48 | 0.44519 | 0.44 | 0.5 | | 0.25 | 0.25 | 0.5 |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.82 | 0.75842 | 0.75 | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.2 | 0.18228 | 0.18 | 5 | | 2.5 | 2.5 | 5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.13 | 0.12209 | 0.12 | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.78 | 0.72791 | 0.72 | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.65 | 0.60734 | 0.60 | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10000 | 1.10 | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.92 | 0.86025 | 0.85 | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.73 | 0.67766 | 0.67 | 50 | | 25 | 25 | 50 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.098 | 0.09106 | 0.09 | 0.05 | | 0.025 | 0.025 | 0.05 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.92 | 0.86025 | 0.85 | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1.1 | 1.00443 | 1.00 | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 1.1 | 0.98620 | 0.98 | 270000 | | | 270000 | 270000 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.89 | 0.82905 | 0.82 | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.78 | 0.72791 | 0.72 | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.87 | 0.80905 | 0.80 | 1100 | | 29 | 29 | 1100 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.51 | 0.47532 | 0.47 | 0.2 | 1 | 0.0098 | 0.0098 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.83 | 0.76854 | 0.76 | 5 | | 0.14 | 0.14 | 5 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.66 | 0.61734 | 0.61 | 50 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.098 | 0.09106 | 0.09 | 30 | | 0.33 | 0.33 | 30 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.23 | 0.21228 | 0.21 | 0.5 | | 0.25 | 0.25 | 0.5 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.73 | 0.67766 | 0.67 | 400 | | 78 | 78 | 400 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.87 | 0.80905 | 0.80 | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.53 | 0.49532 | 0.49 | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.9 | 0.83911 | 0.83 | 0.5 | | 0.011 | 0.011 | 0.5 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.8 | 0.74835 | 0.74 | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.4 | 2.22229 | 2.20 | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.45 | 0.41513 | 0.41 | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.9 | 0.83911 | 0.83 | 830 | | 12 | 12 | 830 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28000 | 0.28 | 200 | 200 | 800 | 200 | 800 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | 2 | | | 2 | 2 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34000 | 0.34 | | | 1000 | 1000 | 1000 |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08000 | 0.08 | 3 | | | 3 | 3 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | 4 | | 2.8 | 2.8 | 4 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34000 | 0.34 | 7 | | | 7 | 7 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35000 | 0.35 | 0.7 | | 0.7 | 0.7 | 0.7 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27000 | 0.27 | 70 | | 0.4 | 0.4 | 70 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23000 | 0.23 | 0.2 | 0.2 | 0.00033 | 0.00033 | 0.2 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | 600 | 600 | 30 | 30 | 600 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25000 | 0.25 | 4 | 5 | 0.17 | 0.17 | 5 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | 5 | 5 | 0.82 | 0.82 | 5 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | 600 | | | 600 | 600 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | 75 | 75 | 0.48 | 0.48 | 75 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20000 | 2.20 | | | 560 | 560 | 560 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72000 | 0.72 | | | 3.8 | 3.8 | 3.8 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63000 | 0.63 | | | 630 | 630 | 630 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10000 | 1.10 | | | 1400 | 1400 | 1400 |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09000 | 0.09 | 5 | 5 | 0.46 | 0.46 | 5 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | 80 | 80 | 3.3 | 3.3 | 80 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | 10 | | 0.75 | 0.75 | 10 |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | 81 | 81 | 81 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | 3 | 5 | 0.46 | 0.46 | 5 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | 100 | 100 | 7.8 | 7.8 | 100 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30000 | 0.30 | | | 8.3 | 8.3 | 8.3 |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | 4 | 80 | 0.87 | 0.87 | 80 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37000 | 0.37 | | | 2100 | 2100 | 2100 |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | 70 | 80 | 0.22 | 0.22 | 80 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | 30 | | 19 | 19 | 30 |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | 70 | | | 70 | 70 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16000 | 0.16 | 4 | | | 4 | 4 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | | | 1300 | 1300 | 1300 |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15000 | 0.15 | 10 | 80 | 0.13 | 0.13 | 80 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14000 | 0.14 | 1000 | | 20 | 20 | 1000 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30000 | 0.30 | 700 | 700 | 1.5 | 1.5 | 700 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | 0.004 | | | 0.004 | 0.004 |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32000 | 0.32 | | | | | |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58000 | 0.58 | | | 2000 | 2000 | 2000 |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13000 | 0.13 | 30 | | 14 | 14 | 30 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21000 | 0.21 | 5 | 5 | 11 | 5 | 11 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28000 | 0.28 | | | | | |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32000 | 0.32 | 10000 | | 19 | 19 | 10000 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | 100 | 100 | 120 | 100 | 120 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12000 | 0.12 | 5 | | | 5 | 5 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25000 | 0.25 | 1000 | 1000 | 110 | 110 | 1000 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | 100 | | | 100 | 100 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | 2 | | | 2 | 2 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | 5 | | | 5 | 5 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15000 | 0.15 | 10000 | | 520 | 520 | 10000 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06000 | 0.06 | 0.2 | 2 | 0.019 | 0.019 | 2 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | 0.46 | 0.46 | 0.46 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | 24 | 24 | 24 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | 30 | | 1.2 | 1.2 | 30 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | | | |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | 2100 | | 180 | 180 | 2100 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | 190 | 190 | 190 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | 0.5 | | | 0.5 | 0.5 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | 0.05 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | 0.5 | | 0.25 | 0.25 | 0.5 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | 5 | | 2.5 | 2.5 | 5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | 50 | | 25 | 25 | 50 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | 0.05 | | 0.025 | 0.025 | 0.05 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | 270000 | | | 270000 | 270000 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 1100 | | 29 | 29 | 1100 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | 0.2 | 1 | 0.0098 | 0.0098 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 5 | | 0.14 | 0.14 | 5 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | 50 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | 30 | | 0.33 | 0.33 | 30 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | 0.5 | | 0.25 | 0.25 | 0.5 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | 400 | | 78 | 78 | 400 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | 0.5 | | 0.011 | 0.011 | 0.5 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | | | |

**Table 9. Sampling Analyses and MDLs for Groundwater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | 830 | | 12 | 12 | 830 |

**Table 10. Sampling Analyses and MDLs for Groundwater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00000 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 1440 | 93.80913 | 72.00 | | | | | | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 1550 | 87.02893 | 31.00 | | 230000 | | | | 120000 | 120000 | 230000 | 120000 | 230000 |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 1200 | 95.23810 | 60.00 | | | | | | 120 | 120 | 120 | 120 | 120 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 15 | 1200 | 82.12810 | 60.00 | | | | | | 120 | 120 | 120 | 120 | 120 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 250000 | 10413.2231 | 5000.00 | | | | | | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 5000 | 366.80498 | 100.00 | | | | | | | | | | |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 84 | 46.57399 | 48.00 | | | | | | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 12700 | 363.04959 | 127.00 | | | | | | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 500 | 24.95868 | 10.00 | | | | | | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 0.82 | 20 | 1.95380 | 1.00 | | | | | | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 9.1 | 18.2 | 18.12479 | 18.20 | 87 | 87 | 460 | | 87 | | 87 | 460 | 87 | 460 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20000 | 18.20 | 87 | 87 | 460 | | 87 | | 87 | 460 | 87 | 460 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.31 | 0.62 | 0.61744 | 0.62 | | | 610 | 30 | 30 | | 30 | 610 | 30 | 610 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62000 | 0.62 | | | 610 | 30 | 30 | | 30 | 610 | 30 | 610 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.32 | 0.64 | 0.63736 | 0.64 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 150 | 3.1 | 150 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64000 | 0.64 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 150 | 3.1 | 150 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 0.61 | 12.2 | 1.36744 | 1.20 | | | | 4 | 4 | | 4 | 4 | 4 | 4 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20000 | 1.20 | | | | 4 | 4 | | 4 | 4 | 4 | 4 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.12 | 0.24 | 0.23901 | 0.24 | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 | 0.66 | 5.3 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 | 0.66 | 5.3 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.36 | 0.71 | 0.70711 | 0.71 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.15 | 0.09 | 0.15 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71000 | 0.71 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.15 | 0.09 | 0.15 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 30.3 | 605 | 62.50041 | 60.50 | | | 116000 | | 116000 | | 116000 | 116000 | 116000 | 116000 |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50000 | 60.50 | | | 116000 | | 116000 | | 116000 | 116000 | 116000 | 116000 |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 0.66 | 1.3 | 1.29471 | 1.30 | | | | | 85 | | 85 | 85 | 85 | 85 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | | | | | 85 | | 85 | 85 | 85 | 85 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 0.65 | 1.3 | 1.29463 | 1.30 | | | 5.1 | 23 | 23 | | 5.1 | 23 | 5.1 | 23 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | | | 5.1 | 23 | 23 | | 5.1 | 23 | 5.1 | 23 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 0.68 | 1.4 | 1.39405 | 1.40 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 | 0.23 | 9 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40000 | 1.40 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 | 0.23 | 9 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 7.7 | 1.62157 | 1.50 | | | | | | | | | | |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 77 | 3.23789 | 1.50 | | | | | | | | | | |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 40 | 5.04762 | 2.00 | 5.2 | | 7.8 | | 5 | 5 | 5 | 7.8 | 5 | 7.8 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 80 | 5.38843 | 2.00 | 5.2 | | 7.8 | | 5 | 5 | 5 | 7.8 | 5 | 7.8 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 21.2 | 42.4 | 42.22479 | 42.40 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 | 158 | 1000 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40000 | 42.40 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 | 158 | 1000 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.19 | 0.38 | 0.37843 | 0.38 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 12.26 | 0.54 | 12.26 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38000 | 0.38 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 12.26 | 0.54 | 12.26 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 31.8 | 63.6 | 63.33719 | 63.60 | | | 82000 | | 82000 | | 82000 | 82000 | 82000 | 82000 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60000 | 63.60 | | | 82000 | | 82000 | | 82000 | 82000 | 82000 | 82000 |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 1.2 | 2.5 | 2.48926 | 2.50 | | | 1100 | 120 | 120 | | 120 | 1100 | 120 | 1100 |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50000 | 2.50 | | | 1100 | 120 | 120 | | 120 | 1100 | 120 | 1100 |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.3 | 0.026 | 1.3 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.3 | 0.026 | 1.3 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 0.68 | 1.4 | 1.39405 | 1.40 | 16.1 | 24 | 5 | | 52 | | 5 | 52 | 5 | 52 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40000 | 1.40 | 16.1 | 24 | 5 | | 52 | | 5 | 52 | 5 | 52 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 45.7 | 91.4 | 91.02231 | 91.40 | | | 53000 | | 53000 | | 53000 | 53000 | 53000 | 53000 |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40000 | 91.40 | | | 53000 | | 53000 | | 53000 | 53000 | 53000 | 53000 |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.37 | 0.73 | 0.72702 | 0.73 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 | 1 | 88.32 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73000 | 0.73 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 | 1 | 88.32 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 0.64 | 1.3 | 1.29455 | 1.30 | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 | 0.067 | 3.2 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30000 | 1.30 | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 | 0.067 | 3.2 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 34.5 | 690 | 73.84711 | 69.00 | | | 680000 | | 680000 | | 680000 | 680000 | 680000 | 680000 |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 345 | 75.03175 | 69.00 | | | 680000 | | 680000 | | 680000 | 680000 | 680000 | 680000 |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.13 | 0.26 | 0.25893 | 0.26 | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 | 0.8 | 57 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 | 0.8 | 57 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 0.95 | 1.9 | 1.89215 | 1.90 | | | 80 | 20 | 20 | | 20 | 80 | 20 | 80 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90000 | 1.90 | | | 80 | 20 | 20 | | 20 | 80 | 20 | 80 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 3.5 | 7 | 6.97107 | 7.00 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 | 30 | 120 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00000 | 7.00 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 | 30 | 120 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.68 | 0.63747 | 0.63 | | | | 14 | 14 | | 14 | 14 | 14 | 14 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.47 | 0.43519 | 0.43 | | | | | 3 | | 3 | 3 | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.4 | 3.13734 | 3.10 | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 1 | 0.94063 | 0.93 | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | | | 1.2 | 1 | 1 | 1.2 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.53 | 0.49532 | 0.49 | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.58 | 0.53551 | 0.53 | | | | | 4.9 | | 4.9 | 4.9 | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.68 | 0.63747 | 0.63 | | | | | 11 | | 11 | 11 | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.99 | 0.92057 | 0.91 | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.6 | 2.42215 | 2.40 | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | | | | | 44 | | 44 | 44 | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | | | 81 | | 81 | 81 | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.66 | 0.61734 | 0.61 | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.8 | 0.74835 | 0.74 | | | | | 24 | | 24 | 24 | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | | | 4.7 | | 4.7 | 4.7 | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.4 | 1.30443 | 1.30 | | | 489 | 13 | 13 | | 13 | 489 | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.64 | 0.59620 | 0.59 | | | 481 | 300 | 1920 | | 300 | 1920 | 300 | 1920 |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | | | | | 4.5 | | 4.5 | 4.5 | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.89 | 0.82905 | 0.82 | | | | | | | | | | |

**Table 10. Sampling Analyses and MDLs for Groundwater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2.2 | 2.02722 | 2.00 | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1.1 | 1.02215 | 1.00 | | | | 1.5 | 1.5 | | 1.5 | 1.5 | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.83 | 0.76854 | 0.76 | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.79 | 0.73791 | 0.73 | | | | | 232 | | 232 | 232 | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 1 | 0.96994 | 0.96 | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.52 | 0.48532 | 0.48 | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 5.1 | 4.73291 | 4.70 | | | 481 | 300 | 60 | | 60 | 481 | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.96 | 0.89044 | 0.88 | | | 74 | | 5.8 | 5.8 | 5.8 | 74 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1.1 | 1.02722 | 1.00 | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.62 | 0.57614 | 0.57 | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.84 | 0.77905 | 0.77 | | | | | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.93 | 0.87025 | 0.86 | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.6 | 0.55614 | 0.55 | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 | 0.018 | 0.65 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.17 | 0.16222 | 0.16 | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 | 0.014 | 0.3 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.48 | 0.44519 | 0.44 | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.82 | 0.75842 | 0.75 | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.2 | 0.18228 | 0.18 | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.13 | 0.12209 | 0.12 | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.78 | 0.72791 | 0.72 | | | 912 | 3 | 16 | | 3 | 912 | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.65 | 0.60734 | 0.60 | | | | 19 | 19 | | 19 | 19 | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10000 | 1.10 | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.92 | 0.86025 | 0.85 | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.73 | 0.67766 | 0.67 | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.098 | 0.09106 | 0.09 | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.92 | 0.86025 | 0.85 | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1.1 | 1.00443 | 1.00 | | | 85600 | 210 | 210 | | 210 | 85600 | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 1.1 | 0.98620 | 0.98 | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.89 | 0.82905 | 0.82 | | | 697 | 35 | 19 | 19 | 19 | 697 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.75 | 0.69766 | 0.69 | | | 708 | | 22 | | 22 | 708 | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.78 | 0.72791 | 0.72 | | | = | | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.87 | 0.80905 | 0.80 | | | | 3.9 | 3 | 3 | 3 | 3.9 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.51 | 0.47532 | 0.47 | | | | | 0.0003 | | 0.0003 | 0.0003 | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.83 | 0.76854 | 0.76 | | | | | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.66 | 0.61734 | 0.61 | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.098 | 0.09106 | 0.09 | | | | 12 | 12 | | 12 | 12 | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.23 | 0.21228 | 0.21 | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.73 | 0.67766 | 0.67 | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.87 | 0.80905 | 0.80 | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.53 | 0.49532 | 0.49 | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.9 | 0.83911 | 0.83 | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.8 | 0.74835 | 0.74 | | | 332 | 210 | 210 | | 210 | 332 | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.4 | 2.22229 | 2.20 | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.71 | 0.65759 | 0.65 | | | 200 | | 0.4 | 0.4 | 0.4 | 200 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.45 | 0.41513 | 0.41 | | | 200 | | 4 | 4 | 4 | 200 | 4 | 200 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.9 | 0.83911 | 0.83 | | | | | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28000 | 0.28 | | | 3493 | 11 | 11 | | 11 | 3493 | 11 | 3493 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | | | 2400 | 610 | 610 | | 610 | 2400 | 610 | 2400 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34000 | 0.34 | | | | | | | | | | |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08000 | 0.08 | | | 9400 | 1200 | 1200 | | 1200 | 9400 | 1200 | 9400 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | | | 14680 | 47 | 47 | | 47 | 14680 | 47 | 14680 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34000 | 0.34 | | | 2800 | 25 | 25 | | 25 | 2800 | 25 | 2800 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35000 | 0.35 | | | | | | 8 | 8 | 8 | 8 | 8 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27000 | 0.27 | | | | 110 | 24 | 24 | 24 | 110 | 24 | 110 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23000 | 0.23 | | | | | | | | | | |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | | 14 | 0.7 | | 0.7 | 14 | 0.7 | 14 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25000 | 0.25 | | | 15200 | 910 | 100 | 100 | 100 | 15200 | 100 | 15200 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | | | | | | | | | | |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | | | | 71 | 150 | 150 | 71 | 150 | 71 | 150 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | | | | 15 | 26 | 26 | 15 | 26 | 15 | 26 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20000 | 2.20 | | | 282170 | 14000 | 14000 | | 14000 | 282170 | 14000 | 282170 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72000 | 0.72 | | | 32783 | 99 | 99 | | 99 | 32783 | 99 | 32783 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63000 | 0.63 | | | 77400 | 170 | 170 | | 170 | 77400 | 170 | 77400 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10000 | 1.10 | | | 507640 | 1500 | 1500 | | 1500 | 507640 | 1500 | 507640 |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09000 | 0.09 | | | 525000 | 130 | 370 | 370 | 130 | 525000 | 130 | 525000 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | | | | 320 | 320 | | 320 | 320 | 320 | 320 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | | | | | | | | | | |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | 244 | 0.92 | 0.92 | | 0.92 | 244 | 0.92 | 244 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33000 | 0.33 | | | 1970 | 9.8 | 13.3 | | 9.8 | 1970 | 9.8 | 1970 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24000 | 0.24 | | | 1203 | 64 | 1.3 | | 1.3 | 1203 | 1.3 | 1203 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30000 | 0.30 | | | | | | | | | | |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | | | | | | | | |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37000 | 0.37 | | | | | | | | | | |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | 1240 | 28 | 1.8 | | 1.8 | 1240 | 1.8 | 1240 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | | | | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | | | | 590 | | | 590 | 590 | 590 | 590 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16000 | 0.16 | | | | 0.055 | | | 0.055 | 0.055 | 0.055 | 0.055 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26000 | 0.26 | | | | | | | | | | |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15000 | 0.15 | | | | | | | | | | |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14000 | 0.14 | | | | | | | | | | |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30000 | 0.30 | | | 440 | 7.3 | 90 | 90 | 7.3 | 440 | 7.3 | 440 |

**Table 10. Sampling Analyses and MDLs for Groundwater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | | | | | | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32000 | 0.32 | | | | | 2.6 | | 2.6 | 2.6 | 2.6 | 2.6 |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58000 | 0.58 | | | | | | | | | | |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13000 | 0.13 | | | | | 11070 | 10000 | 10000 | 11070 | 10000 | 11070 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | | | | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21000 | 0.21 | | | 42667 | 2200 | 98.1 | | 98.1 | 42667 | 98.1 | 42667 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28000 | 0.28 | | | | 1.8 | | | 1.8 | 1.8 | 1.8 | 1.8 |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32000 | 0.32 | | | | 13 | | | 13 | 13 | 13 | 13 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17000 | 0.17 | | | | | 72 | 72 | 72 | 72 | 72 | 72 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12000 | 0.12 | | | 750 | 98 | 111 | | 98 | 750 | 98 | 750 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25000 | 0.25 | | | 1269 | 9.8 | 2 | 2 | 2 | 1269 | 2 | 1269 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18000 | 0.18 | | | | 590 | 970 | | 590 | 970 | 590 | 970 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19000 | 0.19 | | | | 0.055 | | | 0.055 | 0.055 | 0.055 | 0.055 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22000 | 0.22 | | | 7257 | 47 | 21 | | 21 | 7257 | 21 | 7257 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15000 | 0.15 | | | | | | | | | | |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06000 | 0.06 | | | | | 930 | | 930 | 930 | 930 | 930 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | | | | | 3 | | 3 | 3 | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | | | 1.2 | 1 | 1 | 1.2 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | | | | | 4.9 | | 4.9 | 4.9 | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | 11 | | 11 | 11 | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | | | | | 44 | | 44 | 44 | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | | | | | 81 | | 81 | 81 | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | | | | | 24 | | 24 | 24 | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | | | 4.7 | | 4.7 | 4.7 | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | 489 | 13 | 13 | | 13 | 489 | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | 481 | 300 | 1920 | | 300 | 1920 | 300 | 1920 |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | | | | | 4.5 | | 4.5 | 4.5 | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | 1.5 | 1.5 | | 1.5 | 1.5 | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | | | 232 | | 232 | 232 | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | | | 481 | 300 | 60 | | 60 | 481 | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | 74 | | 5.8 | 5.8 | 5.8 | 74 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | | | | | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 | 0.018 | 0.65 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 | 0.014 | 0.3 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | | | 912 | 3 | 16 | | 3 | 912 | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | | | | 19 | 19 | | 19 | 19 | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | | | 85600 | 210 | 210 | | 210 | 85600 | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | | | 697 | 35 | 19 | 19 | 19 | 697 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | 708 | | 22 | | 22 | 708 | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | | | = | | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | 3.9 | 3 | 3 | 3 | 3.9 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | | | | | 0.0003 | | 0.0003 | 0.0003 | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | 12 | 12 | | 12 | 12 | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | | | 332 | 210 | 210 | | 210 | 332 | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | 200 | | 0.4 | 0.4 | 0.4 | 200 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | | | 200 | | 4 | 4 | 4 | 200 | 4 | 200 |

**Table 10. Sampling Analyses and MDLs for Groundwater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | | | | | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 30 | 46.30 | 31.00 | | | | | |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 60 | 83.48 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 12 | 12 | 58.40 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 5000 | 7045.45 | 5000.00 | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 100 | 101.14 | 100.00 | 10000 | 10000 | | 10000 | 10000 |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 42 | 48.94 | 48.00 | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 105 | 173.80 | 127.00 | | | | | |
| GenChem | 18496-25-8 | Sulfide | T | SM 4500 S2 F | ug/l | 579 | 579 | 579.00 | 579.00 | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 10 | 10.00 | 10.00 | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 1 | 1 | 1.19 | 1.00 | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | 5.6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | 5.6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 0.05 | 2 | 0.063 | 0.05 | 2 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 0.05 | 2 | 0.063 | 0.05 | 2 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 100 | | 39 | 39 | 100 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 100 | | 39 | 39 | 100 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 0.24 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 0.24 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 2000 | | 600 | 600 | 2000 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 2000 | | 600 | 600 | 2000 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | 0.0031 | | 0.0063 | 0.0031 | 0.0063 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.0022 | | 0.046 | 0.0022 | 0.046 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.0022 | | 0.23 | 0.0022 | 0.23 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00049 | | 0.00092 | 0.00049 | 0.00092 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | ug/l | 0.007 | 0.007 | 0.01 | 0.01 | 0.026 | | 0.0072 | 0.0072 | 0.026 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.008 | | | 0.008 | 0.008 |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.091 | | 0.025 | 0.025 | 0.091 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | | | | | |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00052 | | 0.0018 | 0.00052 | 0.0018 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 62 | | | 62 | 62 |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 62 | | | 62 | 62 |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | 62 | | | 62 | 62 |
| Pesticides | 72-20-8 | Endrin | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.059 | 2 | 0.23 | 0.059 | 2 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | 0.29 | | | 0.29 | 0.29 |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | | |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | ug/l | 0.012 | 0.012 | 0.01 | 0.01 | 0.2 | 0.2 | 0.042 | 0.042 | 0.2 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | | | | | |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00079 | 0.4 | 0.0014 | 0.00079 | 0.4 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | 0.00039 | 0.2 | 0.0014 | 0.00039 | 0.2 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 40 | 40 | 3.7 | 3.7 | 40 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | ug/l | 0.11 | 0.11 | 0.11 | 0.11 | 0.0028 | 3 | 0.071 | 0.0028 | 3 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.14 | 0.00064 | 0.14 |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0047 | 0.00064 | 0.0047 |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0047 | 0.00064 | 0.0047 |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | | 0.00064 | 0.00064 |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | | 0.00064 | 0.00064 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | 0.083 | 0.083 | 0.083 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.43 | 0.43 | 0.43 | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.1 | 3.14 | 3.10 | | | 0.46 | 0.46 | 0.46 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 0.93 | 0.94 | 0.93 | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 24 | 24 | 24 |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.53 | 0.53 | 0.53 | 14 | | 1.2 | 1.2 | 14 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.91 | 0.92 | 0.91 | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.4 | 2.41 | 2.40 | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.59 | 0.59 | 0.59 | | | | | |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2 | 2.04 | 2.00 | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1 | 1.01 | 1.00 | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.73 | 0.74 | 0.73 | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 0.96 | 0.97 | 0.96 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.48 | 0.48 | 0.48 | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 4.7 | 4.71 | 4.70 | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.57 | 0.57 | 0.57 | 8300 | | 180 | 180 | 8300 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.77 | 0.78 | 0.77 | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.86 | 0.87 | 0.86 | | | 19 | 19 | 19 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.55 | 0.55 | 0.55 | 0.038 | | | 0.038 | 0.038 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | 0.038 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.44 | 0.44 | 0.44 | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.75 | 0.76 | 0.75 | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 0.038 | | 2.5 | 0.038 | 2.5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.6 | 0.61 | 0.60 | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | 0.038 | | 25 | 0.038 | 25 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 0.038 | | 0.025 | 0.025 | 0.038 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1 | 1.00 | 1.00 | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 0.98 | 0.99 | 0.98 | 270000 | | | 270000 | 270000 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | 1100 | | 29 | 29 | 1100 |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.47 | 0.47 | 0.47 | 0.0028 | 1 | 0.0098 | 0.0028 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | 4.4 | | 0.14 | 0.14 | 4.4 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | 40 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 14 | | 0.33 | 0.33 | 14 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | 350 | | 78 | 78 | 350 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | 0.05 | | 0.011 | 0.011 | 0.05 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.2 | 2.21 | 2.20 | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.41 | 0.41 | 0.41 | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | 830 | | 12 | 12 | 830 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | 200 | 200 | 800 | 200 | 800 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | 1.7 | | | 1.7 | 1.7 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | 1000 | 1000 | 1000 |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08 | 0.08 | 3 | | | 3 | 3 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | 2.8 | 2.8 | 2.8 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | 7 | | | 7 | 7 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35 | 0.35 | | | 0.7 | 0.7 | 0.7 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27 | 0.27 | 35 | | 0.4 | 0.4 | 35 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23 | 0.23 | 0.2 | 0.2 | 0.00033 | 0.00033 | 0.2 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 420 | 600 | 30 | 30 | 600 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | 3.8 | 5 | 0.17 | 0.17 | 5 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 5 | 5 | 0.82 | 0.82 | 5 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 320 | | | 320 | 320 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 75 | 75 | 0.48 | 0.48 | 75 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20 | 2.20 | | | 560 | 560 | 560 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72 | 0.72 | | | 3.8 | 3.8 | 3.8 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63 | 0.63 | | | 630 | 630 | 630 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | 1400 | 1400 | 1400 |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 5 | 5 | 0.46 | 0.46 | 5 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 43 | 80 | 3.3 | 3.3 | 80 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 47 | | 0.75 | 0.75 | 47 |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | 81 | 81 | 81 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 2.3 | 5 | 0.46 | 0.46 | 5 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 100 | 100 | 7.8 | 7.8 | 100 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | 8.3 | 8.3 | 8.3 |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 4 | 80 | 0.87 | 0.87 | 80 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37 | 0.37 | | | 2100 | 2100 | 2100 |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 57 | 80 | 0.22 | 0.22 | 80 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 30 | | 19 | 19 | 30 |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 70 | | | 70 | 70 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | 3.4 | | | 3.4 | 3.4 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | 1300 | 1300 | 1300 |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | 5.5 | 80 | 0.13 | 0.13 | 80 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14 | 0.14 | | | 20 | 20 | 20 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | 530 | 700 | 1.5 | 1.5 | 700 |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58 | 0.58 | | | 2000 | 2000 | 2000 |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13 | 0.13 | 30 | | 14 | 14 | 30 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | 5 | 5 | 11 | 5 | 11 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | 10000 | | 19 | 19 | 10000 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 100 | 100 | 120 | 100 | 120 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | 5 | | | 5 | 5 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | 1000 | 1000 | 110 | 110 | 1000 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 100 | | | 100 | 100 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | 2 | | | 2 | 2 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 5 | | | 5 | 5 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | 10000 | | 520 | 520 | 10000 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06 | 0.06 | 0.25 | 2 | 0.019 | 0.019 | 2 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | 0.46 | 0.46 | 0.46 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | 24 | 24 | 24 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | 14 | | 1.2 | 1.2 | 14 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | 8300 | | 180 | 180 | 8300 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | 19 | 19 | 19 |

**Table 11. Sampling Analyses and MDLs for Surface Water – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | 0.038 | | | 0.038 | 0.038 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | 0.038 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | 0.038 | | 2.5 | 0.038 | 2.5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | 0.038 | | 25 | 0.038 | 25 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | 0.038 | | 0.025 | 0.025 | 0.038 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | 270000 | | | 270000 | 270000 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 1100 | | 29 | 29 | 1100 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | 0.0028 | 1 | 0.0098 | 0.0028 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 4.4 | | 0.14 | 0.14 | 4.4 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | 40 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | 14 | | 0.33 | 0.33 | 14 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | 350 | | 78 | 78 | 350 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | 0.05 | | 0.011 | 0.011 | 0.05 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | 830 | | 12 | 12 | 830 |

**Table 12. Sampling Analyses and MDLs for Surface Water – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 30 | 46.30 | 31.00 | | | | 230000 | | | | 120000 | 120000 | 230000 |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 60 | 83.48 | 60.00 | | | | | | | | 120 | 120 | 120 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 12 | 12 | 58.40 | 60.00 | | | | | | | | 120 | 120 | 120 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 5000 | 7045.45 | 5000.00 | | | | | | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 100 | 101.14 | 100.00 | | | | | | | | | | |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 42 | 48.94 | 48.00 | | | | | | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 105 | 173.80 | 127.00 | | | | | | | | | | |
| GenChem | 18496-25-8 | Sulfide | T | SM 4500 S2 F | ug/l | 579 | 579 | 579.00 | 579.00 | | | | | | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 10 | 10.00 | 10.00 | | | | | | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 1 | 1 | 1.19 | 1.00 | | | | | | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | 750 | 87 | 87 | 87 | 460 | | 87 | | 87 | 750 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | 750 | 87 | 87 | 87 | 460 | | 87 | | 87 | 750 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | | | | | 610 | 30 | 30 | | 30 | 610 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | | | | | 610 | 30 | 30 | | 30 | 610 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 340 | 150 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 340 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 340 | 150 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 340 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | | | | | | 4 | 4 | | 4 | 4 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | | | | | | 4 | 4 | | 4 | 4 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 0.52 | 0.237827934 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.52 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 0.52 | 0.237827934 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.52 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | 116000 | | 116000 | | 116000 | 116000 |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | 116000 | | 116000 | | 116000 | 116000 |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | 74.7 | | | | | 85 | | 74.7 | 85 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | 74.7 | | | | | 85 | | 74.7 | 85 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 5.1 | 23 | 23 | | 5.1 | 23 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 5.1 | 23 | 23 | | 5.1 | 23 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 3.79 | 8.037619479 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 3.79 | 8.037619479 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | | | | | | | | | | |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | | | | | | | | | | |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 22 | 5.2 | 5.2 | | 7.8 | | 5 | 5 | 5 | 22 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 22 | 5.2 | 5.2 | | 7.8 | | 5 | 5 | 5 | 22 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | 1000 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | 1000 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 13.98 | 2.548308447 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 13.98 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 13.98 | 2.548308447 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 13.98 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | 82000 | | 82000 | | 82000 | 82000 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | 82000 | | 82000 | | 82000 | 82000 |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | 1100 | 120 | 120 | | 120 | 1100 |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | 1100 | 120 | 120 | | 120 | 1100 |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 1.7 | 0.91 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.7 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 1.7 | 0.91 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.7 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 145 | 45.00938447 | 16.1 | 24 | 5 | | 52 | | 5 | 145 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 145 | 45.00938447 | 16.1 | 24 | 5 | | 52 | | 5 | 145 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | 53000 | | 53000 | | 53000 | 53000 |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | 53000 | | 53000 | | 53000 | 53000 |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 20 | 5 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 20 | 5 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 0.374 | | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 0.374 | | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | 680000 | | 680000 | | 680000 | 680000 |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | 680000 | | 680000 | | 680000 | 680000 |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | | | 80 | 20 | 20 | | 20 | 80 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | | | 80 | 20 | 20 | | 20 | 80 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 37 | 103.3613472 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 37 | 103.3613472 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | | | | | 1.69 | 0.011 | 0.011 | 0.001 | 0.001 | 1.69 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | | | | | | | | 0.001 | 0.001 | 0.001 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.5 | 0.001 | 0.001 | 0.001 | 0.3 | 0.013 | 0.0005 | 0.001 | 0.0005 | 0.5 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 1.5 | 1.5 | 1.5 | 0.3 | | | 3 | 0.004 | 0.004 | 3 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | ug/l | 0.007 | 0.007 | 0.01 | 0.01 | | | | | 95 | 2.2 | | | 2.2 | 95 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | | 0.0043 | 0.0043 | 0.0043 | 1.09 | | | | 0.0043 | 1.09 |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | | | | | 95 | 2.2 | | | 2.2 | 95 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | | | | | 95 | 2.2 | 141 | | 2.2 | 141 |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.24 | 0.056 | 0.056 | 0.056 | | | 0.056 | | 0.056 | 0.24 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.11 | 0.056 | 0.056 | 0.056 | | 0.051 | 0.051 | 0.003 | 0.003 | 0.11 |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.11 | 0.056 | 0.056 | 0.056 | | 0.051 | 0.051 | | 0.051 | 0.11 |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | | | | 0.056 | | 0.051 | | | 0.051 | 0.056 |
| Pesticides | 72-20-8 | Endrin | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.086 | 0.036 | 0.036 | 0.036 | | | 0.036 | 0.0023 | 0.0023 | 0.086 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | 0.036 | | | | | 0.036 | 0.036 |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | 0.036 | | | | | 0.036 | 0.036 |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | ug/l | 0.012 | 0.012 | 0.01 | 0.01 | | 0.95 | 0.95 | 0.095 | 3.3 | | 0.01 | 0.01 | 0.01 | 3.3 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | | 0.0043 | 0.0043 | 0.0043 | 1.09 | | | | 0.0043 | 1.09 |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.26 | 0.0038 | 0.0038 | 0.0038 | 1.26 | 0.0069 | 0.0019 | 0.01 | 0.0019 | 1.26 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | 0.26 | 0.0038 | 0.0038 | 0.0038 | 1.26 | 0.0069 | 0.0019 | | 0.0019 | 1.26 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | | 0.03 | 0.03 | 0.03 | | 0.019 | 0.019 | | 0.019 | 0.03 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | ug/l | 0.11 | 0.11 | 0.11 | 0.11 | 0.73 | 0.0002 | 0.0002 | 0.0002 | | | 0.0002 | 0.008 | 0.0002 | 0.73 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | | | 0.000074 | | 0.000074 | 0.014 |

**Table 12. Sampling Analyses and MDLs for Surface Water – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 60 | 0.28 | 0.000074 | | 0.000074 | 60 |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 124 | 0.58 | 0.000074 | | 0.000074 | 124 |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 4.9 | 0.053 | 0.000074 | | 0.000074 | 4.9 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | | 0.081 | 0.000074 | | 0.000074 | 0.081 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | 0.1 | 0.033 | 0.000074 | | 0.000074 | 0.1 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | 2.3 | 94 | 0.000074 | | 0.000074 | 94 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | | | | | 0.014 | 0.014 |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | | | | | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | 0.014 | 0.1 | 0.14 | 0.000074 | 0.001 | 0.000074 | 0.14 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | | | | 14 | 14 | | 14 | 14 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.43 | 0.43 | 0.43 | | | | | | | 3 | | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.1 | 3.14 | 3.10 | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 0.93 | 0.94 | 0.93 | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | | | 1.2 | 1 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.53 | 0.53 | 0.53 | | | | | | | 4.9 | | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | | | | | 11 | | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.91 | 0.92 | 0.91 | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.4 | 2.41 | 2.40 | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | 44 | | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | 81 | | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | | | | | | | 24 | | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | 4.7 | | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 489 | 13 | 13 | | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.59 | 0.59 | 0.59 | | | | | 481 | 300 | 1920 | | 300 | 1920 |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | 4.5 | | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2 | 2.04 | 2.00 | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1 | 1.01 | 1.00 | | | | | | 1.5 | 1.5 | | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.73 | 0.74 | 0.73 | | | | | | | 232 | | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 0.96 | 0.97 | 0.96 | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.48 | 0.48 | 0.48 | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 4.7 | 4.71 | 4.70 | | | | | 481 | 300 | 60 | | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | 74 | | 5.8 | 5.8 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.57 | 0.57 | 0.57 | | | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.77 | 0.78 | 0.77 | | | | | | | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.86 | 0.87 | 0.86 | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.55 | 0.55 | 0.55 | | | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | | | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.44 | 0.44 | 0.44 | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.75 | 0.76 | 0.75 | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | | | | | 912 | 3 | 16 | | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.6 | 0.61 | 0.60 | | | | | | 19 | 19 | | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1 | 1.00 | 1.00 | | | | | 85600 | 210 | 210 | | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 0.98 | 0.99 | 0.98 | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | 697 | 35 | 19 | 19 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | 708 | | 22 | | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | | | | | = | | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | | | | | | 3.9 | 3 | 3 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.47 | 0.47 | 0.47 | | | | | | | 0.0003 | | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | | | | | | | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | | 12 | 12 | | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | | | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | | | | | 332 | 210 | 210 | | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.2 | 2.21 | 2.20 | 5.3 | 4 | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | 200 | | 0.4 | 0.4 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.41 | 0.41 | 0.41 | | | | | 200 | | 4 | 4 | 4 | 200 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | | | | | | | 0.025 | 0.025 | 0.025 | 0.025 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | 3493 | 11 | 11 | | 11 | 3493 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | 2400 | 610 | 610 | | 610 | 2400 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | | | | | | | | |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08 | 0.08 | | | | | 9400 | 1200 | 1200 | | 1200 | 9400 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 14680 | 47 | 47 | | 47 | 14680 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | | | 2800 | 25 | 25 | | 25 | 2800 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35 | 0.35 | | | | | | | | 8 | 8 | 8 |

**Table 12. Sampling Analyses and MDLs for Surface Water – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27 | 0.27 | | | | | | 110 | 24 | 24 | 24 | 110 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23 | 0.23 | | | | | | | | | | |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | 14 | 0.7 | | 0.7 | 14 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | | | | | 15200 | 910 | 100 | 100 | 100 | 15200 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | | 71 | 150 | 150 | 71 | 150 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | | 15 | 26 | 26 | 15 | 26 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20 | 2.20 | | | | | 282170 | 14000 | 14000 | | 14000 | 282170 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72 | 0.72 | | | | | 32783 | 99 | 99 | | 99 | 32783 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63 | 0.63 | | | | | 77400 | 170 | 170 | | 170 | 77400 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | | | 507640 | 1500 | 1500 | | 1500 | 507640 |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | 525000 | 130 | 370 | 370 | 130 | 525000 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | 320 | 320 | | 320 | 320 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 244 | 0.92 | 0.92 | | 0.92 | 244 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | 1970 | 9.8 | 13.3 | | 9.8 | 1970 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 1203 | 64 | 1.3 | | 1.3 | 1203 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | | | | | | | | |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37 | 0.37 | | | | | | | | | | |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 1240 | 28 | 1.8 | | 1.8 | 1240 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | | 590 | | | 590 | 590 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | | | | | | 0.055 | | | 0.055 | 0.055 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | | | | | | |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | | | | | | | | | | |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14 | 0.14 | | | | | | | | | | |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | | | 440 | 7.3 | 90 | 90 | 7.3 | 440 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | | | 2.6 | | 2.6 | 2.6 |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58 | 0.58 | | | | | | | | | | |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13 | 0.13 | | | | | | | 11070 | 10000 | 10000 | 11070 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | | | | | 42667 | 2200 | 98.1 | | 98.1 | 42667 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | | 1.8 | | | 1.8 | 1.8 |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | | 13 | | | 13 | 13 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | | | | | | | 72 | 72 | 72 | 72 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | | | | | 750 | 98 | 111 | | 98 | 750 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | | | | | 1269 | 9.8 | 2 | 2 | 2 | 1269 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | 590 | 970 | | 590 | 970 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | | 0.055 | | | 0.055 | 0.055 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 7257 | 47 | 21 | | 21 | 7257 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | | | | | | | | | | |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06 | 0.06 | | | | | | | 930 | | 930 | 930 |
| | | *New Phase II Analyses* | | | | RL | MDL | LOD | | | | | | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | | | | | | | 3 | | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | | | | | 1.2 | 1 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | | | | | | | 4.9 | | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | | | 11 | | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | | | | | | | 44 | | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | | | | | | | 81 | | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | | | | | | | 24 | | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | | | | | 4.7 | | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | | | 489 | 13 | 13 | | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | 481 | 300 | 1920 | | 300 | 1920 |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | | | | | | | 4.5 | | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | | | 1.5 | 1.5 | | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | | | | | 232 | | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | | | | | 481 | 300 | 60 | | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | 74 | | 5.8 | 5.8 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | | | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | | | | | | | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | | | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | | | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | | | | | | | | | | |

**Table 12. Sampling Analyses and MDLs for Surface Water – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | | | | | 912 | 3 | 16 | | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | | | | | | 19 | 19 | | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | | | | | 85600 | 210 | 210 | | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | | | | | 697 | 35 | 19 | 19 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | | | 708 | | 22 | | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | | | | | = | | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | 3.9 | 3 | 3 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | | | | | | | 0.0003 | | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | | | 12 | 12 | | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | | | | | 332 | 210 | 210 | | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 5.3 | 4 | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | | | 200 | | 0.4 | 0.4 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | | | | | 200 | | 4 | 4 | 4 | 200 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | | | | | | | 0.025 | 0.025 | 0.025 | 0.025 |

**Table 13. Sampling Analyses and MDLs for Sediment – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00179 | Corrosivity | T | 9045D | pH Units | | | | | | | | | |
| GenChem | 16984-48-8 | Fluoride | D | 9056A | mgkg | 1.83 | 6.76 | 2.94313 | 2.2950 | 310 | 4700 | 12 | 12 | 4700 |
| GenChem | STL00204 | pH | T | 9045D | pH Units | | | | | | | | | |
| GenChem | STL00338 | Total Organic Carbon (1) | T | Lloyd Kahn | mgkg | 86.3 | 302 | 133.81875 | 107.5000 | | | | | |
| Metals | 7429-90-5 | Aluminum | T | 6020A | mgkg | 9 | 29.6 | 14.90625 | 13.4000 | 7700 | 110000 | 3000 | 3000 | 110000 |
| Metals | 7440-36-0 | Antimony | T | 6020A | mgkg | 0.32 | 1.1 | 0.53375 | 0.4750 | 3.1 | 47 | 0.035 | 0.035 | 47 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | mgkg | 0.32 | 1.1 | 0.53750 | 0.4800 | 0.68 | 3 | 0.0015 | 0.0015 | 3 |
| Metals | 7440-39-3 | Barium | T | 6020A | mgkg | 0.63 | 2.1 | 1.05063 | 0.9450 | 1500 | 22000 | 16 | 16 | 22000 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | mgkg | 0.097 | 0.32 | 0.16231 | 0.1450 | 16 | 230 | 1.9 | 1.9 | 230 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | mgkg | 0.34 | 1.1 | 0.55813 | 0.5050 | | | | | |
| Metals | 7440-70-2 | Calcium | T | 6020A | mgkg | 43.7 | 144 | 72.73125 | 65.4000 | | | | | |
| Metals | 7440-47-3 | Chromium | T | 6020A | mgkg | 0.6 | 2 | 1.00375 | 0.9050 | | | | | |
| Metals | 16065-83-1 | Chromium(III), Insoluble Salts | T | 6020A | mg/kg | 0.6 | 2 | 1.00375 | 0.9050 | 12000 | 180000 | 4000000 | 12000 | 4000000 |
| Metals | 18540-29-9 | Chromium(VI) | T | 6020A | mg/kg | 0.6 | 2 | 1.00375 | 0.9050 | 0.3 | 6.3 | 0.00067 | 0.00067 | 6.3 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | mgkg | 0.61 | 2 | 1.01250 | 0.9050 | 2.3 | 35 | 0.027 | 0.027 | 35 |
| Metals | 7440-50-8 | Copper | T | 6020A | mgkg | 0.61 | 2 | 1.01750 | 0.9150 | 310 | 4700 | 2.8 | 2.8 | 4700 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | mgkg | 0.42 | 0.64 | 0.49000 | 0.4650 | 2.3 | 15 | 0.0015 | 0.0015 | 15 |
| Metals | 57-12-5 | Cyanide, Total | T | 9012B | mgkg | 0.076 | 0.26 | 0.11563 | 0.0925 | 2.3 | 15 | 0.0015 | 0.0015 | 15 |
| Metals | 7439-89-6 | Iron | T | 6020A | mgkg | 19 | 62.8 | 31.61250 | 28.4500 | 5500 | 82000 | 35 | 35 | 82000 |
| Metals | 7439-92-1 | Lead | T | 6020A | mgkg | 0.18 | 0.59 | 0.29938 | 0.2700 | 400 | 800 | | 400 | 800 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | mgkg | 30.2 | 100 | 50.34375 | 45.2500 | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | mgkg | 1.2 | 4 | 2.03125 | 1.8000 | | | | | |
| Metals | 7439-97-6 | Mercury | T | 7471B | mgkg | 0.013 | 0.045 | 0.02038 | 0.0165 | 1.1 | 4.6 | 0.0033 | 0.0033 | 4.6 |
| Metals | 7440-02-0 | Nickel | T | 6020A | mgkg | 0.61 | 2 | 1.02000 | 0.9150 | 150 | 2200 | 2.6 | 2.6 | 2200 |
| Metals | 7440-09-7 | Potassium | T | 6020A | mgkg | 29.7 | 98.1 | 49.40000 | 44.4500 | | | | | |
| Metals | 7782-49-2 | Selenium | T | 6020A | mgkg | 0.3 | 0.98 | 0.49375 | 0.4450 | 39 | 580 | 0.052 | 0.052 | 580 |
| Metals | 7440-22-4 | Silver | T | 6020A | mgkg | 0.62 | 2.1 | 1.03563 | 0.9350 | 39 | 580 | 0.08 | 0.08 | 580 |
| Metals | 7440-23-5 | Sodium | T | 6020A | mgkg | 43.1 | 143 | 71.78125 | 64.5500 | | | | | |
| Metals | 7440-28-0 | Thallium | T | 6020A | mgkg | 0.13 | 0.42 | 0.20875 | 0.1900 | 0.078 | 1.2 | 0.0014 | 0.0014 | 1.2 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | mgkg | 0.88 | 2.9 | 1.46063 | 1.3000 | 39 | 580 | 8.6 | 8.6 | 580 |
| Metals | 7440-66-6 | Zinc | T | 6020A | mgkg | 3.2 | 10.5 | 5.30625 | 4.7500 | 2300 | 35000 | 37 | 37 | 35000 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mgkg | 0.035 | 0.12 | 0.05463 | 0.0440 | 4.7 | 20 | 0.00087 | 0.00087 | 20 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mgkg | 0.031 | 0.11 | 0.04819 | 0.0385 | 2.3 | 35 | 0.00079 | 0.00079 | 35 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mgkg | 0.11 | 0.39 | 0.17250 | 0.1400 | 5.3 | 24 | 0.000094 | 0.000094 | 24 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mgkg | 0.017 | 0.06 | 0.02644 | 0.0210 | 310 | 4700 | 0.026 | 0.026 | 4700 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mgkg | 0.039 | 0.14 | 0.06069 | 0.0490 | 190 | 2500 | 0.018 | 0.018 | 2500 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mgkg | 0.041 | 0.15 | 0.06438 | 0.0515 | 630 | 8200 | 0.4 | 0.4 | 8200 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mgkg | 0.012 | 0.041 | 0.01844 | 0.0150 | 6.3 | 82 | 0.0012 | 0.0012 | 82 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mgkg | 0.0098 | 0.034 | 0.01518 | 0.0120 | 19 | 250 | 0.0023 | 0.0023 | 250 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mgkg | 0.092 | 0.32 | 0.14131 | 0.1100 | 130 | 1600 | 0.042 | 0.042 | 1600 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mgkg | 0.31 | 1.1 | 0.48625 | 0.3900 | 13 | 160 | 0.0044 | 0.0044 | 160 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mgkg | 0.016 | 0.058 | 0.02556 | 0.0205 | 1.7 | 7.4 | 0.00032 | 0.00032 | 7.4 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mgkg | 0.022 | 0.078 | 0.03444 | 0.0280 | 0.36 | 1.5 | 0.000067 | 0.000067 | 1.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mgkg | 0.0094 | 0.033 | 0.01459 | 0.0120 | 480 | 6000 | 0.39 | 0.39 | 6000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mgkg | 0.011 | 0.037 | 0.01644 | 0.0130 | 39 | 580 | 0.0089 | 0.0089 | 580 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mgkg | 0.0092 | 0.032 | 0.01426 | 0.0110 | 24 | 300 | 0.019 | 0.019 | 300 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mgkg | 0.018 | 0.064 | 0.02825 | 0.0230 | 320 | 4100 | 0.075 | 0.075 | 4100 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mgkg | 0.014 | 0.048 | 0.02125 | 0.0170 | 63 | 800 | 0.008 | 0.008 | 800 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mgkg | 0.014 | 0.049 | 0.02163 | 0.0170 | | | | | |

**Table 13. Sampling Analyses and MDLs for Sediment – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | mgkg | 0.011 | 0.039 | 0.01725 | 0.0140 | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mgkg | 0.046 | 0.16 | 0.07138 | 0.0580 | 1.2 | 5.1 | 0.00082 | 0.00082 | 5.1 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mgkg | 0.012 | 0.043 | 0.01900 | 0.0150 | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mgkg | 0.11 | 0.39 | 0.17250 | 0.1400 | 0.51 | 6.6 | 0.00026 | 0.00026 | 6.6 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mgkg | 0.013 | 0.046 | 0.02025 | 0.0160 | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mgkg | 0.018 | 0.063 | 0.02763 | 0.0220 | 630 | 8200 | 0.17 | 0.17 | 8200 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mgkg | 0.011 | 0.038 | 0.01663 | 0.0130 | 2.7 | 11 | 0.00016 | 0.00016 | 11 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mgkg | 0.012 | 0.044 | 0.01925 | 0.0155 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mgkg | 0.016 | 0.055 | 0.02444 | 0.0200 | 25 | 110 | 0.0016 | 0.0016 | 110 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mgkg | 0.2 | 0.7 | 0.31000 | 0.2500 | | | | | |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mgkg | 0.01 | 0.035 | 0.01563 | 0.0130 | 360 | 4500 | 0.55 | 0.55 | 4500 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mgkg | 0.011 | 0.038 | 0.01663 | 0.0130 | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mgkg | 0.0091 | 0.032 | 0.01406 | 0.0110 | 780 | 12000 | 0.058 | 0.058 | 12000 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mgkg | 0.04 | 0.14 | 0.06119 | 0.0490 | 1800 | 23000 | 5.8 | 5.8 | 23000 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mgkg | 0.019 | 0.065 | 0.02863 | 0.0230 | 2.4 | 10 | 0.0002 | 0.0002 | 10 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mgkg | 0.032 | 0.11 | 0.04925 | 0.0395 | 170 | 820 | 0.0041 | 0.0041 | 820 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mgkg | 0.035 | 0.12 | 0.05375 | 0.0430 | 1.1 | 21 | 0.011 | 0.011 | 21 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mgkg | 0.013 | 0.044 | 0.01956 | 0.0160 | 0.11 | 2.1 | 0.029 | 0.029 | 2.1 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mgkg | 0.016 | 0.057 | 0.02519 | 0.0200 | 1.1 | 21 | 0.3 | 0.3 | 21 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mgkg | 0.024 | 0.084 | 0.03713 | 0.0300 | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mgkg | 0.018 | 0.064 | 0.02825 | 0.0230 | 1.6 | 210 | 2.9 | 1.6 | 210 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mgkg | 0.013 | 0.045 | 0.02000 | 0.0160 | 19 | 250 | 0.0013 | 0.0013 | 250 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mgkg | 0.0098 | 0.034 | 0.01518 | 0.0120 | 0.23 | 1 | 0.0000036 | 0.0000036 | 1 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mgkg | 0.016 | 0.057 | 0.02519 | 0.0200 | 39 | 160 | 1.3 | 1.3 | 160 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mgkg | 0.013 | 0.045 | 0.01994 | 0.0160 | 290 | 1200 | 0.24 | 0.24 | 1200 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mgkg | 0.03 | 0.11 | 0.04675 | 0.0370 | 3100 | 40000 | 0.25 | 0.25 | 40000 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mgkg | 0.01 | 0.036 | 0.01606 | 0.0130 | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mgkg | 0.011 | 0.04 | 0.01756 | 0.0140 | 110 | 2100 | 9 | 9 | 2100 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mgkg | 0.022 | 0.076 | 0.03363 | 0.0270 | 0.11 | 2.1 | 0.096 | 0.096 | 2.1 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mgkg | 0.013 | 0.044 | 0.01956 | 0.0160 | 7.3 | 100 | 0.015 | 0.015 | 100 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mgkg | 0.012 | 0.041 | 0.01844 | 0.0150 | 5100 | 66000 | 0.61 | 0.61 | 66000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mgkg | 0.012 | 0.042 | 0.01875 | 0.0150 | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mgkg | 0.012 | 0.044 | 0.01925 | 0.0155 | 630 | 8200 | 0.23 | 0.23 | 8200 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mgkg | 0.021 | 0.074 | 0.03275 | 0.0260 | 63 | 820 | 5.7 | 5.7 | 820 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mgkg | 0.012 | 0.043 | 0.01900 | 0.0150 | 240 | 3000 | 8.9 | 8.9 | 3000 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mgkg | 0.0091 | 0.032 | 0.01406 | 0.0110 | 240 | 3000 | 0.54 | 0.54 | 3000 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mgkg | 0.017 | 0.059 | 0.02619 | 0.0210 | 0.21 | 0.96 | 0.00012 | 0.00012 | 0.96 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mgkg | 0.012 | 0.041 | 0.01819 | 0.0150 | 1.2 | 5.3 | 0.00027 | 0.00027 | 5.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mgkg | 0.026 | 0.091 | 0.04019 | 0.0320 | 0.18 | 0.75 | 0.00013 | 0.00013 | 0.75 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mgkg | 0.015 | 0.053 | 0.02369 | 0.0190 | 1.8 | 8 | 0.0002 | 0.0002 | 8 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mgkg | 0.028 | 0.097 | 0.04294 | 0.0345 | 1.1 | 21 | 0.98 | 0.98 | 21 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mgkg | 0.0089 | 0.031 | 0.01391 | 0.0110 | 570 | 2400 | 0.026 | 0.026 | 2400 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mgkg | 0.011 | 0.037 | 0.01644 | 0.0130 | 3.8 | 17 | 0.00054 | 0.00054 | 17 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mgkg | 0.013 | 0.046 | 0.02025 | 0.0160 | 5.1 | 22 | 0.000092 | 0.000092 | 22 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mgkg | 0.014 | 0.049 | 0.02163 | 0.0170 | 0.078 | 0.33 | 0.0000081 | 0.0000081 | 0.33 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mgkg | 0.038 | 0.13 | 0.05844 | 0.0470 | 110 | 470 | 0.067 | 0.067 | 470 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mgkg | 0.05 | 0.18 | 0.07844 | 0.0630 | 1 | 4 | 0.000057 | 0.000057 | 4 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mgkg | 0.011 | 0.039 | 0.01725 | 0.0140 | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | mgkg | 0.014 | 0.048 | 0.02119 | 0.0170 | 1900 | 25000 | 0.33 | 0.33 | 25000 |

**Table 13. Sampling Analyses and MDLs for Sediment – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mgkg | 0.019 | 0.066 | 0.02938 | 0.0235 | 180 | 2300 | 1.3 | 1.3 | 2300 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | mgkg | 0.00024 | 0.0019 | 0.00053 | 0.0003 | 810 | 3600 | 0.28 | 0.28 | 3600 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | mgkg | 0.00022 | 0.0017 | 0.00049 | 0.0003 | 0.6 | 2.7 | 0.00003 | 0.00003 | 2.7 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | mgkg | 0.00031 | 0.0024 | 0.00068 | 0.0004 | 670 | 2800 | 2.6 | 2.6 | 2800 |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | 0.15 | 0.63 | 0.000013 | 0.000013 | 0.63 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | mgkg | 0.00021 | 0.0017 | 0.00047 | 0.0003 | 3.6 | 16 | 0.00078 | 0.00078 | 16 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | mgkg | 0.00023 | 0.0018 | 0.00051 | 0.0003 | 23 | 100 | 0.01 | 0.01 | 100 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | mgkg | 0.00018 | 0.0015 | 0.00041 | 0.0002 | 6.3 | 93 | 0.0021 | 0.0021 | 93 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | mgkg | 9.4E-05 | 0.00074 | 0.00021 | 0.0001 | 5.8 | 26 | 0.0012 | 0.0012 | 26 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | mgkg | 0.00047 | 0.0037 | 0.00104 | 0.0006 | 0.0053 | 0.064 | 0.00000014 | 0.00000014 | 0.064 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | 180 | 930 | 0.03 | 0.03 | 930 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | mgkg | 0.0003 | 0.0024 | 0.00068 | 0.0004 | 0.46 | 2 | 0.000048 | 0.000048 | 2 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | mgkg | 0.00043 | 0.0034 | 0.00097 | 0.0006 | 1.6 | 6.6 | 0.00027 | 0.00027 | 6.6 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | mgkg | 0.00016 | 0.0013 | 0.00036 | 0.0002 | | | | | |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | mgkg | 0.0001 | 0.0008 | 0.00023 | 0.0001 | 2.6 | 11 | 0.00046 | 0.00046 | 11 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | mgkg | 0.0011 | 0.0089 | 0.00251 | 0.0015 | 2700 | 19000 | 0.12 | 0.12 | 19000 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | mgkg | 0.0008 | 0.0063 | 0.00178 | 0.0011 | 20 | 130 | 0.00088 | 0.00088 | 130 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | mgkg | 0.00068 | 0.0053 | 0.00150 | 0.0009 | 3300 | 14000 | 0.14 | 0.14 | 14000 |
| VOC | 67-64-1 | Acetone | T | 8260B | mgkg | 0.0039 | 0.03 | 0.00859 | 0.0052 | 6100 | 67000 | 0.29 | 0.29 | 67000 |
| VOC | 71-43-2 | Benzene | T | 8260B | mgkg | 0.00026 | 0.0021 | 0.00059 | 0.0004 | 1.2 | 5.1 | 0.00023 | 0.00023 | 5.1 |
| VOC | 75-25-2 | Bromoform | T | 8260B | mgkg | 0.00043 | 0.0034 | 0.00097 | 0.0006 | 19 | 86 | 0.00087 | 0.00087 | 86 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | mgkg | 0.00048 | 0.0038 | 0.00107 | 0.0007 | 0.68 | 3 | 0.00019 | 0.00019 | 3 |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | mgkg | 0.00027 | 0.0021 | 0.00060 | 0.0004 | 77 | 350 | 0.024 | 0.024 | 350 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | mgkg | 0.00018 | 0.0015 | 0.00041 | 0.0002 | 0.65 | 2.9 | 0.00018 | 0.00018 | 2.9 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | 28 | 130 | 0.0053 | 0.0053 | 130 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | mgkg | 0.00029 | 0.0023 | 0.00064 | 0.0004 | 15 | 63 | 0.0021 | 0.0021 | 63 |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | mgkg | 0.0002 | 0.0016 | 0.00044 | 0.0003 | 8.3 | 39 | 0.00023 | 0.00023 | 39 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | mgkg | 0.00053 | 0.0042 | 0.00118 | 0.0007 | 1400 | 5700 | 0.59 | 0.59 | 5700 |
| VOC | 67-66-3 | Chloroform | T | 8260B | mgkg | 0.00033 | 0.0026 | 0.00072 | 0.0004 | 0.32 | 1.4 | 0.000061 | 0.000061 | 1.4 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | mgkg | 0.00044 | 0.0035 | 0.00098 | 0.0006 | 11 | 46 | 0.0049 | 0.0049 | 46 |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | mgkg | 0.00016 | 0.0012 | 0.00034 | 0.0002 | 16 | 230 | 0.0011 | 0.0011 | 230 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | mgkg | 0.00028 | 0.0022 | 0.00062 | 0.0004 | | | | | |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | mgkg | 0.00023 | 0.0018 | 0.00050 | 0.0003 | 650 | 2700 | 1.3 | 1.3 | 2700 |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | mgkg | 0.00026 | 0.0021 | 0.00059 | 0.0004 | 0.29 | 1.3 | 0.000036 | 0.000036 | 1.3 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | mgkg | 0.00034 | 0.0027 | 0.00076 | 0.0005 | 8.7 | 37 | 0.03 | 0.03 | 37 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | mgkg | 0.0002 | 0.0016 | 0.00045 | 0.0003 | 5.8 | 25 | 0.0017 | 0.0017 | 25 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00041 | 0.0002 | 0.036 | 0.16 | 0.0000021 | 0.0000021 | 0.16 |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | mgkg | 0.00013 | 0.001 | 0.00029 | 0.0002 | 190 | 990 | 0.074 | 0.074 | 990 |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | mgkg | 0.0044 | 0.035 | 0.00979 | 0.0059 | 7800 | 120000 | 0.41 | 0.41 | 120000 |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | mgkg | 0.00013 | 0.001 | 0.00028 | 0.0002 | 47 | 210 | 0.0032 | 0.0032 | 210 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | mgkg | 0.00016 | 0.0013 | 0.00036 | 0.0002 | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | mgkg | 0.00017 | 0.0013 | 0.00037 | 0.0002 | 35 | 320 | 0.0027 | 0.0027 | 320 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | 56 | 240 | | 56 | 240 |
| VOC | 95-47-6 | o-Xylene | T | 8260B | mgkg | 9.7E-05 | 0.00076 | 0.00021 | 0.0001 | 65 | 280 | 0.019 | 0.019 | 280 |
| VOC | 100-42-5 | Styrene | T | 8260B | mgkg | 0.00013 | 0.00099 | 0.00028 | 0.0002 | 600 | 3500 | 0.13 | 0.13 | 3500 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | 8.1 | 39 | 0.0018 | 0.0018 | 39 |
| VOC | 108-88-3 | Toluene | T | 8260B | mgkg | 0.00064 | 0.005 | 0.00141 | 0.0009 | 490 | 4700 | 0.076 | 0.076 | 4700 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | mgkg | 0.00025 | 0.002 | 0.00056 | 0.0003 | 160 | 2300 | 0.011 | 0.011 | 2300 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | mgkg | 0.00027 | 0.0021 | 0.00060 | 0.0004 | | | | | |

**Table 13. Sampling Analyses and MDLs for Sediment – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | 0.41 | 1.9 | 0.0001 | 0.0001 | 1.9 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | mgkg | 0.00041 | 0.0033 | 0.00092 | 0.0006 | 2300 | 35000 | 0.33 | 0.33 | 35000 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | mgkg | 0.00056 | 0.0044 | 0.00124 | 0.0007 | 0.059 | 1.7 | 0.0000065 | 0.0000065 | 1.7 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | |
| Metals | 7439-97-6 | Mercury SEM | T | 7470A | mg/Kg | 0.00500 | 0.00163 | | | 1.1 | 4.6 | 0.0033 | 0.0033 | 4.6 |
| Metals | STL00343 | SEM/AVS Ratio | T | SEM | NONE | 0.00100 | 0.00100 | | | | | | | |
| Metals | 7440-43-9 | Cadmium SEM | T | 6010C | mg/Kg | 0.125 | 0.00625 | | | | | | | |
| Metals | 7440-50-8 | Copper SEM | T | 6010C | mg/Kg | 0.625 | 0.0841 | | | 310 | 4700 | 2.8 | 2.8 | 4700 |
| Metals | 7439-92-1 | Lead SEM | T | 6010C | mg/Kg | 0.250 | 0.0766 | | | 400 | 800 | | 400 | 800 |
| Metals | 7440-66-6 | Zinc SEM | T | 6010C | mg/Kg | 2.50 | 0.172 | | | 2300 | 35000 | 37 | 37 | 35000 |
| Metals | 7440-02-0 | Nickel SEM | T | 6010C | mg/Kg | 1.00 | 0.0809 | | | 150 | 2200 | 2.6 | 2.6 | 2200 |
| GenChem | 18496-25-8 | Acid Volatile Sulfides (AVS) | T | 9034_Calc_AVS | mg/Kg | 30.0 | 10.0 | 15.0 | | | | | | |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/Kg | 0.0330 | 0.00140 | | | 4.7 | 20 | 0.00087 | 0.00087 | 20 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/Kg | 0.0330 | 0.00144 | | | 2.3 | 35 | 0.00079 | 0.00079 | 35 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/Kg | 0.0667 | 0.0104 | | | 5.3 | 24 | 0.000094 | 0.000094 | 24 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/Kg | 0.00670 | 0.00247 | | | 310 | 4700 | 0.026 | 0.026 | 4700 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.0139 | | | 190 | 2500 | 0.018 | 0.018 | 2500 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00238 | | | 630 | 8200 | 0.4 | 0.4 | 8200 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00183 | | | 6.3 | 82 | 0.0012 | 0.0012 | 82 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/Kg | 0.00670 | 0.00257 | | | 19 | 250 | 0.0023 | 0.0023 | 250 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00207 | | | 130 | 1600 | 0.042 | 0.042 | 1600 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/Kg | 0.330 | 0.0897 | | | 13 | 160 | 0.0044 | 0.0044 | 160 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00166 | | | 1.7 | 7.4 | 0.00032 | 0.00032 | 7.4 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00206 | | | 0.36 | 1.5 | 0.000067 | 0.000067 | 1.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00153 | | | 480 | 6000 | 0.39 | 0.39 | 6000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00155 | | | 39 | 580 | 0.0089 | 0.0089 | 580 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00160 | | | 24 | 300 | 0.019 | 0.019 | 300 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00956 | | | 320 | 4100 | 0.075 | 0.075 | 4100 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.0152 | | | 63 | 800 | 0.008 | 0.008 | 800 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/Kg | 0.0330 | 0.00191 | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/Kg | 0.0330 | 0.0311 | | | 1.2 | 5.1 | 0.00082 | 0.00082 | 5.1 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00848 | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/Kg | 0.170 | 0.0575 | | | 0.51 | 6.6 | 0.00026 | 0.00026 | 6.6 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00233 | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00157 | | | 630 | 8200 | 0.17 | 0.17 | 8200 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/Kg | 0.0330 | 0.00111 | | | 2.7 | 11 | 0.00016 | 0.00016 | 11 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00202 | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00162 | | | 25 | 110 | 0.0016 | 0.0016 | 110 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/Kg | 0.170 | 0.0234 | | | | | | | |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/Kg | 0.00670 | 0.00192 | | | 360 | 4500 | 0.55 | 0.55 | 4500 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/Kg | 0.00670 | 0.00146 | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/Kg | 0.0670 | 0.00181 | | | 780 | 12000 | 0.058 | 0.058 | 12000 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00173 | | | 1800 | 23000 | 5.8 | 5.8 | 23000 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/Kg | 0.0670 | 0.0146 | | | 2.4 | 10 | 0.0002 | 0.0002 | 10 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/Kg | 0.0670 | 0.00414 | | | 170 | 820 | 0.0041 | 0.0041 | 820 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00126 | | | 1.1 | 21 | 0.011 | 0.011 | 21 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00145 | | | 0.11 | 2.1 | 0.029 | 0.029 | 2.1 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00164 | | | 1.1 | 21 | 0.3 | 0.3 | 21 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/Kg | 0.00670 | 0.00144 | | | | | | | |

**Table 13. Sampling Analyses and MDLs for Sediment – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | Residential | Industrial | Protection GW | Minimum Screening Level | Maximum Screening Level |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00200 | | | 1.6 | 210 | 2.9 | 1.6 | 210 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/Kg | 0.0330 | 0.00159 | | | 19 | 250 | 0.0013 | 0.0013 | 250 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/Kg | 0.00670 | 0.00121 | | | 0.23 | 1 | 0.0000036 | 0.0000036 | 1 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/Kg | 0.330 | 0.0355 | | | 39 | 160 | 1.3 | 1.3 | 160 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0229 | | | 290 | 1200 | 0.24 | 0.24 | 1200 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/Kg | 0.170 | 0.0217 | | | 3100 | 40000 | 0.25 | 0.25 | 40000 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/Kg | 0.00670 | 0.00156 | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 110 | 2100 | 9 | 9 | 2100 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00149 | | | 0.11 | 2.1 | 0.096 | 0.096 | 2.1 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/Kg | 0.0330 | 0.00146 | | | 7.3 | 100 | 0.015 | 0.015 | 100 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0100 | | | 5100 | 66000 | 0.61 | 0.61 | 66000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.00121 | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0146 | | | 630 | 8200 | 0.23 | 0.23 | 8200 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0194 | | | 63 | 820 | 5.7 | 5.7 | 820 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00176 | | | 240 | 3000 | 8.9 | 8.9 | 3000 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 240 | 3000 | 0.54 | 0.54 | 3000 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/Kg | 0.00670 | 0.00239 | | | 0.21 | 0.96 | 0.00012 | 0.00012 | 0.96 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/Kg | 0.00670 | 0.00195 | | | 1.2 | 5.3 | 0.00027 | 0.00027 | 5.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 0.18 | 0.75 | 0.00013 | 0.00013 | 0.75 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/Kg | 0.0330 | 0.00172 | | | 1.8 | 8 | 0.0002 | 0.0002 | 8 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00135 | | | 1.1 | 21 | 0.98 | 0.98 | 21 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 570 | 2400 | 0.026 | 0.026 | 2400 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00130 | | | 3.8 | 17 | 0.00054 | 0.00054 | 17 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/Kg | 0.0667 | 0.0122 | | | 5.1 | 22 | 0.000092 | 0.000092 | 22 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/Kg | 0.00670 | 0.00226 | | | 0.078 | 0.33 | 0.0000081 | 0.0000081 | 0.33 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/Kg | 0.0330 | 0.0111 | | | 110 | 470 | 0.067 | 0.067 | 470 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/Kg | 0.170 | 0.0536 | | | 1 | 4 | 0.000057 | 0.000057 | 4 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/Kg | 0.00670 | 0.00179 | | | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/Kg | 0.0330 | 0.0101 | | | 1900 | 25000 | 0.33 | 0.33 | 25000 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00158 | | | 180 | 2300 | 1.3 | 1.3 | 2300 |

**Table 14. Sampling Analyses and MDLs for Sediment – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | USEPA Region 5 RCRA Ecological Screening Levels (USEPA 2003) | Ingersoll, et al. (1996); Threshold Effect Level (TEL) and Probable Effect Level (PEL) for total extraction of sediment (BT) samples from Hyalella azteca 28-day (HA28) tests. | MacDonald et al. (2000); consensus-based threshold effect concentration (TEC) and probable effect concentration (PEC). | USEPA Region 3 Freshwater Sediment Screening Benchmarks (USEPA 2006) | Derived based on the equilibrium partitioning (EqP) approach normalized to 1% TOC. | From Table 3-4 in EPA (2003); column titled "Coc, PAHi, FCVi (µg/goc)" normalized to 1% TOC and adjusted to ppm. | Minimum ESV | Maximum ESV |
| | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00179 | Corrosivity | T | 9045D | pH Units | | | | | | | | | | | | |
| GenChem | 16984-48-8 | Fluoride | D | 9056A | mgkg | 1.83 | 6.76 | 2.94313 | 2.2950 | | | | | | | | |
| GenChem | STL00204 | pH | T | 9045D | pH Units | | | | | | | | | | | | |
| GenChem | STL00338 | Total Organic Carbon (1) | T | Lloyd Kahn | mgkg | 86.3 | 302 | 133.81875 | 107.5000 | | | | | | | | |
| Metals | 7429-90-5 | Aluminum | T | 6020A | mgkg | 9 | 29.6 | 14.90625 | 13.4000 | | 26000 | | | | | 26000 | 26000 |
| Metals | 7440-36-0 | Antimony | T | 6020A | mgkg | 0.32 | 1.1 | 0.53375 | 0.4750 | | | | 2 | | | 2 | 2 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | mgkg | 0.32 | 1.1 | 0.53750 | 0.4800 | 9.79 | 10.787 | 9.79 | 9.8 | | | 9.79 | 10.787 |
| Metals | 7440-39-3 | Barium | T | 6020A | mgkg | 0.63 | 2.1 | 1.05063 | 0.9450 | | | | | | | | |
| Metals | 7440-41-7 | Beryllium | T | 6020A | mgkg | 0.097 | 0.32 | 0.16231 | 0.1450 | | | | | | | | |
| Metals | 7440-43-9 | Cadmium | T | 6020A | mgkg | 0.34 | 1.1 | 0.55813 | 0.5050 | 0.99 | 0.583 | 0.99 | 0.99 | | | 0.583 | 0.99 |
| Metals | 7440-70-2 | Calcium | T | 6020A | mgkg | 43.7 | 144 | 72.73125 | 65.4000 | | | | | | | | |
| Metals | 7440-47-3 | Chromium | T | 6020A | mgkg | 0.6 | 2 | 1.00375 | 0.9050 | 43.4 | 36.2 | 43.4 | 43.4 | | | 36.2 | 43.4 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | mgkg | 0.61 | 2 | 1.01250 | 0.9050 | 50 | | | 50 | | | 50 | 50 |
| Metals | 7440-50-8 | Copper | T | 6020A | mgkg | 0.61 | 2 | 1.01750 | 0.9150 | 31.6 | 28 | 31.6 | 31.6 | | | 28 | 31.6 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | mgkg | 0.42 | 0.64 | 0.49000 | 0.4650 | | | | | | | | |
| Metals | 57-12-5 | Cyanide, Total | T | 9012B | mgkg | 0.076 | 0.26 | 0.11563 | 0.0925 | 0.0001 | | | 0.1 | | | 0.0001 | 0.1 |
| Metals | 7439-89-6 | Iron | T | 6020A | mgkg | 19 | 62.8 | 31.61250 | 28.4500 | | 188400 | | 20000 | | | 20000 | 188400 |
| Metals | 7439-92-1 | Lead | T | 6020A | mgkg | 0.18 | 0.59 | 0.29938 | 0.2700 | 35.8 | 37.2 | 35.8 | 35.8 | | | 35.8 | 37.2 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | mgkg | 30.2 | 100 | 50.34375 | 45.2500 | | | | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | mgkg | 1.2 | 4 | 2.03125 | 1.8000 | | 631 | | 460 | | | 460 | 631 |
| Metals | 7439-97-6 | Mercury | T | 7471B | mgkg | 0.013 | 0.045 | 0.02038 | 0.0165 | 0.174 | | 0.18 | 0.18 | | | 0.174 | 0.18 |
| Metals | 7440-02-0 | Nickel | T | 6020A | mgkg | 0.61 | 2 | 1.02000 | 0.9150 | 22.7 | 19.5 | 22.7 | 22.7 | | | 19.5 | 22.7 |
| Metals | 7440-09-7 | Potassium | T | 6020A | mgkg | 29.7 | 98.1 | 49.40000 | 44.4500 | | | | | | | | |
| Metals | 7782-49-2 | Selenium | T | 6020A | mgkg | 0.3 | 0.98 | 0.49375 | 0.4450 | | | | 2 | | | 2 | 2 |
| Metals | 7440-22-4 | Silver | T | 6020A | mgkg | 0.62 | 2.1 | 1.03563 | 0.9350 | 0.5 | | | 1 | | | 0.5 | 1 |
| Metals | 7440-23-5 | Sodium | T | 6020A | mgkg | 43.1 | 143 | 71.78125 | 64.5500 | | | | | | | | |
| Metals | 7440-28-0 | Thallium | T | 6020A | mgkg | 0.13 | 0.42 | 0.20875 | 0.1900 | | | | | | | | |
| Metals | 7440-62-2 | Vanadium | T | 6020A | mgkg | 0.88 | 2.9 | 1.46063 | 1.3000 | | | | | | | | |
| Metals | 7440-66-6 | Zinc | T | 6020A | mgkg | 3.2 | 10.5 | 5.30625 | 4.7500 | 121 | 98 | 121 | 121 | | | 98 | 121 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mgkg | 0.035 | 0.12 | 0.05463 | 0.0440 | | | | 1.22 | | | 1.22 | 1.22 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mgkg | 0.031 | 0.11 | 0.04819 | 0.0385 | | | | | | | | |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mgkg | 0.11 | 0.39 | 0.17250 | 0.1400 | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mgkg | 0.017 | 0.06 | 0.02644 | 0.0210 | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mgkg | 0.039 | 0.14 | 0.06069 | 0.0490 | 0.129 | | | 0.284 | | | 0.129 | 0.284 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mgkg | 0.041 | 0.15 | 0.06438 | 0.0515 | | | | | 0.288 | | 0.288 | 0.288 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mgkg | 0.012 | 0.041 | 0.01844 | 0.0150 | 0.208 | | | 0.213 | | | 0.208 | 0.213 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mgkg | 0.0098 | 0.034 | 0.01518 | 0.0120 | 0.0817 | | | 0.117 | | | 0.0817 | 0.117 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mgkg | 0.092 | 0.32 | 0.14131 | 0.1100 | 0.304 | | | 0.029 | | | 0.029 | 0.304 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mgkg | 0.31 | 1.1 | 0.48625 | 0.3900 | 0.00621 | | | | | | 0.00621 | 0.00621 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mgkg | 0.016 | 0.058 | 0.02556 | 0.0205 | 0.0144 | | | 0.0416 | | | 0.0144 | 0.0416 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mgkg | 0.022 | 0.078 | 0.03444 | 0.0280 | 0.0398 | | | | | | 0.0398 | 0.0398 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mgkg | 0.0094 | 0.033 | 0.01459 | 0.0120 | 0.417 | | | | | | 0.417 | 0.417 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mgkg | 0.011 | 0.037 | 0.01644 | 0.0130 | 0.0319 | | | 0.0312 | 0.02716 | | 0.02716 | 0.0319 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mgkg | 0.0092 | 0.032 | 0.01426 | 0.0110 | 0.0202 | | | 0.0202 | | 4.47 | 0.0202 | 4.47 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mgkg | 0.018 | 0.064 | 0.02825 | 0.0230 | | | | | 0.011856 | | 0.011856 | 0.011856 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mgkg | 0.014 | 0.048 | 0.02125 | 0.0170 | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mgkg | 0.014 | 0.049 | 0.02163 | 0.0170 | | | | | | | | |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | mgkg | 0.011 | 0.039 | 0.01725 | 0.0140 | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mgkg | 0.046 | 0.16 | 0.07138 | 0.0580 | 0.127 | | | | | | 0.127 | 0.127 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mgkg | 0.012 | 0.043 | 0.01900 | 0.0150 | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mgkg | 0.11 | 0.39 | 0.17250 | 0.1400 | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mgkg | 0.013 | 0.046 | 0.02025 | 0.0160 | 1.55 | | | 1.23 | 0.255 | | 0.255 | 1.55 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mgkg | 0.018 | 0.063 | 0.02763 | 0.0220 | 0.388 | | | | | | 0.388 | 0.388 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mgkg | 0.011 | 0.038 | 0.01663 | 0.0130 | 0.146 | | | | | | 0.146 | 0.146 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mgkg | 0.012 | 0.044 | 0.01925 | 0.0155 | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mgkg | 0.016 | 0.055 | 0.02444 | 0.0200 | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mgkg | 0.2 | 0.7 | 0.31000 | 0.2500 | 0.013 | | | | | | 0.013 | 0.013 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mgkg | 0.01 | 0.035 | 0.01563 | 0.0130 | 0.00671 | | | 0.00671 | | 4.91 | 0.00671 | 4.91 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mgkg | 0.011 | 0.038 | 0.01663 | 0.0130 | 0.00587 | | | 0.0059 | | 4.52 | 0.00587 | 4.52 |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mgkg | 0.0091 | 0.032 | 0.01406 | 0.0110 | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mgkg | 0.04 | 0.14 | 0.06119 | 0.0490 | 0.0572 | 0.01 | 0.0572 | 0.0572 | | 5.94 | 0.01 | 5.94 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mgkg | 0.019 | 0.065 | 0.02863 | 0.0230 | | | | 0.00662 | | | 0.00662 | 0.00662 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mgkg | 0.032 | 0.11 | 0.04925 | 0.0395 | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mgkg | 0.035 | 0.12 | 0.05375 | 0.0430 | 0.108 | 0.016 | 0.108 | 0.108 | | 8.41 | 0.016 | 8.41 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mgkg | 0.013 | 0.044 | 0.01956 | 0.0160 | 0.15 | 0.032 | 0.15 | 0.15 | | 9.65 | 0.032 | 9.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mgkg | 0.016 | 0.057 | 0.02519 | 0.0200 | 10.4 | | | | | 9.79 | 9.79 | 10.4 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mgkg | 0.024 | 0.084 | 0.03713 | 0.0300 | 0.17 | 0.016 | | 0.17 | | 10.95 | 0.016 | 10.95 |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mgkg | 0.018 | 0.064 | 0.02825 | 0.0230 | 0.24 | | | 0.24 | | 9.81 | 0.24 | 9.81 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mgkg | 0.013 | 0.045 | 0.02000 | 0.0160 | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mgkg | 0.0098 | 0.034 | 0.01518 | 0.0120 | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mgkg | 0.016 | 0.057 | 0.02519 | 0.0200 | 0.182 | | | 0.18 | 453 | | 0.18 | 453 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mgkg | 0.013 | 0.045 | 0.01994 | 0.0160 | 1.97 | | | 10.9 | 10.925 | | 1.97 | 10.925 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mgkg | 0.03 | 0.11 | 0.04675 | 0.0370 | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mgkg | 0.01 | 0.036 | 0.01606 | 0.0130 | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mgkg | 0.011 | 0.04 | 0.01756 | 0.0140 | 0.166 | 0.027 | 0.166 | 0.166 | | 8.44 | 0.027 | 8.44 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mgkg | 0.022 | 0.076 | 0.03363 | 0.0270 | | 0.01 | 0.033 | 0.033 | | 11.23 | 0.01 | 11.23 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mgkg | 0.013 | 0.044 | 0.01956 | 0.0160 | 0.449 | | | 0.415 | 0.300736 | | 0.300736 | 0.449 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mgkg | 0.012 | 0.041 | 0.01844 | 0.0150 | | | | 0.603 | 0.6048 | | 0.603 | 0.6048 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mgkg | 0.012 | 0.042 | 0.01875 | 0.0150 | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mgkg | 0.012 | 0.044 | 0.01925 | 0.0155 | | | | 6.47 | 1.1989 | | 1.1989 | 6.47 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mgkg | 0.021 | 0.074 | 0.03275 | 0.0260 | | | | | 16.8858 | | 16.8858 | 16.8858 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mgkg | 0.012 | 0.043 | 0.01900 | 0.0150 | 0.423 | 0.031 | 0.423 | 0.423 | | 7.07 | 0.031 | 7.07 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mgkg | 0.0091 | 0.032 | 0.01406 | 0.0110 | 0.0774 | 0.01 | 0.0774 | 0.0774 | | 5.38 | 0.01 | 5.38 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mgkg | 0.017 | 0.059 | 0.02619 | 0.0210 | 0.02 | | | 0.02 | | | 0.02 | 0.02 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mgkg | 0.012 | 0.041 | 0.01819 | 0.0150 | 0.0265 | | | | 0.6981 | | 0.0265 | 0.6981 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mgkg | 0.026 | 0.091 | 0.04019 | 0.0320 | 0.901 | | | | | | 0.901 | 0.901 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mgkg | 0.015 | 0.053 | 0.02369 | 0.0190 | 0.584 | | | 1.027 | 0.2136 | | 0.2136 | 1.027 |

**Table 14. Sampling Analyses and MDLs for Sediment – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | USEPA Region 5 RCRA Ecological Screening Levels (USEPA 2003) | Ingersoll, et al. (1996); Threshold Effect Level (TEL) and Probable Effect Level (PEL) for total extraction of sediment (BT) samples from Hyalella azteca 28-day (HA28) tests. | MacDonald et al. (2000); consensus-based threshold effect concentration (TEC) and probable effect concentration (PEC). | USEPA Region 3 Freshwater Sediment Screening Benchmarks (USEPA 2006) | Derived based on the equilibrium partitioning (EqP) approach normalized to 1% TOC. | From Table 3-4 in EPA (2003); column titled "Coc, PAHi, FCVi (µg/goc)" normalized to 1% TOC and adjusted to ppm. | Minimum ESV | Maximum ESV |
| | | | | | | | | | | A | B | C | D | E | F | | |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mgkg | 0.028 | 0.097 | 0.04294 | 0.0345 | 0.2 | 0.017 | | 0.017 | | 11.15 | 0.017 | 11.15 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mgkg | 0.0089 | 0.031 | 0.01391 | 0.0110 | 0.432 | | | | | | 0.432 | 0.432 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mgkg | 0.011 | 0.037 | 0.01644 | 0.0130 | 0.176 | 0.015 | 0.176 | 0.176 | | 3.85 | 0.015 | 3.85 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mgkg | 0.013 | 0.046 | 0.02025 | 0.0160 | 0.145 | | | | | | 0.145 | 0.145 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mgkg | 0.014 | 0.049 | 0.02163 | 0.0170 | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mgkg | 0.038 | 0.13 | 0.05844 | 0.0470 | | | | | 0.516 | | 0.516 | 0.516 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mgkg | 0.05 | 0.18 | 0.07844 | 0.0630 | 23 | | | 0.504 | | | 0.504 | 23 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mgkg | 0.011 | 0.039 | 0.01725 | 0.0140 | 0.204 | 0.019 | 0.204 | 0.204 | | 5.96 | 0.019 | 5.96 |
| SVOC | 108-95-2 | Phenol | T | 8270D | mgkg | 0.014 | 0.048 | 0.02119 | 0.0170 | 0.0491 | | | 0.42 | 0.001152 | | 0.001152 | 0.42 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mgkg | 0.019 | 0.066 | 0.02938 | 0.0235 | 0.195 | 0.044 | 0.195 | 0.195 | | 6.97 | 0.044 | 6.97 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | mgkg | 0.00024 | 0.0019 | 0.00053 | 0.0003 | | | | | | | | |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | mgkg | 0.00022 | 0.0017 | 0.00049 | 0.0003 | | | | | | | | |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | mgkg | 0.00031 | 0.0024 | 0.00068 | 0.0004 | | | | | | | | |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | | | | | | | | |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | mgkg | 0.00021 | 0.0017 | 0.00047 | 0.0003 | | | | | | | | |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | mgkg | 0.00023 | 0.0018 | 0.00051 | 0.0003 | | | | | | | | |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | mgkg | 0.00018 | 0.0015 | 0.00041 | 0.0002 | | | | | | | | |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | mgkg | 9.4E-05 | 0.00074 | 0.00021 | 0.0001 | | | | | | | | |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | mgkg | 0.00047 | 0.0037 | 0.00104 | 0.0006 | | | | | | | | |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | | | | | | | | |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | mgkg | 0.0003 | 0.0024 | 0.00068 | 0.0004 | | | | | | | | |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | mgkg | 0.00043 | 0.0034 | 0.00097 | 0.0006 | | | | | | | | |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | mgkg | 0.00016 | 0.0013 | 0.00036 | 0.0002 | | | | | | | | |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | mgkg | 0.0001 | 0.0008 | 0.00023 | 0.0001 | | | | | | | | |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | mgkg | 0.0011 | 0.0089 | 0.00251 | 0.0015 | | | | | | | | |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | mgkg | 0.0008 | 0.0063 | 0.00178 | 0.0011 | | | | | | | | |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | mgkg | 0.00068 | 0.0053 | 0.00150 | 0.0009 | | | | | | | | |
| VOC | 67-64-1 | Acetone | T | 8260B | mgkg | 0.0039 | 0.03 | 0.00859 | 0.0052 | | | | | | | | |
| VOC | 71-43-2 | Benzene | T | 8260B | mgkg | 0.00026 | 0.0021 | 0.00059 | 0.0004 | | | | | | | | |
| VOC | 75-25-2 | Bromoform | T | 8260B | mgkg | 0.00043 | 0.0034 | 0.00097 | 0.0006 | | | | | | | | |
| VOC | 74-83-9 | Bromomethane | T | 8260B | mgkg | 0.00048 | 0.0038 | 0.00107 | 0.0007 | | | | | | | | |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | mgkg | 0.00027 | 0.0021 | 0.00060 | 0.0004 | | | | | | | | |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | mgkg | 0.00018 | 0.0015 | 0.00041 | 0.0002 | | | | | | | | |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | | | | | | | | |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | mgkg | 0.00029 | 0.0023 | 0.00064 | 0.0004 | | | | | | | | |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | mgkg | 0.0002 | 0.0016 | 0.00044 | 0.0003 | | | | | | | | |
| VOC | 75-00-3 | Chloroethane | T | 8260B | mgkg | 0.00053 | 0.0042 | 0.00118 | 0.0007 | | | | | | | | |
| VOC | 67-66-3 | Chloroform | T | 8260B | mgkg | 0.00033 | 0.0026 | 0.00072 | 0.0004 | | | | | | | | |
| VOC | 74-87-3 | Chloromethane | T | 8260B | mgkg | 0.00044 | 0.0035 | 0.00098 | 0.0006 | | | | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | mgkg | 0.00016 | 0.0012 | 0.00034 | 0.0002 | | | | | | | | |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | mgkg | 0.00028 | 0.0022 | 0.00062 | 0.0004 | | | | | | | | |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | mgkg | 0.00023 | 0.0018 | 0.00050 | 0.0003 | | | | | | | | |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | mgkg | 0.00026 | 0.0021 | 0.00059 | 0.0004 | | | | | | | | |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | mgkg | 0.00034 | 0.0027 | 0.00076 | 0.0005 | | | | | | | | |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | mgkg | 0.0002 | 0.0016 | 0.00045 | 0.0003 | | | | | | | | |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00041 | 0.0002 | | | | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | mgkg | 0.00013 | 0.001 | 0.00029 | 0.0002 | | | | | | | | |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | mgkg | 0.0044 | 0.035 | 0.00979 | 0.0059 | | | | | | | | |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | mgkg | 0.00013 | 0.001 | 0.00028 | 0.0002 | | | | | | | | |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | mgkg | 0.00016 | 0.0013 | 0.00036 | 0.0002 | | | | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | mgkg | 0.00017 | 0.0013 | 0.00037 | 0.0002 | | | | | | | | |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | mgkg | 0.00018 | 0.0014 | 0.00040 | 0.0002 | | | | | | | | |
| VOC | 95-47-6 | o-Xylene | T | 8260B | mgkg | 9.7E-05 | 0.00076 | 0.00021 | 0.0001 | | | | | | | | |
| VOC | 100-42-5 | Styrene | T | 8260B | mgkg | 0.00013 | 0.00099 | 0.00028 | 0.0002 | | | | | | | | |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | | | | | | | | |
| VOC | 108-88-3 | Toluene | T | 8260B | mgkg | 0.00064 | 0.005 | 0.00141 | 0.0009 | | | | | | | | |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | mgkg | 0.00025 | 0.002 | 0.00056 | 0.0003 | | | | | | | | |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | mgkg | 0.00027 | 0.0021 | 0.00060 | 0.0004 | | | | | | | | |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | mgkg | 0.00015 | 0.0012 | 0.00033 | 0.0002 | | | | | | | | |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | mgkg | 0.00041 | 0.0033 | 0.00092 | 0.0006 | | | | | | | | |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | mgkg | 0.00056 | 0.0044 | 0.00124 | 0.0007 | | | | | | | | |
| ***New Phase II Analyses*** | | | | | | RL | MDL | LOD | | | | | | | | | |
| Metals | 7439-97-6 | Mercury SEM | T | 7470A | mg/Kg | 0.00500 | 0.00163 | | | 0.174 | | 0.18 | 0.18 | | | 0.174 | 0.18 |
| Metals | STL00343 | SEM/AVS Ratio | T | SEM | NONE | 0.00100 | 0.00100 | | | | | | | | | | |
| Metals | 7440-43-9 | Cadmium SEM | T | 6010C | mg/Kg | 0.125 | 0.00625 | | | 0.99 | 0.583 | 0.99 | 0.99 | | | 0.583 | 0.99 |
| Metals | 7440-50-8 | Copper SEM | T | 6010C | mg/Kg | 0.625 | 0.0841 | | | 31.6 | 28 | 31.6 | 31.6 | | | 28 | 31.6 |
| Metals | 7439-92-1 | Lead SEM | T | 6010C | mg/Kg | 0.250 | 0.0766 | | | 35.8 | 37.2 | 35.8 | 35.8 | | | 35.8 | 37.2 |
| Metals | 7440-66-6 | Zinc SEM | T | 6010C | mg/Kg | 2.50 | 0.172 | | | 121 | 98 | 121 | 121 | | | 98 | 121 |
| Metals | 7440-02-0 | Nickel SEM | T | 6010C | mg/Kg | 1.00 | 0.0809 | | | 22.7 | 19.5 | 22.7 | 22.7 | | | 19.5 | 22.7 |
| GenChem | 18496-25-8 | Acid Volatile Sulfides (AVS) | T | 9034_Calc_AVS | mg/Kg | 30.0 | 10.0 | 15.0 | | | | | | | | | |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | mg/Kg | 0.0330 | 0.00140 | | | | | | 1.22 | | | 1.22 | 1.22 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | mg/Kg | 0.0330 | 0.00144 | | | | | | | | | | |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | mg/Kg | 0.0667 | 0.0104 | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | mg/Kg | 0.00670 | 0.00247 | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.0139 | | | 0.129 | | | 0.284 | | | 0.129 | 0.284 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00238 | | | | | | | 0.288 | | 0.288 | 0.288 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00183 | | | 0.208 | | | 0.213 | | | 0.208 | 0.213 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | mg/Kg | 0.00670 | 0.00257 | | | 0.0817 | | | 0.117 | | | 0.0817 | 0.117 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00207 | | | 0.304 | | | 0.029 | | | 0.029 | 0.304 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | mg/Kg | 0.330 | 0.0897 | | | 0.00621 | | | | | | 0.00621 | 0.00621 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00166 | | | 0.0144 | | | 0.0416 | | | 0.0144 | 0.0416 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | mg/Kg | 0.0330 | 0.00206 | | | 0.0398 | | | | | | 0.0398 | 0.0398 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00153 | | | 0.417 | | | | | | 0.417 | 0.417 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | mg/Kg | 0.0330 | 0.00155 | | | 0.0319 | | | 0.0312 | 0.02716 | | 0.02716 | 0.0319 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00160 | | | 0.0202 | | | 0.0202 | | 4.47 | 0.0202 | 4.47 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00956 | | | | | | | 0.011856 | | 0.011856 | 0.011856 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.0152 | | | | | | | | | | |

**Table 14. Sampling Analyses and MDLs for Sediment – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | USEPA Region 5 RCRA Ecological Screening Levels (USEPA 2003) | Ingersoll, et al. (1996); Threshold Effect Level (TEL) and Probable Effect Level (PEL) for total extraction of sediment (BT) samples from Hyalella azteca 28-day (HA28) tests. | MacDonald et al. (2000); consensus-based threshold effect concentration (TEC) and probable effect concentration (PEC). | USEPA Region 3 Freshwater Sediment Screening Benchmarks (USEPA 2006) | Derived based on the equilibrium partitioning (EqP) approach normalized to 1% TOC. | From Table 3-4 in EPA (2003); column titled "Coc, PAHi, FCVi (µg/goc)" normalized to 1% TOC and adjusted to ppm. | Minimum ESV | Maximum ESV |
| | | | | | | | | | | A | B | C | D | E | F | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | mg/Kg | 0.0330 | 0.00191 | | | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | mg/Kg | 0.0330 | 0.0311 | | | 0.127 | | | | | | 0.127 | 0.127 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00848 | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | mg/Kg | 0.170 | 0.0575 | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00233 | | | 1.55 | | | 1.23 | 0.255 | | 0.255 | 1.55 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | mg/Kg | 0.0330 | 0.00157 | | | 0.388 | | | | | | 0.388 | 0.388 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | mg/Kg | 0.0330 | 0.00111 | | | 0.146 | | | | | | 0.146 | 0.146 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | mg/Kg | 0.0330 | 0.00202 | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | mg/Kg | 0.170 | 0.00162 | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | mg/Kg | 0.170 | 0.0234 | | | 0.013 | | | | | | 0.013 | 0.013 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | mg/Kg | 0.00670 | 0.00192 | | | 0.00671 | | | 0.00671 | | 4.91 | 0.00671 | 4.91 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | mg/Kg | 0.00670 | 0.00146 | | | 0.00587 | | | 0.0059 | | 4.52 | 0.00587 | 4.52 |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | mg/Kg | 0.0670 | 0.00181 | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00173 | | | 0.0572 | 0.01 | 0.0572 | 0.0572 | | 5.94 | 0.01 | 5.94 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | mg/Kg | 0.0670 | 0.0146 | | | | | | 0.00662 | | | 0.00662 | 0.00662 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | mg/Kg | 0.0670 | 0.00414 | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00126 | | | 0.108 | 0.016 | 0.108 | 0.108 | | 8.41 | 0.016 | 8.41 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00145 | | | 0.15 | 0.032 | 0.15 | 0.15 | | 9.65 | 0.032 | 9.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00164 | | | 10.4 | | | | | 9.79 | 9.79 | 10.4 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | mg/Kg | 0.00670 | 0.00144 | | | 0.17 | 0.016 | | 0.17 | | 10.95 | 0.016 | 10.95 |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00200 | | | 0.24 | | | 0.24 | | 9.81 | 0.24 | 9.81 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | mg/Kg | 0.0330 | 0.00159 | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | mg/Kg | 0.00670 | 0.00121 | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | mg/Kg | 0.330 | 0.0355 | | | 0.182 | | | 0.18 | 453 | | 0.18 | 453 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0229 | | | 1.97 | | | 10.9 | 10.925 | | 1.97 | 10.925 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | mg/Kg | 0.170 | 0.0217 | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | mg/Kg | 0.00670 | 0.00156 | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 0.166 | 0.027 | 0.166 | 0.166 | | 8.44 | 0.027 | 8.44 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | mg/Kg | 0.00670 | 0.00149 | | | | 0.01 | 0.033 | 0.033 | | 11.23 | 0.01 | 11.23 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | mg/Kg | 0.0330 | 0.00146 | | | 0.449 | | | 0.415 | 0.300736 | | 0.300736 | 0.449 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0100 | | | | | | 0.603 | 0.6048 | | 0.603 | 0.6048 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.00121 | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0146 | | | | | | 6.47 | 1.1989 | | 1.1989 | 6.47 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | mg/Kg | 0.0330 | 0.0194 | | | | | | | 16.8858 | | 16.8858 | 16.8858 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | mg/Kg | 0.00670 | 0.00176 | | | 0.423 | 0.031 | 0.423 | 0.423 | | 7.07 | 0.031 | 7.07 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | mg/Kg | 0.00670 | 0.00131 | | | 0.0774 | 0.01 | 0.0774 | 0.0774 | | 5.38 | 0.01 | 5.38 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | mg/Kg | 0.00670 | 0.00239 | | | 0.02 | | | 0.02 | | | 0.02 | 0.02 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | mg/Kg | 0.00670 | 0.00195 | | | 0.0265 | | | | 0.6981 | | 0.0265 | 0.6981 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 0.901 | | | | | | 0.901 | 0.901 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | mg/Kg | 0.0330 | 0.00172 | | | 0.584 | | | 1.027 | 0.2136 | | 0.2136 | 1.027 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00135 | | | 0.2 | 0.017 | | 0.017 | | 11.15 | 0.017 | 11.15 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | mg/Kg | 0.0330 | 0.00170 | | | 0.432 | | | | | | 0.432 | 0.432 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | mg/Kg | 0.00670 | 0.00130 | | | 0.176 | 0.015 | 0.176 | 0.176 | | 3.85 | 0.015 | 3.85 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | mg/Kg | 0.0667 | 0.0122 | | | 0.145 | | | | | | 0.145 | 0.145 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | mg/Kg | 0.00670 | 0.00226 | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | mg/Kg | 0.0330 | 0.0111 | | | | | | | 0.516 | | 0.516 | 0.516 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | mg/Kg | 0.170 | 0.0536 | | | 23 | | | 0.504 | | | 0.504 | 23 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | mg/Kg | 0.00670 | 0.00179 | | | 0.204 | 0.019 | 0.204 | 0.204 | | 5.96 | 0.019 | 5.96 |
| SVOC | 108-95-2 | Phenol | T | 8270D | mg/Kg | 0.0330 | 0.0101 | | | 0.0491 | | | 0.42 | 0.001152 | | 0.001152 | 0.42 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | mg/Kg | 0.00670 | 0.00158 | | | 0.195 | 0.044 | 0.195 | 0.195 | | 6.97 | 0.044 | 6.97 |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 30 | 46.30 | 31.00 | | | | | |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 60 | 83.48 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 12 | 12 | 58.40 | 60.00 | 4000 | 4000 | 80 | 80 | 4000 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 5000 | 7045.45 | 5000.00 | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 100 | 101.14 | 100.00 | 10000 | 10000 | | 10000 | 10000 |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 42 | 48.94 | 48.00 | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 105 | 173.80 | 127.00 | | | | | |
| GenChem | 18496-25-8 | Sulfide | T | SM 4500 S2 F | ug/l | 579 | 579 | 579.00 | 579.00 | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 10 | 10.00 | 10.00 | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 1 | 1 | 1.19 | 1.00 | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | | | 2000 | 2000 | 2000 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | 5.6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | 5.6 | 6 | 0.78 | 0.78 | 6 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 10 | 10 | 0.052 | 0.052 | 10 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | 1000 | 2000 | 380 | 380 | 2000 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 4 | 4 | 2.5 | 2.5 | 4 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 5 | 5 | 0.92 | 0.92 | 5 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | 100 | | 100 | 100 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | 0.6 | 0.6 | 0.6 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 1300 | 1300 | 80 | 80 | 1300 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | 200 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 140 | 200 | 0.15 | 0.15 | 200 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | | 1400 | 1400 | 1400 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 15 | 15 | 15 | 15 | 15 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 0.05 | 2 | 0.063 | 0.05 | 2 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 0.05 | 2 | 0.063 | 0.05 | 2 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 100 | | 39 | 39 | 100 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 100 | | 39 | 39 | 100 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 50 | 50 | 10 | 10 | 50 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 100 | | 9.4 | 9.4 | 100 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 0.24 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 0.24 | 2 | 0.02 | 0.02 | 2 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | 8.6 | 8.6 | 8.6 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 2000 | | 600 | 600 | 2000 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 2000 | | 600 | 600 | 2000 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | 0.0031 | | 0.0063 | 0.0031 | 0.0063 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.0022 | | 0.046 | 0.0022 | 0.046 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.0022 | | 0.23 | 0.0022 | 0.23 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00049 | | 0.00092 | 0.00049 | 0.00092 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | ug/l | 0.007 | 0.007 | 0.01 | 0.01 | 0.026 | | 0.0072 | 0.0072 | 0.026 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.008 | | | 0.008 | 0.008 |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.091 | | 0.025 | 0.025 | 0.091 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | | | | | |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00052 | | 0.0018 | 0.00052 | 0.0018 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 62 | | | 62 | 62 |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 62 | | | 62 | 62 |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | 62 | | | 62 | 62 |
| Pesticides | 72-20-8 | Endrin | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.059 | 2 | 0.23 | 0.059 | 2 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | 0.29 | | | 0.29 | 0.29 |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | | |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | ug/l | 0.012 | 0.012 | 0.01 | 0.01 | 0.2 | 0.2 | 0.042 | 0.042 | 0.2 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | | | | | |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.00079 | 0.4 | 0.0014 | 0.00079 | 0.4 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | 0.00039 | 0.2 | 0.0014 | 0.00039 | 0.2 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 40 | 40 | 3.7 | 3.7 | 40 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | ug/l | 0.11 | 0.11 | 0.11 | 0.11 | 0.0028 | 3 | 0.071 | 0.0028 | 3 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.14 | 0.00064 | 0.14 |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0047 | 0.00064 | 0.0047 |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0047 | 0.00064 | 0.0047 |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | 0.0078 | 0.00064 | 0.0078 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | 0.00064 | | | 0.00064 | 0.00064 |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | 0.00064 | | | 0.00064 | 0.00064 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | 0.083 | 0.083 | 0.083 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.43 | 0.43 | 0.43 | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.1 | 3.14 | 3.10 | | | 0.46 | 0.46 | 0.46 |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 0.93 | 0.94 | 0.93 | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 24 | 24 | 24 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.53 | 0.53 | 0.53 | 14 | | 1.2 | 1.2 | 14 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.91 | 0.92 | 0.91 | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.4 | 2.41 | 2.40 | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.59 | 0.59 | 0.59 | | | | | |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2 | 2.04 | 2.00 | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1 | 1.01 | 1.00 | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.73 | 0.74 | 0.73 | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 0.96 | 0.97 | 0.96 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.48 | 0.48 | 0.48 | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 4.7 | 4.71 | 4.70 | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.57 | 0.57 | 0.57 | 8300 | | 180 | 180 | 8300 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.77 | 0.78 | 0.77 | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.86 | 0.87 | 0.86 | | | 19 | 19 | 19 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.55 | 0.55 | 0.55 | 0.038 | | | 0.038 | 0.038 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | 0.038 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.44 | 0.44 | 0.44 | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.75 | 0.76 | 0.75 | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 0.038 | | 2.5 | 0.038 | 2.5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.6 | 0.61 | 0.60 | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | 0.038 | | 25 | 0.038 | 25 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 0.038 | | 0.025 | 0.025 | 0.038 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1 | 1.00 | 1.00 | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 0.98 | 0.99 | 0.98 | 270000 | | | 270000 | 270000 |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | 1100 | | 29 | 29 | 1100 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.47 | 0.47 | 0.47 | 0.0028 | 1 | 0.0098 | 0.0028 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | 4.4 | | 0.14 | 0.14 | 4.4 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | 40 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 14 | | 0.33 | 0.33 | 14 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | 350 | | 78 | 78 | 350 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | 0.05 | | 0.011 | 0.011 | 0.05 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.2 | 2.21 | 2.20 | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.41 | 0.41 | 0.41 | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | 830 | | 12 | 12 | 830 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | 200 | 200 | 800 | 200 | 800 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | 1.7 | | | 1.7 | 1.7 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | 1000 | 1000 | 1000 |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08 | 0.08 | 3 | | | 3 | 3 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | 2.8 | 2.8 | 2.8 |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | 7 | | | 7 | 7 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35 | 0.35 | | | 0.7 | 0.7 | 0.7 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27 | 0.27 | 35 | | 0.4 | 0.4 | 35 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23 | 0.23 | 0.2 | 0.2 | 0.00033 | 0.00033 | 0.2 |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 420 | 600 | 30 | 30 | 600 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | 3.8 | 5 | 0.17 | 0.17 | 5 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 5 | 5 | 0.82 | 0.82 | 5 |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 320 | | | 320 | 320 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 75 | 75 | 0.48 | 0.48 | 75 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20 | 2.20 | | | 560 | 560 | 560 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72 | 0.72 | | | 3.8 | 3.8 | 3.8 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63 | 0.63 | | | 630 | 630 | 630 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | 1400 | 1400 | 1400 |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | 5 | 5 | 0.46 | 0.46 | 5 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 43 | 80 | 3.3 | 3.3 | 80 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 47 | | 0.75 | 0.75 | 47 |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | 81 | 81 | 81 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | 2.3 | 5 | 0.46 | 0.46 | 5 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | 100 | 100 | 7.8 | 7.8 | 100 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | 8.3 | 8.3 | 8.3 |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 4 | 80 | 0.87 | 0.87 | 80 |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37 | 0.37 | | | 2100 | 2100 | 2100 |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 57 | 80 | 0.22 | 0.22 | 80 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 30 | | 19 | 19 | 30 |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | 70 | | | 70 | 70 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | 3.4 | | | 3.4 | 3.4 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | 1300 | 1300 | 1300 |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | 5.5 | 80 | 0.13 | 0.13 | 80 |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14 | 0.14 | | | 20 | 20 | 20 |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | 530 | 700 | 1.5 | 1.5 | 700 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58 | 0.58 | | | 2000 | 2000 | 2000 |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13 | 0.13 | 30 | | 14 | 14 | 30 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | 5 | 5 | 11 | 5 | 11 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | 10000 | | 19 | 19 | 10000 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 100 | 100 | 120 | 100 | 120 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | 5 | | | 5 | 5 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | 1000 | 1000 | 110 | 110 | 1000 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | 100 | | | 100 | 100 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | 2 | | | 2 | 2 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | 5 | | | 5 | 5 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | 10000 | | 520 | 520 | 10000 |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06 | 0.06 | 0.25 | 2 | 0.019 | 0.019 | 2 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | 0.97 | | 0.17 | 0.17 | 0.97 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | 0.46 | 0.46 | 0.46 |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | 1400 | | | 1400 | 1400 |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | 24 | 24 | 24 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 1800 | | 120 | 120 | 1800 |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | 14 | | 1.2 | 1.2 | 14 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | 77 | | 4.6 | 4.6 | 77 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | 380 | | 36 | 36 | 380 |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | 69 | | 3.9 | 3.9 | 69 |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | 1.1 | | 0.24 | 0.24 | 1.1 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | 0.5 | | 0.049 | 0.049 | 0.5 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 1000 | | | 1000 | 1000 |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | 81 | | 9.1 | 9.1 | 81 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | 3.6 | 3.6 | 3.6 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | | | |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | 19 | 19 | 19 |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | 0.21 | | 0.13 | 0.13 | 0.21 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | 13 | | | 13 | 13 |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | | |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | 3000 | | | 3000 | 3000 |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | 0.37 | 0.37 | 0.37 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | |

**Table 15. Sampling Analyses and MDLs for Sediment Porewater – Human Health**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Human Health Screening Levels | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 HH | Drinking MCL | Tapwater RSL | Minimum Screening Level | Maximum Screening Level |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | 3.8 | 3.8 | 3.8 |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | 60 | | | 60 | 60 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | 670 | | 53 | 53 | 670 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | 190 | 190 | 190 |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | 8300 | | 180 | 180 | 8300 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | 3 | 3 | 0.3 | 0.3 | 3 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | 19 | 19 | 19 |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | 0.038 | | | 0.038 | 0.038 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | 0.038 | 0.2 | 0.025 | 0.025 | 0.2 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | 0.038 | | 2.5 | 0.038 | 2.5 |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | 5.9 | 5.9 | 5.9 |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | 0.3 | | 0.014 | 0.014 | 0.3 |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | 6 | 6 | 5.6 | 5.6 | 6 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | 1500 | | 16 | 16 | 1500 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | 990 | 990 | 990 |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | 0.038 | | 25 | 0.038 | 25 |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | 0.038 | | 0.025 | 0.025 | 0.038 |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | 0.79 | 0.79 | 0.79 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | 17000 | | | 17000 | 17000 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | 270000 | | | 270000 | 270000 |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | 2000 | | | 2000 | 2000 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | 20 | 20 | 20 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | 130 | | 80 | 80 | 130 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 1100 | | 29 | 29 | 1100 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | 0.0028 | 1 | 0.0098 | 0.0028 | 1 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | 4.4 | | 0.14 | 0.14 | 4.4 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | 40 | 50 | 0.041 | 0.041 | 50 |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | 14 | | 0.33 | 0.33 | 14 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | 0.038 | | 0.25 | 0.038 | 0.25 |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | 350 | | 78 | 78 | 350 |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | 100 | | 0.17 | 0.17 | 100 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | 17 | | 0.14 | 0.14 | 17 |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | 0.05 | | 0.011 | 0.011 | 0.05 |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | 33 | | 12 | 12 | 33 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 1 | 1 | 0.041 | 0.041 | 1 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | | | |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | 300 | | 580 | 300 | 580 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | 830 | | 12 | 12 | 830 |

**Table 16. Sampling Analyses and MDLs for Sediment Porewater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | | | | | | |
| GenChem | 16887-00-6 | Chloride | T | 300.0 | ug/l | 30 | 30 | 46.30 | 31.00 | | | | 230000 | | | | 120000 | 120000 | 230000 |
| GenChem | 16984-48-8 | Fluoride | DI | 300.0 | ug/l | 60 | 60 | 83.48 | 60.00 | | | | | | | | 120 | 120 | 120 |
| GenChem | 16984-48-8 | Fluoride | T | 300.0 | ug/l | 12 | 12 | 58.40 | 60.00 | | | | | | | | 120 | 120 | 120 |
| GenChem | STL00009 | Hardness as calcium carbonate | T | SM 2340C | ug/l | 5000 | 5000 | 7045.45 | 5000.00 | | | | | | | | | | |
| GenChem | STL00217 | Nitrate Nitrite as N | T | 353.2 | ug/l | 100 | 100 | 101.14 | 100.00 | | | | | | | | | | |
| GenChem | STL00599 | Orthophosphate as P | T | 9056A | ug/l | 42 | 42 | 48.94 | 48.00 | | | | | | | | | | |
| GenChem | 14808-79-8 | Sulfate | T | 300.0 | ug/l | 105 | 105 | 173.80 | 127.00 | | | | | | | | | | |
| GenChem | 18496-25-8 | Sulfide | T | SM 4500 S2 F | ug/l | 579 | 579 | 579.00 | 579.00 | | | | | | | | | | |
| GenChem | STL00242 | Total Dissolved Solids | T | SM 2540C | mg/l | 10 | 10 | 10.00 | 10.00 | | | | | | | | | | |
| GenChem | STL00161 | Total Suspended Solids | T | SM 2540D | mg/l | 1 | 1 | 1.19 | 1.00 | | | | | | | | | | |
| Metals | 7429-90-5 | Aluminum | DI | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | 750 | 87 | 87 | 87 | 460 | | 87 | | 87 | 750 |
| Metals | 7429-90-5 | Aluminum | T | 6020A | ug/l | 18.2 | 18.2 | 18.20 | 18.20 | 750 | 87 | 87 | 87 | 460 | | 87 | | 87 | 750 |
| Metals | 7440-36-0 | Antimony | DI | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | | | | | 610 | 30 | 30 | | 30 | 610 |
| Metals | 7440-36-0 | Antimony | T | 6020A | ug/l | 0.62 | 0.62 | 0.62 | 0.62 | | | | | 610 | 30 | 30 | | 30 | 610 |
| Metals | 7440-38-2 | Arsenic | DI | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 340 | 150 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 340 |
| Metals | 7440-38-2 | Arsenic | T | 6020A | ug/l | 0.64 | 0.64 | 0.64 | 0.64 | 340 | 150 | 150 | 150 | 48 | 3.1 | 5 | 5 | 3.1 | 340 |
| Metals | 7440-39-3 | Barium | DI | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | | | | | | 4 | 4 | | 4 | 4 |
| Metals | 7440-39-3 | Barium | T | 6020A | ug/l | 1.2 | 1.2 | 1.20 | 1.20 | | | | | | 4 | 4 | | 4 | 4 |
| Metals | 7440-41-7 | Beryllium | DI | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 |
| Metals | 7440-41-7 | Beryllium | T | 6020A | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 5.3 | 0.66 | 0.66 | | 0.66 | 5.3 |
| Metals | 7440-43-9 | Cadmium | DI | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 0.52 | 0.237827934 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.52 |
| Metals | 7440-43-9 | Cadmium | T | 6020A | ug/l | 0.71 | 0.71 | 0.71 | 0.71 | 0.52 | 0.237827934 | 0.097 | 0.13 | 0.15 | | | 0.09 | 0.09 | 0.52 |
| Metals | 7440-70-2 | Calcium | DI | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | 116000 | | 116000 | | 116000 | 116000 |
| Metals | 7440-70-2 | Calcium | T | 6020A | ug/l | 60.5 | 60.5 | 60.50 | 60.50 | | | | | 116000 | | 116000 | | 116000 | 116000 |
| Metals | 7440-47-3 | Chromium | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | 74.7 | | | | | 85 | | 74.7 | 85 |
| Metals | 7440-47-3 | Chromium | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | 74.7 | | | | | 85 | | 74.7 | 85 |
| Metals | 7440-48-4 | Cobalt | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 5.1 | 23 | 23 | | 5.1 | 23 |
| Metals | 7440-48-4 | Cobalt | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 5.1 | 23 | 23 | | 5.1 | 23 |
| Metals | 7440-50-8 | Copper | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 3.79 | 8.037619479 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 |
| Metals | 7440-50-8 | Copper | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 3.79 | 8.037619479 | 2.85 | 1.6 | 0.23 | | 9 | | 0.23 | 9 |
| Metals | STL00131 | Cyanide, Free | DI | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | | | | | | | | | | |
| Metals | STL00131 | Cyanide, Free | T | 9016 | ug/l | 1.5 | 1.5 | 1.50 | 1.50 | | | | | | | | | | |
| Metals | 57-12-5 | Cyanide, Total | DI | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 22 | 5.2 | 5.2 | | 7.8 | | 5 | 5 | 5 | 22 |
| Metals | 57-12-5 | Cyanide, Total | T | 335.4 | ug/l | 2 | 2 | 2.00 | 2.00 | 22 | 5.2 | 5.2 | | 7.8 | | 5 | 5 | 5 | 22 |
| Metals | 7439-89-6 | Iron | DI | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | 1000 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 |
| Metals | 7439-89-6 | Iron | T | 6020A | ug/l | 42.4 | 42.4 | 42.40 | 42.40 | | 1000 | 1000 | 1000 | 158 | | 300 | 300 | 158 | 1000 |
| Metals | 7439-92-1 | Lead | DI | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 13.98 | 2.548308447 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 13.98 |
| Metals | 7439-92-1 | Lead | T | 6020A | ug/l | 0.38 | 0.38 | 0.38 | 0.38 | 13.98 | 2.548308447 | 0.54 | 0.92 | 12.26 | | 2.5 | | 0.54 | 13.98 |
| Metals | 7439-95-4 | Magnesium | DI | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | 82000 | | 82000 | | 82000 | 82000 |
| Metals | 7439-95-4 | Magnesium | T | 6020A | ug/l | 63.6 | 63.6 | 63.60 | 63.60 | | | | | 82000 | | 82000 | | 82000 | 82000 |
| Metals | 7439-96-5 | Manganese | DI | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | 1100 | 120 | 120 | | 120 | 1100 |
| Metals | 7439-96-5 | Manganese | T | 6020A | ug/l | 2.5 | 2.5 | 2.50 | 2.50 | | | | | 1100 | 120 | 120 | | 120 | 1100 |
| Metals | 7439-97-6 | Mercury | DI | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 1.7 | 0.91 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.7 |
| Metals | 7439-97-6 | Mercury | T | 7470A | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | 1.7 | 0.91 | 0.91 | 0.77 | 0.23 | 1.3 | 0.026 | 0.026 | 0.026 | 1.7 |
| Metals | 7440-02-0 | Nickel | DI | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 145 | 45.00938447 | 16.1 | 24 | 5 | | 52 | | 5 | 145 |
| Metals | 7440-02-0 | Nickel | T | 6020A | ug/l | 1.4 | 1.4 | 1.40 | 1.40 | 145 | 45.00938447 | 16.1 | 24 | 5 | | 52 | | 5 | 145 |
| Metals | 7440-09-7 | Potassium | DI | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | 53000 | | 53000 | | 53000 | 53000 |
| Metals | 7440-09-7 | Potassium | T | 6020A | ug/l | 91.4 | 91.4 | 91.40 | 91.40 | | | | | 53000 | | 53000 | | 53000 | 53000 |
| Metals | 7782-49-2 | Selenium | DI | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 20 | 5 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 |
| Metals | 7782-49-2 | Selenium | T | 6020A | ug/l | 0.73 | 0.73 | 0.73 | 0.73 | 20 | 5 | 5 | 5 | 88.32 | | 1 | 1 | 1 | 88.32 |
| Metals | 7440-22-4 | Silver | DI | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 0.374 | | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 |
| Metals | 7440-22-4 | Silver | T | 6020A | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | 0.374 | | 0.374 | 0.067 | 0.12 | 0.36 | 3.2 | 0.25 | 0.067 | 3.2 |
| Metals | 7440-23-5 | Sodium | DI | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | 680000 | | 680000 | | 680000 | 680000 |
| Metals | 7440-23-5 | Sodium | T | 6020A | ug/l | 69 | 69 | 69.00 | 69.00 | | | | | 680000 | | 680000 | | 680000 | 680000 |
| Metals | 7440-28-0 | Thallium | DI | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 |
| Metals | 7440-28-0 | Thallium | T | 6020A | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | 57 | 12 | 0.8 | 0.8 | 0.8 | 57 |
| Metals | 7440-62-2 | Vanadium | DI | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | | | 80 | 20 | 20 | | 20 | 80 |
| Metals | 7440-62-2 | Vanadium | T | 6020A | ug/l | 1.9 | 1.9 | 1.90 | 1.90 | | | | | 80 | 20 | 20 | | 20 | 80 |
| Metals | 7440-66-6 | Zinc | DI | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 37 | 103.3613472 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 |
| Metals | 7440-66-6 | Zinc | T | 6020A | ug/l | 7 | 7 | 7.00 | 7.00 | 37 | 103.3613472 | 37 | 54 | 30 | | 120 | 30 | 30 | 120 |
| Pesticides | 72-54-8 | 4,4'-DDD | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | | | | | 1.69 | 0.011 | 0.011 | 0.001 | 0.001 | 1.69 |
| Pesticides | 72-55-9 | 4,4'-DDE | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | | | | | | | | 0.001 | 0.001 | 0.001 |
| Pesticides | 50-29-3 | 4,4'-DDT | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.5 | 0.001 | 0.001 | 0.001 | 0.3 | 0.013 | 0.0005 | 0.001 | 0.0005 | 0.5 |
| Pesticides | 309-00-2 | Aldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 1.5 | 1.5 | 1.5 | 0.3 | | | 3 | 0.004 | 0.004 | 3 |
| Pesticides | 319-84-6 | alpha-BHC | T | 8081B | ug/l | 0.007 | 0.007 | 0.01 | 0.01 | | | | | 95 | 2.2 | | | 2.2 | 95 |
| Pesticides | 5103-71-9 | alpha-Chlordane | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | | 0.0043 | 0.0043 | 0.0043 | 1.09 | | | | 0.0043 | 1.09 |
| Pesticides | 319-85-7 | beta-BHC | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | | | | | 95 | 2.2 | | | 2.2 | 95 |
| Pesticides | 319-86-8 | delta-BHC | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | | | | | 95 | 2.2 | 141 | | 2.2 | 141 |
| Pesticides | 60-57-1 | Dieldrin | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.24 | 0.056 | 0.056 | 0.056 | | | 0.056 | | 0.056 | 0.24 |
| Pesticides | 959-98-8 | Endosulfan I | T | 8081B | ug/l | 0.002 | 0.002 | 0.00 | 0.00 | 0.11 | 0.056 | 0.056 | 0.056 | | 0.051 | 0.051 | 0.003 | 0.003 | 0.11 |
| Pesticides | 33213-65-9 | Endosulfan II | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.11 | 0.056 | 0.056 | 0.056 | | 0.051 | 0.051 | | 0.051 | 0.11 |
| Pesticides | 1031-07-8 | Endosulfan sulfate | T | 8081B | ug/l | 0.006 | 0.006 | 0.01 | 0.01 | | | | 0.056 | | 0.051 | | | 0.051 | 0.056 |
| Pesticides | 72-20-8 | Endrin | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | 0.086 | 0.036 | 0.036 | 0.036 | | | 0.036 | 0.0023 | 0.0023 | 0.086 |
| Pesticides | 7421-93-4 | Endrin aldehyde | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | 0.036 | | | | | 0.036 | 0.036 |
| Pesticides | 53494-70-5 | Endrin ketone | T | 8081B | ug/l | 0.008 | 0.008 | 0.01 | 0.01 | | | | 0.036 | | | | | 0.036 | 0.036 |
| Pesticides | 58-89-9 | gamma-BHC (Lindane) | T | 8081B | ug/l | 0.012 | 0.012 | 0.01 | 0.01 | | 0.95 | 0.95 | 0.095 | 3.3 | | 0.01 | 0.01 | 0.01 | 3.3 |
| Pesticides | 5103-74-2 | gamma-Chlordane | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | | 0.0043 | 0.0043 | 0.0043 | 1.09 | | | | 0.0043 | 1.09 |
| Pesticides | 76-44-8 | Heptachlor | T | 8081B | ug/l | 0.003 | 0.003 | 0.00 | 0.00 | 0.26 | 0.0038 | 0.0038 | 0.0038 | 1.26 | 0.0069 | 0.0019 | 0.01 | 0.0019 | 1.26 |
| Pesticides | 1024-57-3 | Heptachlor epoxide | T | 8081B | ug/l | 0.005 | 0.005 | 0.01 | 0.01 | 0.26 | 0.0038 | 0.0038 | 0.0038 | 1.26 | 0.0069 | 0.0019 | | 0.0019 | 1.26 |
| Pesticides | 72-43-5 | Methoxychlor | T | 8081B | ug/l | 0.004 | 0.004 | 0.00 | 0.00 | | 0.03 | 0.03 | 0.03 | | 0.019 | 0.019 | | 0.019 | 0.03 |
| Pesticides | 8001-35-2 | Toxaphene | T | 8081B | ug/l | 0.11 | 0.11 | 0.11 | 0.11 | 0.73 | 0.0002 | 0.0002 | 0.0002 | | | 0.0002 | 0.008 | 0.0002 | 0.73 |
| PCB | 12674-11-2 | Aroclor 1016 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | | | 0.000074 | | 0.000074 | 0.014 |

**Table 16. Sampling Analyses and MDLs for Sediment Porewater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | | | | | | |
| PCB | 11104-28-2 | Aroclor 1221 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 60 | 0.28 | 0.000074 | | 0.000074 | 60 |
| PCB | 11141-16-5 | Aroclor 1232 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 124 | 0.58 | 0.000074 | | 0.000074 | 124 |
| PCB | 53469-21-9 | Aroclor 1242 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | 4.9 | 0.053 | 0.000074 | | 0.000074 | 4.9 |
| PCB | 12672-29-6 | Aroclor 1248 | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | | | 0.081 | 0.000074 | | 0.000074 | 0.081 |
| PCB | 11097-69-1 | Aroclor 1254 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | 0.1 | 0.033 | 0.000074 | | 0.000074 | 0.1 |
| PCB | 11096-82-5 | Aroclor 1260 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | 2.3 | 94 | 0.000074 | | 0.000074 | 94 |
| PCB | 11100-14-4 | Aroclor 1268 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | 0.014 | 0.014 | | | | | | 0.014 | 0.014 |
| PCB | 37324-23-5 | Aroclor-1262 | T | 8082A | ug/l | 0.099 | 0.099 | 0.10 | 0.10 | | | | | | | | | | |
| PCB | 1336-36-3 | Polychlorinated biphenyls, Total | T | 8082A | ug/l | 0.1 | 0.1 | 0.10 | 0.10 | | 0.014 | 0.014 | 0.014 | 0.1 | 0.14 | 0.000074 | 0.001 | 0.000074 | 0.14 |
| SVOC | 92-52-4 | 1,1'-Biphenyl | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | | | | 14 | 14 | | 14 | 14 |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 0.43 | 0.43 | 0.43 | 0.43 | | | | | | | 3 | | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 3.1 | 3.1 | 3.14 | 3.10 | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.93 | 0.93 | 0.94 | 0.93 | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | | | 1.2 | 1 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 0.53 | 0.53 | 0.53 | 0.53 | | | | | | | 4.9 | | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.63 | 0.63 | 0.64 | 0.63 | | | | | | | 11 | | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 0.91 | 0.91 | 0.92 | 0.91 | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 2.4 | 2.4 | 2.41 | 2.40 | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | 44 | | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | 81 | | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | | | | | | | 24 | | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | 4.7 | | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.3 | 1.3 | 1.30 | 1.30 | | | | | 489 | 13 | 13 | | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 0.59 | 0.59 | 0.59 | 0.59 | | | | | 481 | 300 | 1920 | | 300 | 1920 |
| SVOC | 15831-10-4 | 3 & 4 Methylphenol | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | | | | | | |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | 4.5 | | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 2 | 2 | 2.04 | 2.00 | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1 | 1 | 1.01 | 1.00 | | | | | | 1.5 | 1.5 | | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 0.73 | 0.73 | 0.74 | 0.73 | | | | | | | 232 | | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 0.96 | 0.96 | 0.97 | 0.96 | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 0.48 | 0.48 | 0.48 | 0.48 | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 4.7 | 4.7 | 4.71 | 4.70 | | | | | 481 | 300 | 60 | | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.88 | 0.88 | 0.89 | 0.88 | | | | | 74 | | 5.8 | 5.8 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1 | 1 | 1.04 | 1.00 | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.57 | 0.57 | 0.57 | 0.57 | | | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 0.77 | 0.77 | 0.78 | 0.77 | | | | | | | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 0.86 | 0.86 | 0.87 | 0.86 | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.55 | 0.55 | 0.55 | 0.55 | | | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | | | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.44 | 0.44 | 0.44 | 0.44 | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.75 | 0.75 | 0.76 | 0.75 | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | | | | | 912 | 3 | 16 | | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 0.6 | 0.6 | 0.61 | 0.60 | | | | | | 19 | 19 | | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 0.85 | 0.85 | 0.86 | 0.85 | | | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1 | 1 | 1.00 | 1.00 | | | | | 85600 | 210 | 210 | | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 0.98 | 0.98 | 0.99 | 0.98 | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 0.82 | 0.82 | 0.83 | 0.82 | | | | | 697 | 35 | 19 | 19 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 0.69 | 0.69 | 0.70 | 0.69 | | | | | 708 | | 22 | | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.72 | 0.72 | 0.73 | 0.72 | | | | | = | | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | | | | | | 3.9 | 3 | 3 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.47 | 0.47 | 0.47 | 0.47 | | | | | | | 0.0003 | | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.76 | 0.76 | 0.77 | 0.76 | | | | | | | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 0.61 | 0.61 | 0.62 | 0.61 | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | | 12 | 12 | | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 0.67 | 0.67 | 0.68 | 0.67 | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.8 | 0.8 | 0.81 | 0.80 | | | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 0.49 | 0.49 | 0.49 | 0.49 | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 0.74 | 0.74 | 0.75 | 0.74 | | | | | 332 | 210 | 210 | | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 2.2 | 2.2 | 2.21 | 2.20 | 5.3 | 4 | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.65 | 0.65 | 0.66 | 0.65 | | | | | 200 | | 0.4 | 0.4 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 0.41 | 0.41 | 0.41 | 0.41 | | | | | 200 | | 4 | 4 | 4 | 200 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.83 | 0.83 | 0.84 | 0.83 | | | | | | | 0.025 | 0.025 | 0.025 | 0.025 |
| VOC | 71-55-6 | 1,1,1-Trichloroethane | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | 3493 | 11 | 11 | | 11 | 3493 |
| VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | 2400 | 610 | 610 | | 610 | 2400 |
| VOC | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | | | | | | | | |
| VOC | 79-00-5 | 1,1,2-Trichloroethane | T | 8260B | ug/l | 0.08 | 0.08 | 0.08 | 0.08 | | | | | 9400 | 1200 | 1200 | | 1200 | 9400 |
| VOC | 75-34-3 | 1,1-Dichloroethane | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 14680 | 47 | 47 | | 47 | 14680 |

**Table 16. Sampling Analyses and MDLs for Sediment Porewater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | | | | | | |
| VOC | 75-35-4 | 1,1-Dichloroethene | T | 8260B | ug/l | 0.34 | 0.34 | 0.34 | 0.34 | | | | | 2800 | 25 | 25 | | 25 | 2800 |
| VOC | 87-61-6 | 1,2,3-Trichlorobenzene | T | 8260B | ug/l | 0.35 | 0.35 | 0.35 | 0.35 | | | | | | | | 8 | 8 | 8 |
| VOC | 120-82-1 | 1,2,4-Trichlorobenzene | T | 8260B | ug/l | 0.27 | 0.27 | 0.27 | 0.27 | | | | | | 110 | 24 | 24 | 24 | 110 |
| VOC | 96-12-8 | 1,2-Dibromo-3-Chloropropane | T | 8260B | ug/l | 0.23 | 0.23 | 0.23 | 0.23 | | | | | | | | | | |
| VOC | 95-50-1 | 1,2-Dichlorobenzene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | 14 | 0.7 | | 0.7 | 14 |
| VOC | 107-06-2 | 1,2-Dichloroethane | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | | | | | 15200 | 910 | 100 | 100 | 100 | 15200 |
| VOC | 78-87-5 | 1,2-Dichloropropane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| VOC | 541-73-1 | 1,3-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | | 71 | 150 | 150 | 71 | 150 |
| VOC | 106-46-7 | 1,4-Dichlorobenzene | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | | 15 | 26 | 26 | 15 | 26 |
| VOC | 78-93-3 | 2-Butanone (MEK) | T | 8260B | ug/l | 2.2 | 2.2 | 2.20 | 2.20 | | | | | 282170 | 14000 | 14000 | | 14000 | 282170 |
| VOC | 591-78-6 | 2-Hexanone | T | 8260B | ug/l | 0.72 | 0.72 | 0.72 | 0.72 | | | | | 32783 | 99 | 99 | | 99 | 32783 |
| VOC | 108-10-1 | 4-Methyl-2-pentanone (MIBK) | T | 8260B | ug/l | 0.63 | 0.63 | 0.63 | 0.63 | | | | | 77400 | 170 | 170 | | 170 | 77400 |
| VOC | 67-64-1 | Acetone | T | 8260B | ug/l | 1.1 | 1.1 | 1.10 | 1.10 | | | | | 507640 | 1500 | 1500 | | 1500 | 507640 |
| VOC | 71-43-2 | Benzene | T | 8260B | ug/l | 0.09 | 0.09 | 0.09 | 0.09 | | | | | 525000 | 130 | 370 | 370 | 130 | 525000 |
| VOC | 75-25-2 | Bromoform | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | 320 | 320 | | 320 | 320 |
| VOC | 74-83-9 | Bromomethane | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | | | | | |
| VOC | 75-15-0 | Carbon disulfide | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 244 | 0.92 | 0.92 | | 0.92 | 244 |
| VOC | 56-23-5 | Carbon tetrachloride | T | 8260B | ug/l | 0.33 | 0.33 | 0.33 | 0.33 | | | | | 1970 | 9.8 | 13.3 | | 9.8 | 1970 |
| VOC | 108-90-7 | Chlorobenzene | T | 8260B | ug/l | 0.24 | 0.24 | 0.24 | 0.24 | | | | | 1203 | 64 | 1.3 | | 1.3 | 1203 |
| VOC | 74-97-5 | Chlorobromomethane | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | | | | | | | | |
| VOC | 124-48-1 | Chlorodibromomethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 75-00-3 | Chloroethane | T | 8260B | ug/l | 0.37 | 0.37 | 0.37 | 0.37 | | | | | | | | | | |
| VOC | 67-66-3 | Chloroform | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 1240 | 28 | 1.8 | | 1.8 | 1240 |
| VOC | 74-87-3 | Chloromethane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 156-59-2 | cis-1,2-Dichloroethene | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | | 590 | | | 590 | 590 |
| VOC | 10061-01-5 | cis-1,3-Dichloropropene | T | 8260B | ug/l | 0.16 | 0.16 | 0.16 | 0.16 | | | | | | 0.055 | | | 0.055 | 0.055 |
| VOC | 110-82-7 | Cyclohexane | T | 8260B | ug/l | 0.26 | 0.26 | 0.26 | 0.26 | | | | | | | | | | |
| VOC | 75-27-4 | Dichlorobromomethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | | | | | | | | | | |
| VOC | 75-71-8 | Dichlorodifluoromethane | T | 8260B | ug/l | 0.14 | 0.14 | 0.14 | 0.14 | | | | | | | | | | |
| VOC | 100-41-4 | Ethylbenzene | T | 8260B | ug/l | 0.3 | 0.3 | 0.30 | 0.30 | | | | | 440 | 7.3 | 90 | 90 | 7.3 | 440 |
| VOC | 106-93-4 | Ethylene Dibromide | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | | | | | | |
| VOC | 98-82-8 | Isopropylbenzene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | | | 2.6 | | 2.6 | 2.6 |
| VOC | 79-20-9 | Methyl acetate | T | 8260B | ug/l | 0.58 | 0.58 | 0.58 | 0.58 | | | | | | | | | | |
| VOC | 1634-04-4 | Methyl tert-butyl ether | T | 8260B | ug/l | 0.13 | 0.13 | 0.13 | 0.13 | | | | | | | 11070 | 10000 | 10000 | 11070 |
| VOC | 108-87-2 | Methylcyclohexane | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | | | | | | |
| VOC | 75-09-2 | Methylene Chloride | T | 8260B | ug/l | 0.21 | 0.21 | 0.21 | 0.21 | | | | | 42667 | 2200 | 98.1 | | 98.1 | 42667 |
| VOC | 179601-23-1 | m-Xylene & p-Xylene | T | 8260B | ug/l | 0.28 | 0.28 | 0.28 | 0.28 | | | | | | 1.8 | | | 1.8 | 1.8 |
| VOC | 95-47-6 | o-Xylene | T | 8260B | ug/l | 0.32 | 0.32 | 0.32 | 0.32 | | | | | | 13 | | | 13 | 13 |
| VOC | 100-42-5 | Styrene | T | 8260B | ug/l | 0.17 | 0.17 | 0.17 | 0.17 | | | | | | | 72 | 72 | 72 | 72 |
| VOC | 127-18-4 | Tetrachloroethene | T | 8260B | ug/l | 0.12 | 0.12 | 0.12 | 0.12 | | | | | 750 | 98 | 111 | | 98 | 750 |
| VOC | 108-88-3 | Toluene | T | 8260B | ug/l | 0.25 | 0.25 | 0.25 | 0.25 | | | | | 1269 | 9.8 | 2 | 2 | 2 | 1269 |
| VOC | 156-60-5 | trans-1,2-Dichloroethene | T | 8260B | ug/l | 0.18 | 0.18 | 0.18 | 0.18 | | | | | | 590 | 970 | | 590 | 970 |
| VOC | 10061-02-6 | trans-1,3-Dichloropropene | T | 8260B | ug/l | 0.19 | 0.19 | 0.19 | 0.19 | | | | | | 0.055 | | | 0.055 | 0.055 |
| VOC | 79-01-6 | Trichloroethene | T | 8260B | ug/l | 0.22 | 0.22 | 0.22 | 0.22 | | | | | 7257 | 47 | 21 | | 21 | 7257 |
| VOC | 75-69-4 | Trichlorofluoromethane | T | 8260B | ug/l | 0.15 | 0.15 | 0.15 | 0.15 | | | | | | | | | | |
| VOC | 75-01-4 | Vinyl chloride | T | 8260B | ug/l | 0.06 | 0.06 | 0.06 | 0.06 | | | | | | | 930 | | 930 | 930 |
| *New Phase II Analyses* | | | | | | RL | MDL | LOD | | | | | | | | | | | |
| SVOC | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | T | 8270D | ug/l | 1.00 | 0.0520 | | | | | | | | | 3 | | 3 | 3 |
| SVOC | 123-91-1 | 1,4-Dioxane | T | 8270D | ug/l | 2.00 | 0.193 | | | | | | | | | | | | |
| SVOC | 108-60-1 | 2,2'-oxybis[1-chloropropane] | T | 8270D | ug/l | 0.190 | 0.0580 | | | | | | | | | | | | |
| SVOC | 58-90-2 | 2,3,4,6-Tetrachlorophenol | T | 8270D | ug/l | 1.00 | 0.0450 | | | | | | | | | 1.2 | 1 | 1 | 1.2 |
| SVOC | 95-95-4 | 2,4,5-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 88-06-2 | 2,4,6-Trichlorophenol | T | 8270D | ug/l | 1.00 | 0.0680 | | | | | | | | | 4.9 | | 4.9 | 4.9 |
| SVOC | 120-83-2 | 2,4-Dichlorophenol | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | | | 11 | | 11 | 11 |
| SVOC | 105-67-9 | 2,4-Dimethylphenol | T | 8270D | ug/l | 1.00 | 0.0410 | | | | | | | | | | | | |
| SVOC | 51-28-5 | 2,4-Dinitrophenol | T | 8270D | ug/l | 10.0 | 1.53 | | | | | | | | | | | | |
| SVOC | 121-14-2 | 2,4-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0510 | | | | | | | | | 44 | | 44 | 44 |
| SVOC | 606-20-2 | 2,6-Dinitrotoluene | T | 8270D | ug/l | 1.00 | 0.0600 | | | | | | | | | 81 | | 81 | 81 |
| SVOC | 91-58-7 | 2-Chloronaphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | | | | | | | | |
| SVOC | 95-57-8 | 2-Chlorophenol | T | 8270D | ug/l | 1.00 | 0.0640 | | | | | | | | | 24 | | 24 | 24 |
| SVOC | 91-57-6 | 2-Methylnaphthalene | T | 8270D | ug/l | 0.190 | 0.0620 | | | | | | | | | 4.7 | | 4.7 | 4.7 |
| SVOC | 95-48-7 | 2-Methylphenol | T | 8270D | ug/l | 1.00 | 0.109 | | | | | | | 489 | 13 | 13 | | 13 | 489 |
| SVOC | 88-74-4 | 2-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.207 | | | | | | | | | | | | |
| SVOC | 88-75-5 | 2-Nitrophenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | 481 | 300 | 1920 | | 300 | 1920 |
| SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | T | 8270D | ug/l | 1.00 | 0.583 | | | | | | | | | 4.5 | | 4.5 | 4.5 |
| SVOC | 99-09-2 | 3-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | T | 8270D | ug/l | 5.00 | 1.47 | | | | | | | | | | | | |
| SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0630 | | | | | | | | 1.5 | 1.5 | | 1.5 | 1.5 |
| SVOC | 59-50-7 | 4-Chloro-3-methylphenol | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 106-47-8 | 4-Chloroaniline | T | 8270D | ug/l | 1.00 | 0.0440 | | | | | | | | | 232 | | 232 | 232 |
| SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | T | 8270D | ug/l | 1.00 | 0.0610 | | | | | | | | | | | | |
| SVOC | 100-01-6 | 4-Nitroaniline | T | 8270D | ug/l | 5.00 | 0.0580 | | | | | | | | | | | | |
| SVOC | 100-02-7 | 4-Nitrophenol | T | 8270D | ug/l | 5.00 | 0.142 | | | | | | | 481 | 300 | 60 | | 60 | 481 |
| SVOC | 83-32-9 | Acenaphthene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | 74 | | 5.8 | 5.8 | 5.8 | 74 |
| SVOC | 208-96-8 | Acenaphthylene | T | 8270D | ug/l | 0.190 | 0.0650 | | | | | | | | | | | | |
| SVOC | 98-86-2 | Acetophenone | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | | | | | | | |
| SVOC | 120-12-7 | Anthracene | T | 8270D | ug/l | 0.190 | 0.0490 | | | | | | | 0.09 | 0.73 | 0.012 | 0.012 | 0.012 | 0.73 |
| SVOC | 1912-24-9 | Atrazine | T | 8270D | ug/l | 1.00 | 0.184 | | | | | | | | | 1.8 | 1.8 | 1.8 | 1.8 |
| SVOC | 100-52-7 | Benzaldehyde | T | 8270D | ug/l | 1.00 | 0.111 | | | | | | | | | | | | |
| SVOC | 56-55-3 | Benzo[a]anthracene | T | 8270D | ug/l | 0.190 | 0.0750 | | | | | | | 0.3 | 0.014 | 0.015 | 0.015 | 0.014 | 0.3 |
| SVOC | 50-32-8 | Benzo[a]pyrene | T | 8270D | ug/l | 0.190 | 0.0530 | | | | | | | 0.65 | 0.027 | 0.018 | 0.018 | 0.018 | 0.65 |
| SVOC | 205-99-2 | Benzo[b]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0970 | | | | | | | | | | | | |

**Table 16. Sampling Analyses and MDLs for Sediment Porewater – Ecological**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Dr, Columbia Falls, MT**

| Analyte Group | Cas ID # | Analyte | Sample Fraction | Analytical Method | Unit | MDL Statistics | | | | Ecological Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min MDL | Max MDL | Mean MDL | Median MDL | DEQ 7 Acute | DEQ 7 Chronic | MDEQ Aquatic Life Standard (MDEQ, 2012. Montana Department of Environmental Quality Circular DEQ-7) | EPA National Recommended Water Quality Criteria (USEPA. 2004b. National Recommended Water Quality Criteria, 2004) | Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter II, G.W. and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision) | Suter & Tsao, 1996. GLWQI Tier II SAV/SCVs and ORNL LCVs | USEPA Region 3 Freshwater Screening Benchmark (USEPA 2006) | Canadian Water Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2008] | Minimum ESV | Maximum ESV |
| | | | | | | | | | | | | A | B | C | D | E | F | | |
| GenChem | STL00171 | Alkalinity | T | SM 2320B | ug/l | 5000 | 5000 | 5000.00 | 5000.00 | | | | | | | | | | |
| GenChem | 7664-41-7 | Ammonia | T | 350.1 | ug/l | 72 | 72 | 82.64 | 72.00 | | | | | | | | | | |
| SVOC | 191-24-2 | Benzo[g,h,i]perylene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | | | | | |
| SVOC | 207-08-9 | Benzo[k]fluoranthene | T | 8270D | ug/l | 0.190 | 0.0880 | | | | | | | | | | | | |
| SVOC | 111-91-1 | Bis(2-chloroethoxy)methane | T | 8270D | ug/l | 1.00 | 0.0670 | | | | | | | | | | | | |
| SVOC | 111-44-4 | Bis(2-chloroethyl)ether | T | 8270D | ug/l | 0.190 | 0.0400 | | | | | | | | | | | | |
| SVOC | 117-81-7 | Bis(2-ethylhexyl) phthalate | T | 8270D | ug/l | 10.0 | 4.61 | | | | | | | 912 | 3 | 16 | | 3 | 912 |
| SVOC | 85-68-7 | Butyl benzyl phthalate | T | 8270D | ug/l | 1.00 | 0.462 | | | | | | | | 19 | 19 | | 19 | 19 |
| SVOC | 105-60-2 | Caprolactam | T | 8270D | ug/l | 5.00 | 0.470 | | | | | | | | | | | | |
| SVOC | 86-74-8 | Carbazole | T | 8270D | ug/l | 0.190 | 0.0510 | | | | | | | | | | | | |
| SVOC | 218-01-9 | Chrysene | T | 8270D | ug/l | 0.190 | 0.0810 | | | | | | | | | | | | |
| SVOC | 53-70-3 | Dibenz(a,h)anthracene | T | 8270D | ug/l | 0.190 | 0.0720 | | | | | | | | | | | | |
| SVOC | 132-64-9 | Dibenzofuran | T | 8270D | ug/l | 1.00 | 0.0730 | | | | | | | 1003 | 3.7 | 3.7 | | 3.7 | 1003 |
| SVOC | 84-66-2 | Diethyl phthalate | T | 8270D | ug/l | 1.00 | 0.567 | | | | | | | 85600 | 210 | 210 | | 210 | 85600 |
| SVOC | 131-11-3 | Dimethyl phthalate | T | 8270D | ug/l | 1.00 | 0.0560 | | | | | | | | | | | | |
| SVOC | 84-74-2 | Di-n-butyl phthalate | T | 8270D | ug/l | 1.00 | 0.743 | | | | | | | 697 | 35 | 19 | 19 | 19 | 697 |
| SVOC | 117-84-0 | Di-n-octyl phthalate | T | 8270D | ug/l | 1.00 | 0.685 | | | | | | | 708 | | 22 | | 22 | 708 |
| SVOC | 206-44-0 | Fluoranthene | T | 8270D | ug/l | 0.190 | 0.0600 | | | | | | | = | | 0.04 | 0.04 | 0.04 | 0.04 |
| SVOC | 86-73-7 | Fluorene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | 3.9 | 3 | 3 | 3 | 3.9 |
| SVOC | 118-74-1 | Hexachlorobenzene | T | 8270D | ug/l | 0.190 | 0.0560 | | | | | | | | | 0.0003 | | 0.0003 | 0.0003 |
| SVOC | 87-68-3 | Hexachlorobutadiene | T | 8270D | ug/l | 0.190 | 0.0690 | | | | | | | | | 1.3 | 1.3 | 1.3 | 1.3 |
| SVOC | 77-47-4 | Hexachlorocyclopentadiene | T | 8270D | ug/l | 1.00 | 0.497 | | | | | | | | | | | | |
| SVOC | 67-72-1 | Hexachloroethane | T | 8270D | ug/l | 1.00 | 0.0620 | | | | | | | | 12 | 12 | | 12 | 12 |
| SVOC | 193-39-5 | Indeno[1,2,3-cd]pyrene | T | 8270D | ug/l | 0.190 | 0.0850 | | | | | | | | | | | | |
| SVOC | 78-59-1 | Isophorone | T | 8270D | ug/l | 1.00 | 0.0540 | | | | | | | | | | | | |
| SVOC | 91-20-3 | Naphthalene | T | 8270D | ug/l | 0.190 | 0.0590 | | | | | | | 620 | 12 | 1.1 | 1.1 | 1.1 | 620 |
| SVOC | 98-95-3 | Nitrobenzene | T | 8270D | ug/l | 2.00 | 0.165 | | | | | | | | | | | | |
| SVOC | 621-64-7 | N-Nitrosodi-n-propylamine | T | 8270D | ug/l | 0.190 | 0.0710 | | | | | | | | | | | | |
| SVOC | 86-30-6 | N-Nitrosodiphenylamine | T | 8270D | ug/l | 1.00 | 0.119 | | | | | | | 332 | 210 | 210 | | 210 | 332 |
| SVOC | 87-86-5 | Pentachlorophenol | T | 8270D | ug/l | 5.00 | 0.242 | | | 5.3 | 4 | 4 | 15 | | | 0.5 | 0.5 | 0.5 | 15 |
| SVOC | 85-01-8 | Phenanthrene | T | 8270D | ug/l | 0.190 | 0.0550 | | | | | | | 200 | | 0.4 | 0.4 | 0.4 | 200 |
| SVOC | 108-95-2 | Phenol | T | 8270D | ug/l | 1.00 | 0.0980 | | | | | | | 200 | | 4 | 4 | 4 | 200 |
| SVOC | 129-00-0 | Pyrene | T | 8270D | ug/l | 0.190 | 0.0540 | | | | | | | | | 0.025 | 0.025 | 0.025 | 0.025 |

# FIGURES

1. RI/FS Site Boundary
2. Site Features
3. Project Organizational Chart

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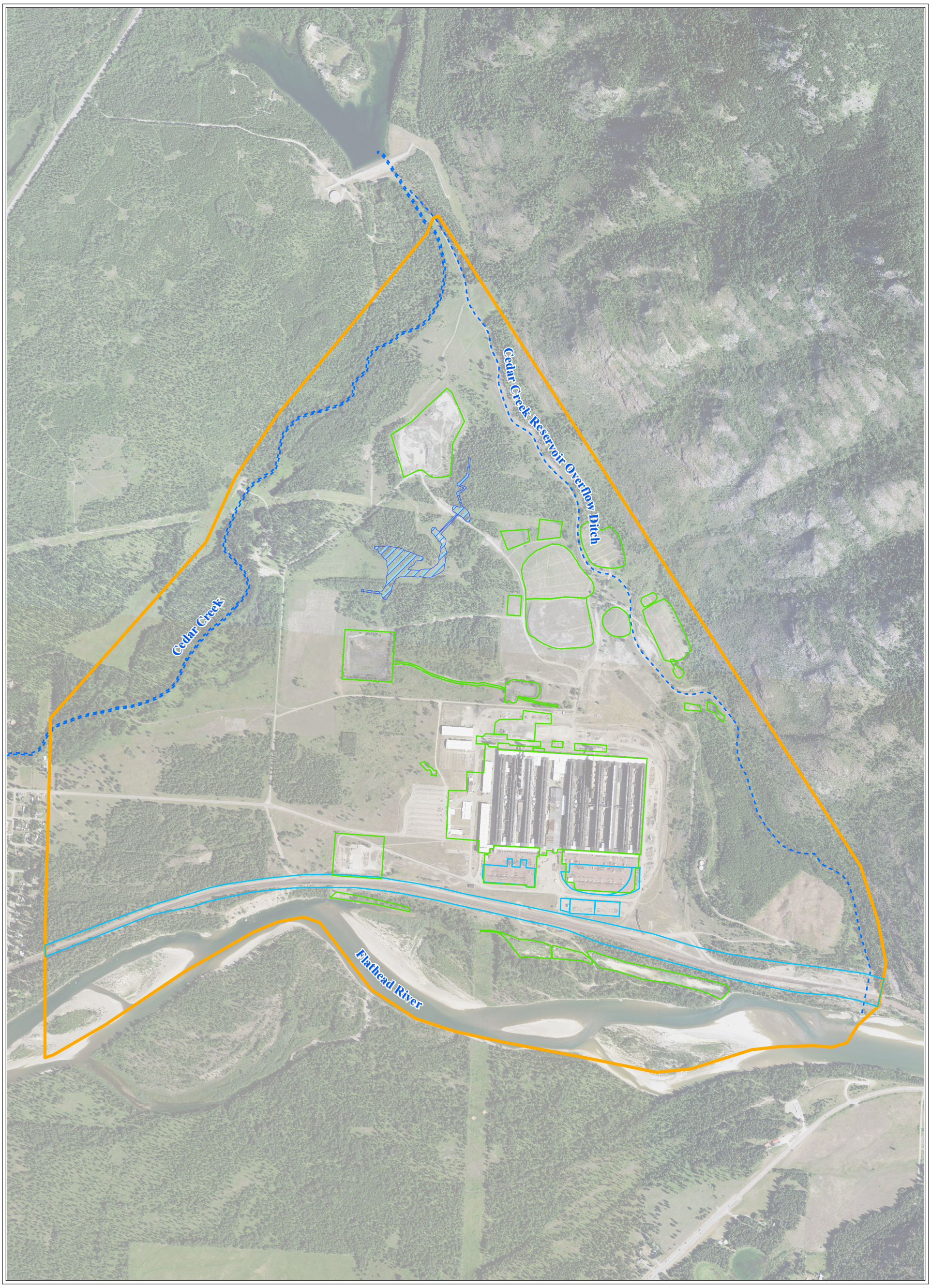
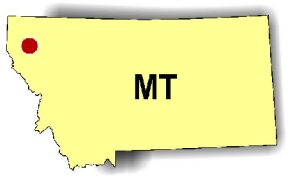



LEGEND

- APPROXIMATE THIRD–PARTY PROPERTY BOUNDARIES
- SITE BOUNDARY
- CREEK FEATURES




N

550 0 550 1,100 Feet

Title:

**RI/FS SITE BOUNDARY**

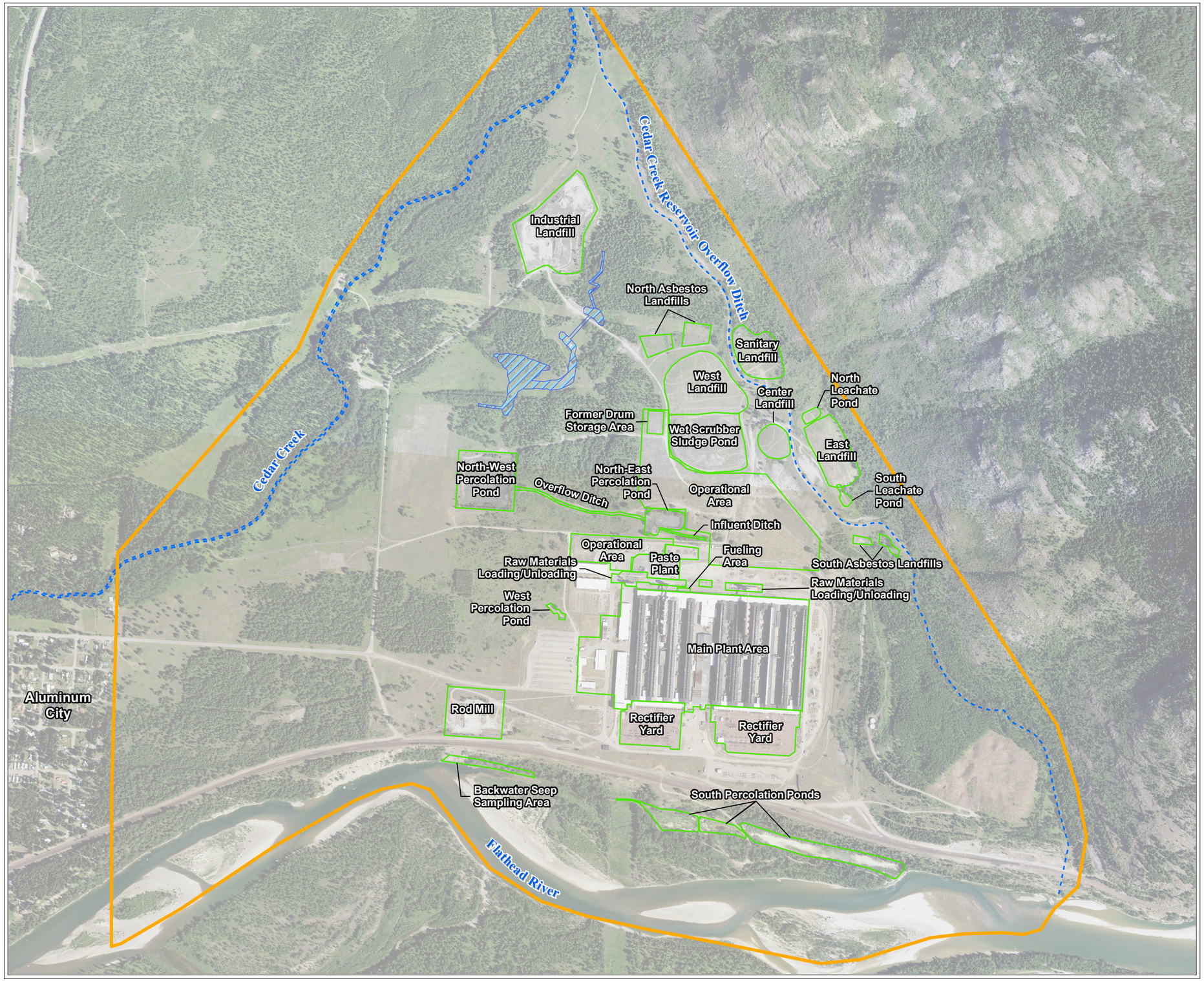
2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 06FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.7.mxd | |

FIGURE 1




N

LEGEND

- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

1,000 0 1,000 Feet

Title:

**SITE FEATURES**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 16FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.8.mxd | |

FIGURE 2

V:\GIS\Projects\2476Y\0001Y\199\2476.0001Y199.8.mxd

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To Be Decided – Hydrometrics

**Laboratory Subcontractor**
TestAmerica

**Data Validation Subcontractor**
Laboratory Data Consultants

**Drilling Subcontracor**
Cascade Drilling

**Other Subcontractor**
Kennedy/Jenks Consultants - Boat Captain
Surveyor - Sands Surveying

Lines of Communication

Lines of Authority

Title:
**ORGANIZATION CHART**
**RI/FS PHASE II REMEDIAL INVESTIGATION**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: M.R. | Date: 16FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: L.J. | Project: 2476.0002Y004 |
| File: 2476.0001Y199.6.mxd | |

FIGURE 3

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# APPENDICES

A. Temporal Variability Evaluation Data
- A–1a. Flathead River Yearly Discharge (2008 to 2017)
- A–1b. Flathead River Yearly Discharge (2016 to 2017)
- A–2a. Flathead River Yearly Discharge Tables (2008 to 2017)
- A–2b. Flathead River Yearly Discharge RPD (2008 to 2017)
- A–2c. Flathead River Discharge During Phase I Sampling Events
- A–3. Average Monthly Precipitation at Glacier National Airport (2007 to 2017)
- A–4. Fluoride Concentration in Backwater Seep Area
- A–5. Cyanide Concentration in Backwater Seep Area
- A–6. Fluoride and Cyanide Concentration in Surface Water
- A–7. CFMW-007 Hydrograph from 1996 to 2017
- A–8. GWE of CFMW-007 from 1996 to 2017
- A–9. Fluoride Concentration in Groundwater Wells
- A–10. Cyanide Concentration in Groundwater Wells
- A–11. Fluoride and Cyanide Concentration in Groundwater Wells

B. Standard Operating Procedures

C. RI/FS Schedule

D. Evaluation of Data Quality Objective-Based Minimum Sample Sizes

# APPENDIX A

## Temporal Variability Evaluation Data

A–1a. Flathead River Yearly Discharge (2008 to 2017)

A–1b. Flathead River Yearly Discharge (2016 to 2017)

A–2a. Flathead River Yearly Discharge Tables (2008 to 2017)

A–2b. Flathead River Yearly Discharge RPD (2008 to 2017)

A–2c. Flathead River Discharge During Phase I Sampling Events

A–3. Average Monthly Precipitation at Glacier National Airport (2007 to 2017)

A–4. Fluoride Concentration in Backwater Seep Area

A–5. Cyanide Concentration in Backwater Seep Area

A–6. Fluoride and Cyanide Concentration in Surface Water

A–7. CFMW-007 Hydrograph from 1996 to 2017

A–8. GWE of CFMW-007 from 1996 to 2017

A–9. Fluoride Concentration in Groundwater Wells

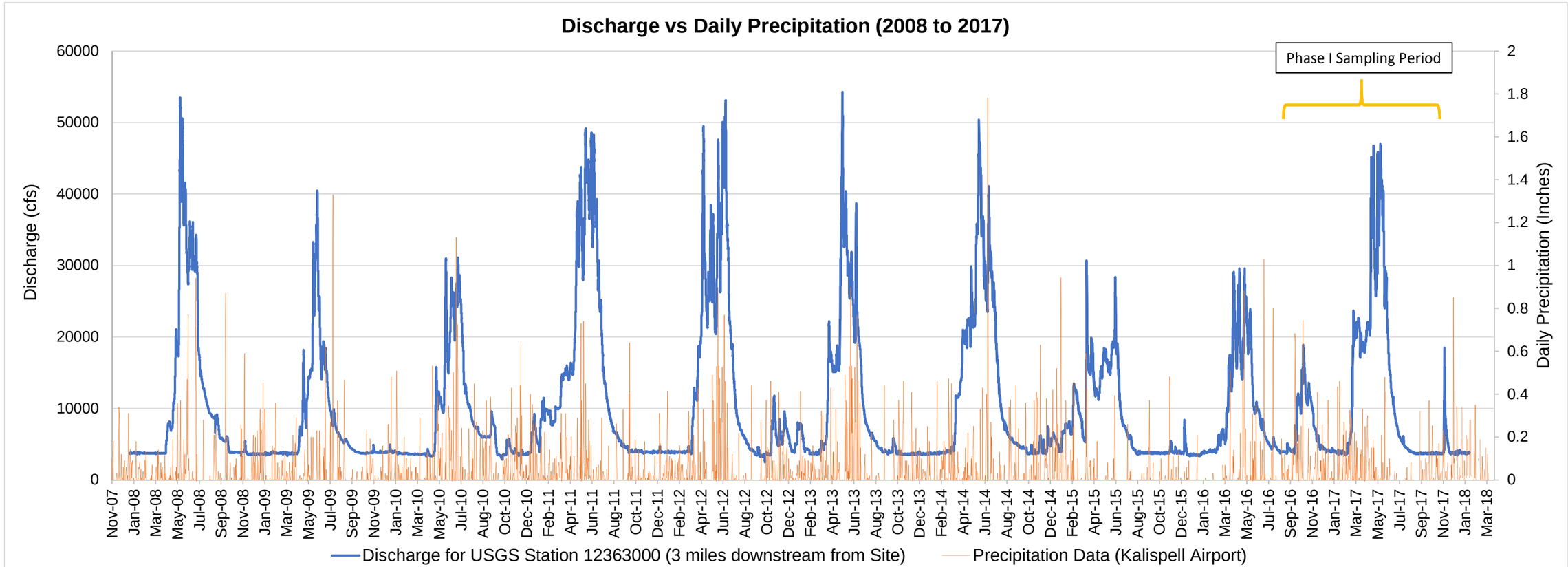
A–10. Cyanide Concentration in Groundwater Wells

A–11. Fluoride and Cyanide Concentration in Groundwater Wells

**APPENDIX A–1a**

# Flathead River Yearly Discharge (2008 to 2017)

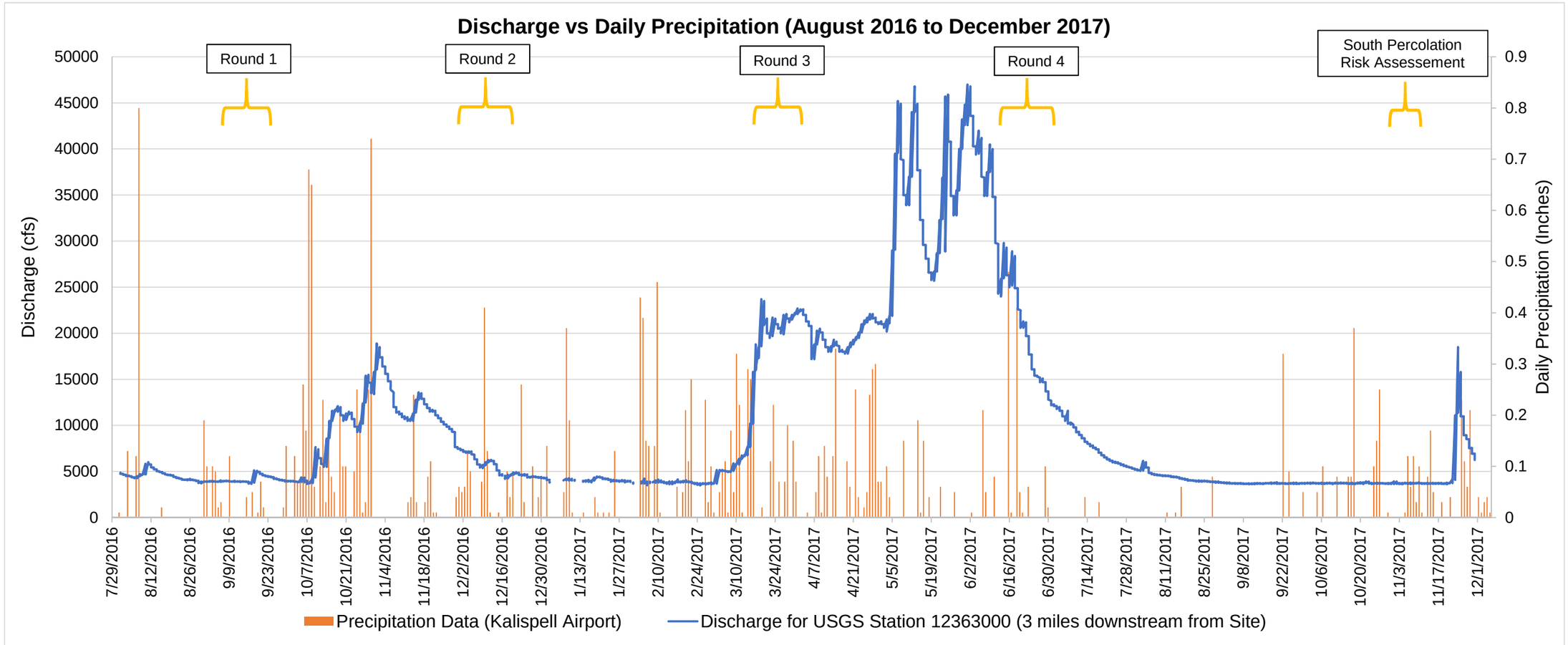
**Appendix A1a. Flathead River Yearly Discharge (2008 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**



# APPENDIX A–1b

Flathead River Yearly Discharge (2016 to 2017)

**Appendix A1b. Flathead River Yearly Discharge (2016 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**



# APPENDIX A–2a

Flathead River Yearly Discharge Tables (2008 to 2017)

**Appendix A2a. Flathead River Yearly Discharge Tables (2008 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| | Average Discharge per Month (cfs) | | | Peak Discharge per Month (cfs) | | Minimum Discharge per Month (cfs) | | Total Precipitation per Month (in) | |
|---|---|---|---|---|---|---|---|---|---|
| Month | 2016 | 2017 | 10 Year Average | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| January | 3560.71 | 4084.26 | 4434.67 | 3950.00 | 4470.00 | 3350.00 | 3590.00 | 0.21 | 0.97 |
| February | 3947.02 | 3810.00 | 4995.93 | 4300.00 | 4240.00 | 3740.00 | 3450.00 | 0.04 | 2.78 |
| March | 5369.88 | 13229.50 | 6772.68 | 7140.00 | 23700.00 | 3770.00 | 3620.00 | 0.17 | 2.7 |
| April | 15800.72 | 19984.38 | 14079.66 | 29100.00 | 22700.00 | 5470.00 | 17200.00 | 0.89 | 2.36 |
| May | 21182.39 | 33720.33 | 25667.68 | 29600.00 | 46800.00 | 14100.00 | 20200.00 | 3.12 | 0.8 |
| June | 14684.72 | 27738.50 | 26661.76 | 23900.00 | 47000.00 | 9260.00 | 12800.00 | 1.34 | 1.48 |
| July | 6940.55 | 8179.72 | 13064.22 | 9910.00 | 12700.00 | 4870.00 | 5210.00 | 1.51 | 0.07 |
| August | 4569.71 | 4407.56 | 6062.04 | 6020.00 | 6160.00 | 3720.00 | 3770.00 | 1.08 | 0.16 |
| September | 4115.16 | 3716.11 | 4603.97 | 5130.00 | 3840.00 | 3670.00 | 3630.00 | 0.86 | 0.51 |
| October | 8572.74 | 3736.55 | 4318.34 | 15800.00 | 3930.00 | 3650.00 | 3630.00 | 4.86 | 1.23 |
| November | 12137.65 | 5285.93 | 5289.74 | 18900.00 | 18500.00 | 7470.00 | 3630.00 | 0.62 | 1.55 |
| December | 5376.87 | 4079.41 | 4407.57 | 7470.00 | 6270.00 | 4210.00 | 3450.00 | 1.75 | 2.19 |
| **Average** | **8854.84** | **10997.69** | **10029.85** | **13435.00** | **16692.50** | **5606.67** | **7015.00** | **1.37** | **1.40** |

# APPENDIX A–2b

Flathead River Yearly Discharge RPD (2008 to 2017)

**Appendix A2b. Flathead River Yearly Discharge RPD (2008 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| | Average Yearly Discharge | | Minimum Discharge | | | Maximum Discharge | | |
|---|---|---|---|---|---|---|---|---|
| Year | (cfs) | RPD for Average | Date | (cfs) | RPD for Average | Date | (cfs) | RPD for Average |
| **2008** | 10272.69 | 2.28% | 11/3/2008 | 3370 | 2.40% | 5/19/2008 | 53500 | 21.76% |
| **2009** | 7338.06 | -26.94% | 3/10/2009 | 3380 | 2.70% | 5/31/2009 | 40500 | -7.83% |
| **2010** | 8146.73 | -18.89% | 10/22/2010 | 2860 | -13.10% | 6/22/2010 | 31100 | -29.22% |
| **2011** | 13276.46 | 32.18% | 1/1/2011 | 3720 | 13.04% | 6/8/2011 | 49200 | 11.97% |
| **2012** | 11868.28 | 18.16% | 10/13/2012 | 2470 | -24.95% | 6/27/2012 | 53100 | 20.85% |
| **2013** | 9759.57 | -2.83% | 12/6/2013 | 3430 | 4.22% | 5/14/2013 | 54300 | 23.58% |
| **2014** | 11479.58 | 14.29% | 1/5/2014 | 3550 | 7.87% | 5/24/2014 | 50400 | 14.70% |
| **2015** | 8195.17 | -18.41% | 12/25/2015 | 3330 | 1.19% | 3/16/2015 | 30700 | -30.13% |
| **2016** | 8853.89 | -11.85% | 1/19/2016 | 3350 | 1.79% | 5/9/2016 | 29600 | -32.64% |
| **2017** | 11248.35 | 11.99% | 2/3/2017 | 3450 | 4.83% | 6/1/2017 | 47000 | 6.96% |
| **Average** | **10043.88** | | | **3291** | | | **43940** | |

| | Minimum Discharge | | | Maximum Discharge | | |
|---|---|---|---|---|---|---|
| Year | (cfs) | 2016 RPD of Min | 2017 RPD of Min | (cfs) | 2016 RPD of Max | 2017 RPD of Max |
| 2008 | 3370 | 0.60% | -0.59% | 53500 | 80.74% | 13.83% |
| 2009 | 3380 | 0.90% | -0.89% | 40500 | 36.82% | -13.83% |
| 2010 | 2860 | -14.63% | 17.13% | 31100 | 5.07% | -33.83% |
| 2011 | 3720 | 11.04% | -9.95% | 49200 | 66.22% | 4.68% |
| 2012 | 2470 | -26.27% | 35.63% | 53100 | 79.39% | 12.98% |
| 2013 | 3430 | 2.39% | -2.33% | 54300 | 83.45% | 15.53% |
| 2014 | 3550 | 5.97% | -5.63% | 50400 | 70.27% | 7.23% |
| 2015 | 3330 | -0.60% | 0.60% | 30700 | 3.72% | -34.68% |
| 2016 | 3350 | 0.00% | 0.00% | 29600 | 0.00% | -37.02% |
| 2017 | 3450 | 2.99% | -2.90% | 47000 | 58.78% | 13.83% |
| **Average** | **3291** | | | **43940** | | |

RPD - Relative Percent Difference
cfs - Cubic Feet per Second

**APPENDIX A–2c**

# Flathead River Discharge During Phase I Sampling Events

**Appendix A2c. Flathead River Discharge During Phase I Sampling Events**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| Round | Sample Date | Flathead River Discharge (cfs) | Flathead River Elevation (NAVD88) | Daily Precipitation (inches) |
|---|---|---|---|---|
| Round 1 | 6/6/2016 | 22225.00 | 96 | 0.00 |
| Round 1 | 6/7/2016 | 23149.47 | 95 | 0.00 |
| Round 1 | 8/29/2016 | 3894.17 | 96 | 0.00 |
| Round 1 | 9/9/2016 | 3969.79 | 96 | 0.00 |
| Round 1 | 9/16/2016 | 3804.69 | 96 | 0.00 |
| Round 2 | 11/30/2016 | 7576.56 | 96 | 0.04 |
| Round 2 | 12/1/2016 | 7385.42 | 96 | 0.06 |
| Round 2 | 12/2/2016 | 7235.42 | 96 | 0.05 |
| Round 2 | 12/20/2016 | 4790.83 | 96 | 0.09 |
| Round 3 | 3/13/2017 | 6757.19 | 96 | 0.29 |
| Round 3 | 3/15/2017 | 8669.38 | 96 | 0.21 |
| Round 3 | 3/16/2017 | 13118.75 | 96 | 0.00 |
| Round 3 | 4/3/2017 | 22357.29 | 96 | 0.01 |
| Round 3 | 4/4/2017 | 21681.25 | 96 | 0.00 |
| Round 4 | 6/12/2017 | 27235.42 | 96 | 0.00 |
| Round 4 | 6/13/2017 | 24381.25 | 96 | 0.48 |
| Round 4 | 6/14/2017 | 28765.63 | 96 | 0.01 |
| Round 4 | 6/15/2017 | 27869.79 | 96 | 0.00 |
| South Perc Pond | 10/31/2017 | 3703.02 | 96 | 0.01 |
| South Perc Pond | 11/1/2017 | 3750.10 | 96 | 0.12 |
| South Perc Pond | 11/3/2017 | 3714.06 | 96 | 0.12 |
| South Perc Pond | 11/7/2017 | 3702.29 | 96 | 0.00 |

**APPENDIX A–3**

# Average Monthly Precipitation at Glacier National Airport (2007 to 2017)

**Appendix A3. Average Monthly Precipitation at Glacier National Airport (2007 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| Year | January Average Precipitation (Inches) | RPD | February Average Precipitation (Inches) | RPD | March Average Precipitation (Inches) | RPD | April Average Precipitation (Inches) | RPD | May Average Precipitation (Inches) | RPD | June Average Precipitation (Inches) | RPD | July Average Precipitation (Inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2007** | 0.69 | -49.74% | 1.29 | 25.02% | 0.39 | -69.70% | 0.89 | -23.81% | 2.59 | 59.07% | 0.91 | -69.74% | 0.60 |
| **2008** | 1.03 | -24.97% | 0.47 | -54.45% | 0.77 | -40.18% | 0.50 | -57.20% | 1.46 | -10.33% | 2.22 | -26.18% | 1.81 |
| **2009** | 1.73 | 26.03% | 0.96 | -6.96% | 1.00 | -22.32% | 0.82 | -29.81% | 1.12 | -31.21% | 1.53 | -49.12% | 2.76 |
| **2010** | 1.58 | 15.10% | 0.43 | -58.33% | 0.61 | -52.61% | 1.95 | 66.93% | 2.43 | 49.25% | 4.20 | 39.66% | 0.92 |
| **2011** | 2.39 | 74.11% | 1.16 | 12.42% | 1.12 | -12.99% | 1.84 | 57.51% | 1.85 | 13.62% | 3.16 | 5.08% | 0.69 |
| **2012** | 1.37 | -0.20% | 1.04 | 0.79% | 1.65 | 28.18% | 1.31 | 12.14% | 1.56 | -4.19% | 6.20 | 106.17% | 0.74 |
| **2013** | 1.37 | -0.20% | 0.97 | -5.99% | 1.65 | 28.18% | 1.31 | 12.14% | 1.56 | -4.19% | 6.20 | 106.17% | 0.74 |
| **2014** | 1.35 | -1.66% | 1.09 | 5.64% | 2.44 | 89.55% | 0.63 | -46.07% | 1.20 | -26.30% | 5.24 | 74.24% | 0.39 |
| **2015** | 2.41 | 75.56% | 1.12 | 8.55% | 1.66 | 28.95% | 0.35 | -70.04% | 0.22 | -86.49% | 0.60 | -80.05% | 0.36 |
| **2016** | 0.21 | -84.70% | 0.04 | -96.12% | 0.17 | -86.79% | 0.89 | -23.81% | 3.12 | 91.62% | 1.34 | -55.44% | 1.51 |
| **2017** | 0.97 | -29.34% | 2.78 | 169.43% | 2.70 | 109.75% | 2.36 | 102.02% | 0.80 | -50.87% | 1.48 | -50.79% | 0.07 |
| **Monthly Average Total Precipitation (Inches)** | **1.37** | | **1.03** | | **1.29** | | **1.17** | | **1.63** | | **3.01**[1] | | **0.96** |

[1] Maximum Monthly Average
[2] Minimum Monthly Average
RPD - Relative Percent Difference

**Appendix A3. Average Monthly Precipitation at Glacier National Airport (2007 to 2017)**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

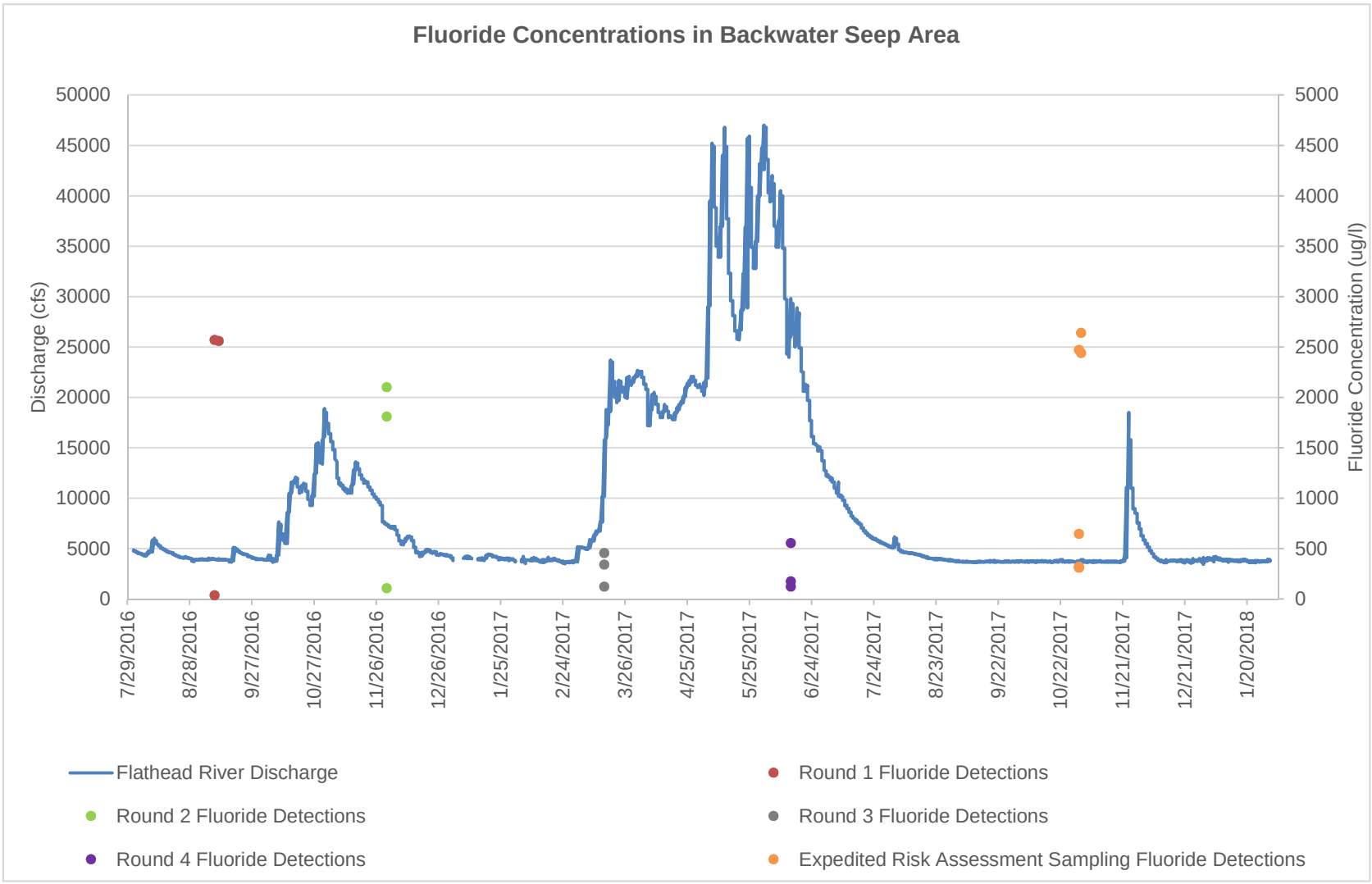
| Year | RPD | August Average Precipitation (Inches) | RPD | September Average Precipitation (Inches) | RPD | October Average Precipitation (Inches) | RPD | November Average Precipitation (Inches) | RPD | December Average Precipitation (Inches) | RPD | Yearly Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2007** | -37.68% | 0.27 | -60.51% | 1.07 | 32.40% | 0.84 | -48.09% | 0.59 | -50.42% | 1.33 | -8.90% | **11.46** |
| **2008** | 88.01% | 0.94 | 37.50% | 1.26 | 55.91% | 0.43 | -73.43% | 1.30 | 9.24% | 2.28 | 56.16% | **14.47** |
| **2009** | 186.69% | 1.16 | 69.68% | 0.14 | -82.68% | 1.29 | -20.28% | 0.37 | -68.91% | 1.35 | -7.53% | **14.23** |
| **2010** | -4.44% | 1.39 | 103.32% | 1.81 | 123.96% | 0.53 | -67.25% | 2.53 | 112.61% | 2.22 | 52.05% | **20.60** |
| **2011** | -28.33% | 0.47 | -31.25% | 0.47 | -41.84% | 1.86 | 14.94% | 0.42 | -64.71% | 0.74 | -49.32% | **16.17** |
| **2012** | -23.14% | 0.30 | -56.12% | 0.44 | -45.56% | 2.66 | 64.38% | 1.53 | 28.57% | 1.19 | -18.49% | **19.99** |
| **2013** | -23.14% | 0.30 | -56.12% | 0.44 | -45.56% | 2.66 | 64.38% | 1.53 | 28.57% | 1.19 | -18.49% | **19.92** |
| **2014** | -59.49% | 1.32 | 93.09% | 1.14 | 41.06% | 1.19 | -26.46% | 2.54 | 113.45% | 2.35 | 60.96% | **20.88** |
| **2015** | -62.61% | 0.13 | -80.98% | 0.75 | -7.20% | 1.14 | -29.55% | 0.47 | -60.50% | 0.20 | -86.30% | **9.41** |
| **2016** | 56.85% | 1.08 | 57.98% | 0.86 | 6.41% | 4.86 | 200.34% | 0.62 | -47.90% | 1.75 | 19.86% | **16.45** |
| **2017** | -92.73% | 0.16 | -76.60% | 0.51 | -36.90% | 0.47 | -78.99% | 0.10 | -91.60% | 0.04 | -97.26% | **12.44** |
| **Monthly Average Total Precipitation (Inches)** | | **0.68**[2] | | **0.81** | | **1.62** | | **1.19** | | **1.46** | **Yearly Average Total Precipitation (Inches)** | **16.00** |

[1] Maximum Monthly Average
[2] Minimum Monthly Average
RPD - Relative Percent Difference

# APPENDIX A–4

Fluoride Concentration in
Backwater Seep Area

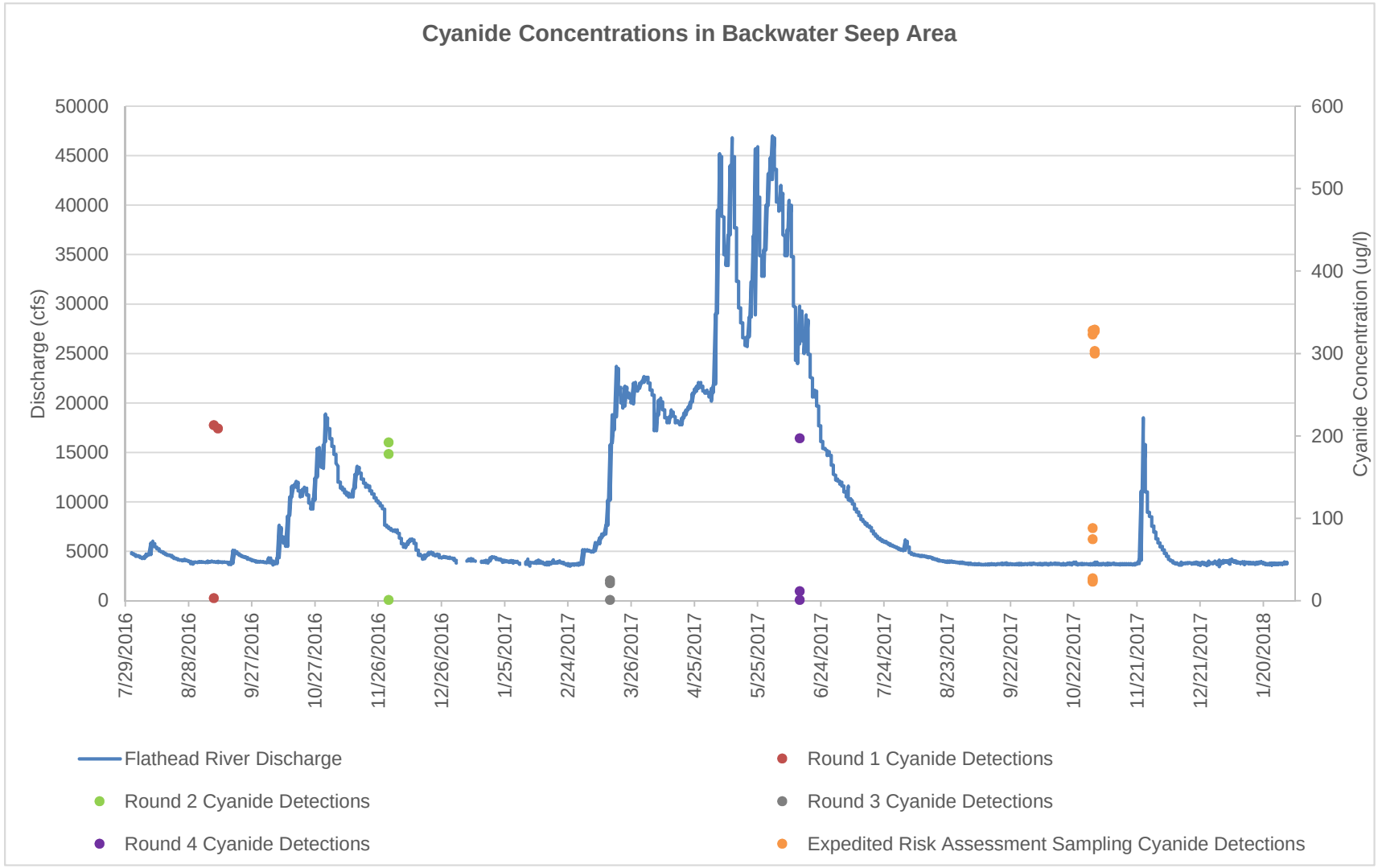
**Appendix A4. Fluoride Concentration in Backwater Seep Area**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**



# APPENDIX A–5

Cyanide Concentration in
Backwater Seep Area

**Appendix A5. Cyanide Concentration in Backwater Seep Area**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**






2476.0001Y004.199/WKB

# APPENDIX A–6

# Fluoride and Cyanide Concentration in Surface Water

**Appendix A6. Fluoride and Cyanide Concentration in Surface Water**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

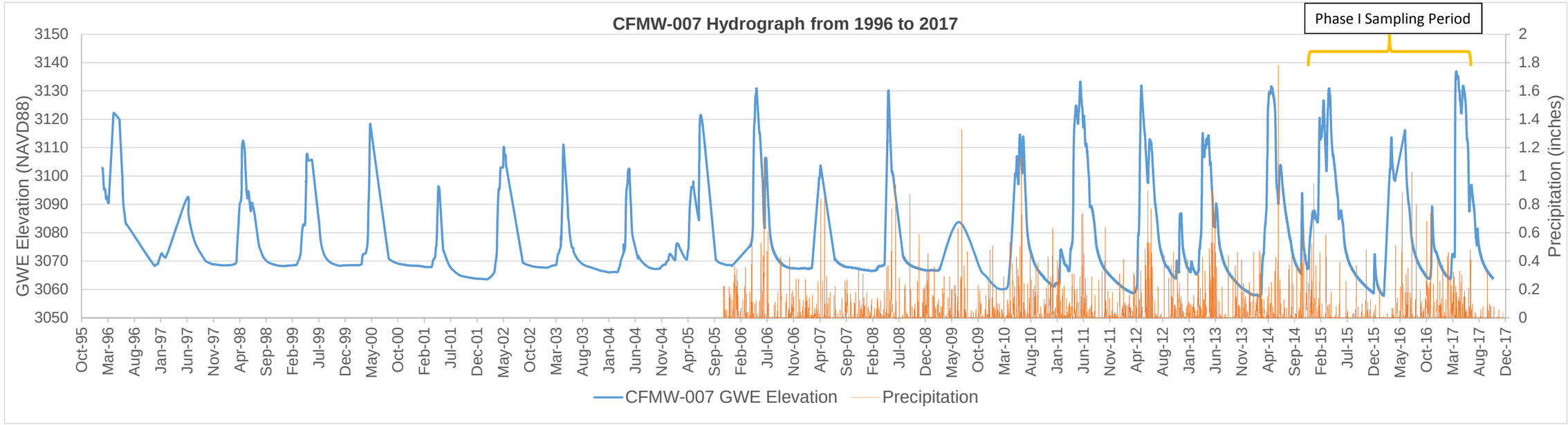
| Sample Location | Site Feature | Cyanide, Total | | | | Fluoride | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Round 1 | Round 2 | Round 3 | Round 4 | Round 1 | Round 2 | Round 3 | Round 4 |
| CFSWP-001 | Flathead River | 2 U | 2 U | 2 U | 2 U | 35.8 J- | 211 J- | 84.2 | 118 |
| CFSWP-002 | Flathead River | 2 U | 2 U | 2 U | 2 U | 35.9 J- | 547 J- | 95 | 119 |
| CFSWP-003 | Seep Area | 18.8 | 36.2 | 7.7 J | 9.5 J | 181 | 615 J- | 198 J | 192 |
| CFSWP-004 | Seep Area | 209 | 178 | 21.3 | 11.5 | 2560 | 1810 J- | 342 J | 175 |
| CFSWP-005 | Seep Area | 213 | 192 | 24.7 | 197 | 2570 | 2100 J- | 457 J | 555 |
| CFSWP-006 | Flathead River | 3.2 J | 2 U | 2 U | 2 U | 37.3 J | 106 J- | 122 J | 122 |
| CFSWP-007 | Flathead River | 2 U | 2 U | 2 U | 2 U | 33.8 J- | 110 J- | 114 J | 123 |
| CFSWP-008 | Flathead River | 2 U | 2 U | 2 U | 2 U | 33.5 J- | 107 J- | 96.8 | 124 |
| CFSWP-009 | Flathead River | 4 U | DRY | 2 U | 2 U | 80.3 | DRY | 105 | 188 |
| CFSWP-010 | Cedar Creek Reservoir Overflow Ditch | 4 U | DRY | 2 U | 2 U | 39.4 J | DRY | 2600 | 181 |
| CFSWP-011 | Cedar Creek Reservoir Overflow Ditch | 4 U | DRY | 2 U | 2 U | 38.7 J | DRY | 103 | 131 |
| CFSWP-012 | Cedar Creek Reservoir Overflow Ditch | 4 U | DRY | 2 U | 2 U | 39.5 J | DRY | 101 | 131 |
| CFSWP-013 | Cedar Creek Reservoir Overflow Ditch | 4 U | 2 U | 2 U | 2 U | 39.2 J | 473 J- | 308 | 131 |
| CFSWP-014 | Cedar Creek Reservoir Overflow Ditch | 2 U | 15.3 J | 2 U | 2 U | 55.8 J | 117 J- | 126 | 137 |
| CFSWP-015 | Cedar Creek | 2.3 J | 10.6 | 2 U | 2 U | 62.4 J | 119 J- | 129 | 135 |
| CFSWP-016 | Cedar Creek | 2 U | 2 U | 2 U | 2 U | 58.8 J | 123 J- | 132 | 135 |
| CFSWP-017 | Flathead River | 2 U | 2 U | 2 U | 2 U | 56.2 J- | 106 J- | 85.7 | 121 |
| CFSWP-018 | South Percolation Ponds | 4 U | 2 U | 2 U | 77.2 | 353 | 828 J- | 365 | 1700 |
| CFSWP-019 | South Percolation Ponds | 4 U | 2 U | 2 U | 2 U | 379 | 785 J- | 350 | 305 |
| CFSWP-020 | South Percolation Ponds | 12.5 | 16.4 | 11.3 | 2 U | 250 | 265 J- | 330 J | 308 |
| CFSWP-021 | Northern SW Area | 4 U | 2 U | 2 U | 2 U | 166 | 189 J- | 231 | 243 |
| CFSWP-022 | Northern SW Area | 4 U | DRY | 2 U | DRY | 177 | DRY | 223 | DRY |
| CFSWP-023 | Northwest Percolation Pond | DRY | DRY | 7.6 J | DRY | DRY | DRY | 2150 | DRY |
| CFSWP-024 | Northeast Percolation Pond | DRY | DRY | DRY | 2 U | DRY | DRY | DRY | 22400 J+ |
| CFSWP-025 | Cedar Creek | NA | 2 U | 2 U | 2 U | NA | 115 J- | 128 | 134 |
| | Minimum | 1 | 0 | 3 | 1 | 19 | 1 | 1 | 2 |
| | Maximum | 3 | 4 | 1 | 1 | 2 | 5 | 5 | 14 |

Orange shading indicates minimum concentration across sampling rounds
Purple shading indicates maximum concentration across sampling rounds

**APPENDIX A–7**

CFMW-007 Hydrograph from
1996 to 2017

**Appendix A7. CFMW-007 Hydrograph from 1996 to 2017**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**



**APPENDIX A–8**

# GWE of CFMW-007 from 1996 to 2017

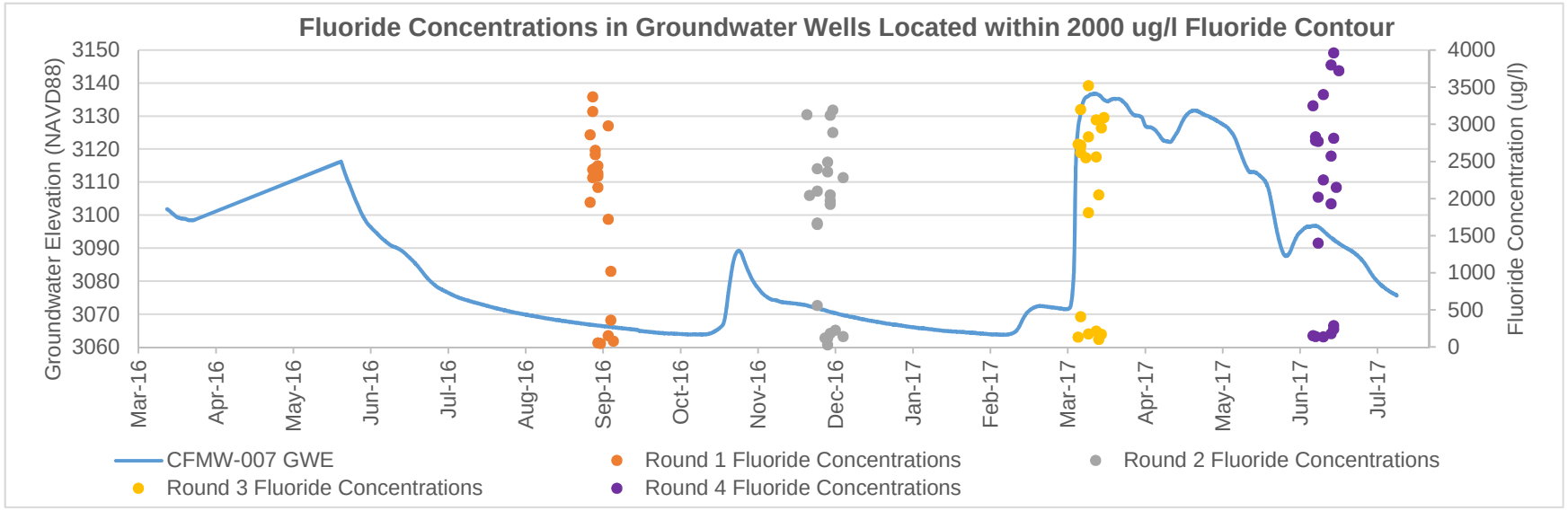
**Appendix A8. Groundwater Elevation of CFMW-007 from 1996 to 2017**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

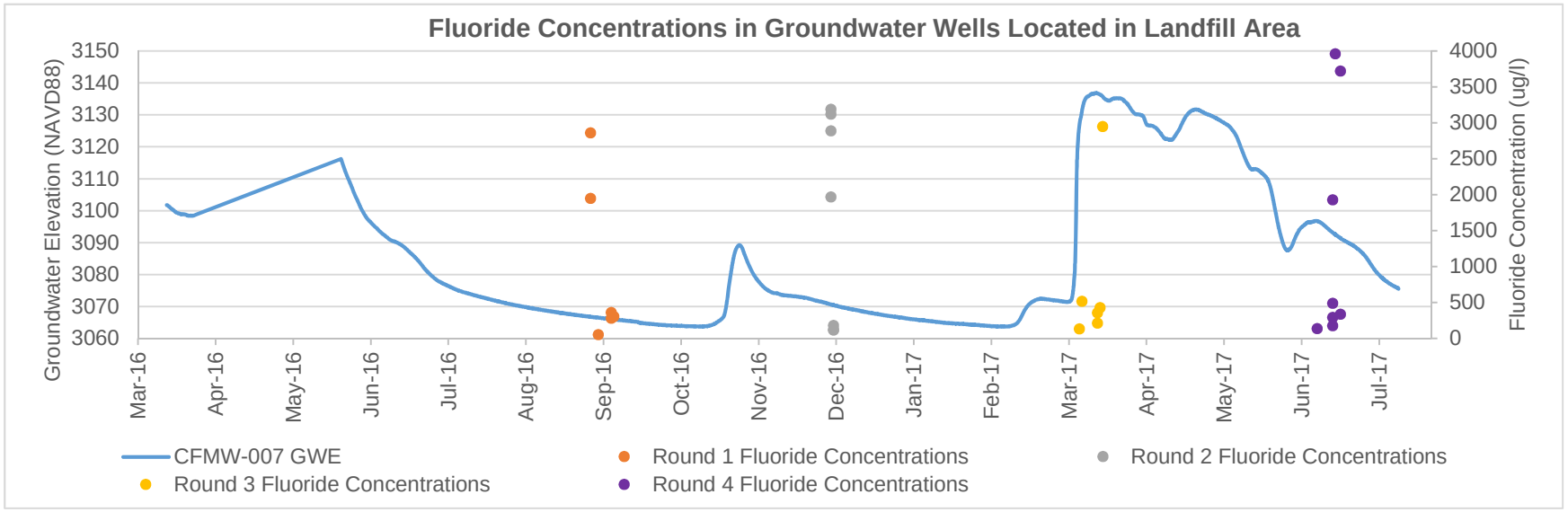
| Year | Date of Maximum Elevation | Maximum Elevation (NAVD88) | Date of Minimum Elevation | Minimum Elevation (NAVD88) |
|---|---|---|---|---|
| 1996 | 4/27/1996 | 3122.23 | 12/13/1996 | 3068.46 |
| 1997 | 6/17/1997 | 3092.11 | 1/3/1997 | 3069.10 |
| 1998 | 5/4/1998 | 3112.47 | 12/28/1998 | 3068.24 |
| 1999 | 5/2/1999 | 3107.90 | 1/1/1999 | 3068.36 |
| 2000 | 4/26/2000 | 3118.41 | 12/29/2000 | 3068.42 |
| 2001 | 5/19/2001 | 3096.43 | 12/29/2001 | 3063.80 |
| 2002 | 5/25/2002 | 3110.27 | 2/16/2002 | 3063.63 |
| 2003 | 4/30/2003 | 3111.07 | 12/31/2003 | 3066.24 |
| 2004 | 5/6/2004 | 3102.58 | 1/15/2004 | 3066.07 |
| 2005 | 6/24/2005 | 3120.43 | 12/14/2005 | 3068.34 |
| 2006 | 5/1/2006 | 3130.90 | 12/27/2006 | 3067.37 |
| 2007 | 5/1/2007 | 3103.75 | 12/31/2007 | 3066.95 |
| 2008 | 5/21/2008 | 3130.18 | 2/12/2008 | 3066.53 |
| 2009 | 6/26/2009 | 3083.78 | 11/24/2009 | 3064.89 |
| 2010 | 6/7/2010 | 3114.57 | 2/3/2010 | 3060.33 |
| 2011 | 5/18/2011 | 3133.24 | 12/31/2011 | 3061.40 |
| 2012 | 4/29/2012 | 3131.93 | 3/16/2012 | 3058.69 |
| 2013 | 4/13/2013 | 3115.05 | 12/31/2013 | 3058.87 |
| 2014 | 5/8/2014 | 3131.57 | 2/25/2014 | 3057.74 |
| 2015 | 4/2/2015 | 3130.83 | 12/11/2015 | 3058.73 |
| 2016 | 6/7/2016 | 3116.25 | 2/8/2016 | 3057.81 |
| 2017 | 3/26/2017 | 3136.89 | 2/19/2017 | 3063.76 |
| | **Average of Maximum Elevation (NAVD88)** | **3116.04** | **Average of Minimum Elevation (NAVD88)** | **3064.26** |

# APPENDIX A–9

# Fluoride Concentration in Groundwater Wells

**Appendix A9. Fluoride Concentration in Groundwater Wells**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

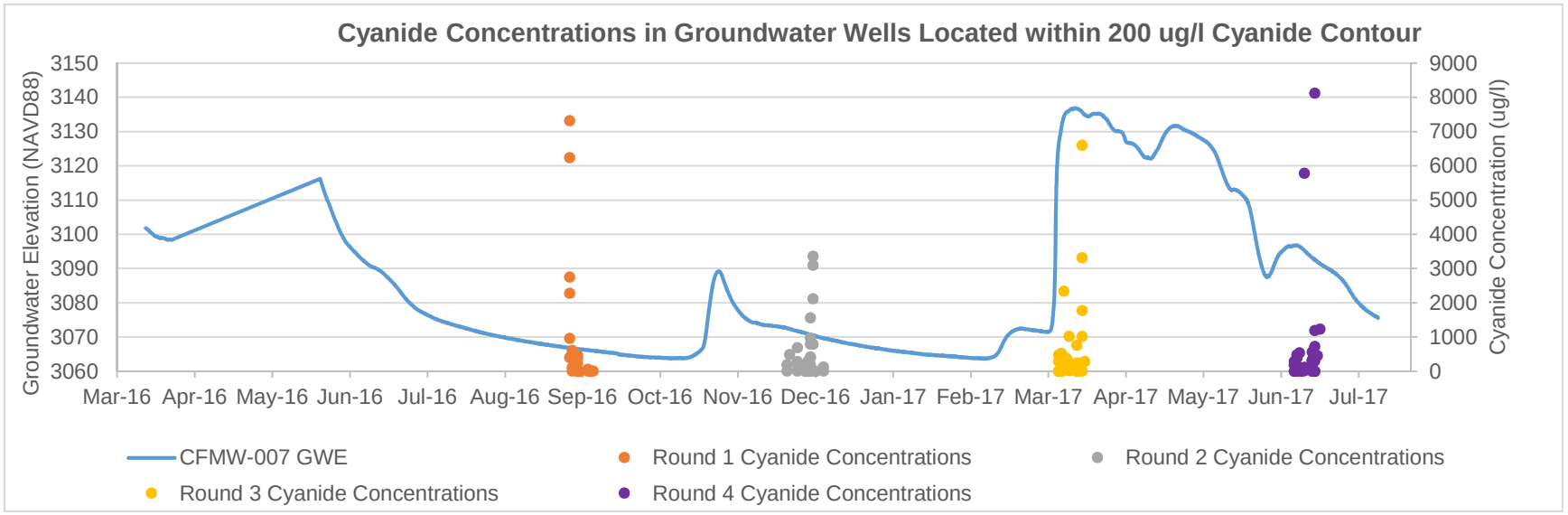


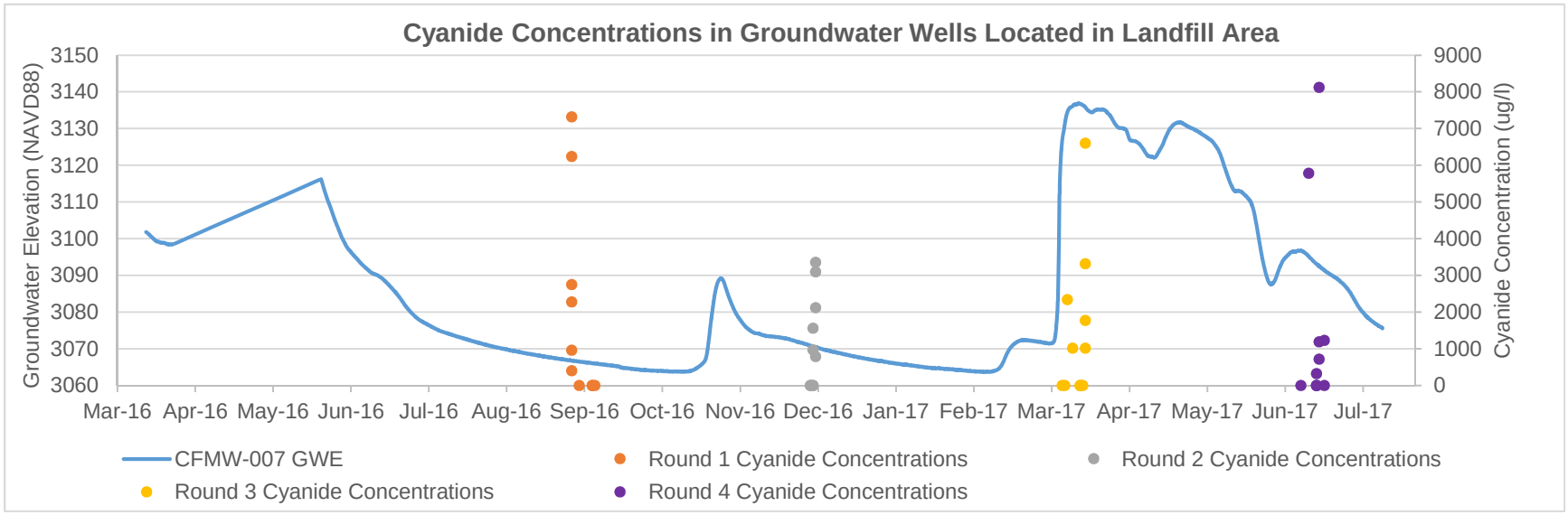



**APPENDIX A–10**

# Cyanide Concentration in Groundwater Wells

**Appendix A10. Cyanide Concentration in Groundwater Wells**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**



**APPENDIX A–11**

# Fluoride and Cyanide Concentration in Groundwater Wells

**Appendix A11. Fluoride and Cyanide Concentration in Groundwater Wells**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| Sample Location | Cyanide, Total | | | | Fluoride | | | | Water Level (ft-amsl) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 4 | Round 1 | Round 2 | Round 3 | Round 4 | Round 1 | Round 2 | Round 3 | Round 4 |
| CFMW-001 | 2.4 J | 2 U | 2 U | 2 U | 91.7 | 132 | 184 | 159 | 3075.253 | 3075.443 | 3075.413 | 3077.603 |
| CFMW-002 | 2060 J | DRY | 1370 | 985 | 18900 | DRY | 8900 | 4930 | 3065.28 | 3064.01 | DRY | 3077.33 |
| CFMW-003 | 15.4 | 19.1 | 14 | 13.2 | 15 U | 536 J- | 60 U | 60 U | 3121.48 | 3122.83 | 3123.35 | 3126.1 |
| CFMW-003a | 2.1 J | 2 U | 2 U | 2 U | 312 | 337 | 373 | 276 | 2994.17 | 2996.23 | 2997.36 | 3001.89 |
| CFMW-007 | 2.1 J | 2 U | 4.7 J | 2 U | 77 J | 123 | 101 | 152 | 3067.849 | 3072.999 | 3071.269 | 3096.249 |
| CFMW-008 | 2 U | 2 U | 2.2 J | 2 U | 777 | 456 J | 427 | 527 | 3099.37 | 3116.79 | 3126.91 | 3163.12 |
| CFMW-008a | 2.2 J | 2 U | 2.8 J | 2 U | 180 | 179 J | 160 | 304 J- | 3131.41 | 3132.43 | 3133.02 | 3133.24 |
| CFMW-010 | 7320 J | 2120 | 1020 | 1190 | 30900 | 3190 | 17200 | 6810 | 3065.38 | 3064.26 | 3061.96 | 3078.96 |
| CFMW-011 | 80.7 | 132 | 235 | 125 | 207 | 241 J | 298 J+ | 297 J- | 3064.99 | 3063.39 | 3060.18 | 3075 |
| CFMW-011a | 2 U | 2 U | 2 U | 2 U | 200 | 194 J- | 246 | 197 | 3003.1 | 3003.78 | 3004.95 | 3011.6 |
| CFMW-012 | 2280 J | 972 | 2340 | 5780 | 12400 | 5750 J | 12600 J+ | 30600 | 3066.78 | 3065.42 | 3062.17 | 3076.98 |
| CFMW-012a | 2 U | 2 U | 2 U | 2 U | 54.6 J | 119 | 135 | 139 | 2997.42 | 2999.05 | 3000.11 | 3006.02 |
| CFMW-014 | 2750 J | 3360 | 3320 | 720 | 8300 | 17300 J- | 13000 | 3960 | 3064.88 | 3063.34 | 3060.18 | 3075.13 |
| CFMW-015 | 6240 J | 3100 | 6600 | 8120 | 38400 | 16800 J- | 4740 | 52900 | 3065.08 | 3064.01 | 3060.97 | 3075.48 |
| CFMW-016 | DRY | DRY | 2.3 J | 2 U | DRY | DRY | 428 | 338 | 3068.89 | 3073.3 | 3072.66 | 3094.73 |
| CFMW-016a | 2.8 J | 2 J | 2.1 J | 2.1 J | 304 | 293 J- | 358 J+ | 293 J+ | 3066.78 | 3073.32 | 3072.67 | 3094.62 |
| CFMW-017 | DRY | DRY | 1880 | 103 | DRY | DRY | 13400 | 1160 J+ | DRY | 3073.549 | 3072.919 | 3094.439 |
| CFMW-018 | DRY | DRY | 12.2 | 78 | DRY | DRY | 569 | 451 | DRY | DRY | 3086 | 3092.74 |
| CFMW-019 | 961 J | 791 | 1770 | 1230 | 2860 | 2890 | 2950 | 3720 | 3064.43 | 3062.7 | 3059.87 | 3073.25 |
| CFMW-019a | 2 U | 2 U | 2 U | 2 U | 361 | 182 J- | 214 J+ | 179 J+ | 2997.48 | 2999.07 | 3000.11 | 3006.71 |
| CFMW-020 | 2.9 J | 2 U | 2 U | 2 J | 281 | 301 | 516 | 489 J+ | 3066.687 | 3073.037 | 3072.357 | 3093.767 |
| CFMW-021 | 400 J | 1560 | 1020 | 321 | 1950 | 3120 J- | 4500 | 1930 J+ | 3064.435 | 3062.775 | 3060.045 | 3073.255 |
| CFMW-022 | 155 | 279 | 141 | 13.3 | 432 | 558 J- | 971 | 573 J+ | 3064.74 | 3064.16 | 3062.06 | 3075.7 |
| CFMW-023 | 2.7 J | 2 U | 7.6 J | 5.9 J | 395 | 452 | 647 | 736 | 3084.582 | 3092.472 | 3092.062 | 3093.672 |
| CFMW-025a | 2 U | 2 U | 2 U | 2 U | 399 | 334 J- | 524 | 413 | 3055.648 | 3047.518 | 3048.528 | 3064.608 |
| CFMW-025b | 2 U | 2 U | 2 U | 2 U | 585 | 970 J- | 828 | 515 | 3068.84 | 3069.73 | 3069.5 | 3073.76 |
| CFMW-026 | 3.9 J | 3.4 J | 7.5 J | 2 U | 1650 | 1440 J- | 2010 | 1150 | 3064.06 | 3061.84 | 3059.99 | 3071.71 |
| CFMW-027 | 603 | 793 | 755 | 560 | 2390 | 1970 J- | 2560 J+ | 5160 | 3064.25 | 3062.34 | 3059.51 | 3072.42 |
| CFMW-028 | 104 | 195 | 283 | 315 | 3170 J+ | 3130 J- | 4400 | 3800 J+ | 3064.239 | 3062.309 | 3059.519 | 3072.379 |
| CFMW-028a | 2 J | 2.9 J | 2 U | 2 U | 1020 | 557 J- | 408 | 286 | 3064.35 | 3062.4 | 3059.68 | 3072.56 |
| CFMW-029 | 366 | 186 | 258 | 128 | 3370 J+ | 4180 J | 1810 J+ | 2570 J+ | 3064.44 | 3062.81 | 3060.11 | 3073.43 |
| CFMW-031 | 233 | 690 | 520 | 104 | 2440 | 2100 J- | 2700 | 2770 J- | 3063.88 | 3061.68 | 3059.04 | 3071.05 |
| CFMW-032 | 412 J- | 152 | 238 | 478 | 5210 J- | 2490 | 3060 J+ | 8570 | 3064.588 | 3062.478 | 3059.608 | 3073.508 |
| CFMW-032a | 2 U | 2 U | 3.9 J | 2 U | 49 J- | 225 J | 171 | 241 | 3003.585 | 3004.675 | 3005.005 | 3012.515 |
| CFMW-033 | 478 | 483 | 515 | 181 | 2340 | 2040 J- | 2620 | 3250 | 3063.76 | 3061.43 | 3058.79 | 3070.5 |
| CFMW-034 | 327 | 255 | 275 | 287 | 4530 J- | 60 U | 3200 | 6590 | 3061.76 | 3056.33 | 3052.69 | 3070.44 |
| CFMW-035 | 57.1 | 51.7 | 45.1 | 53 | 415 | 305 | 276 | 209 | 3063.36 | 3061.91 | 3059.28 | 3072.86 |

**Appendix A11. Fluoride and Cyanide Concentration in Groundwater Wells**
**Columbia Falls Aluminum Company, LLC, Phase II SAP, 2000 Aluminum Drive, Columbia Falls, MT**

| Sample Location | Cyanide, Total | | | | Fluoride | | | | Water Level (ft-amsl) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 4 | Round 1 | Round 2 | Round 3 | Round 4 | Round 1 | Round 2 | Round 3 | Round 4 |
| CFMW-037 | 66.7 | 40.7 | 37.5 | 75.8 | 1030 J- | 1060 J | 1530 | 1030 | 3035.16 | 3027.84 | 3023.62 | 3051.69 |
| CFMW-038 | 260 | 286 | 110 | 298 | 2590 | 2400 J- | 2830 J+ | 2810 | 3026.95 | 3024.26 | 3021.72 | 3031.3 |
| CFMW-040 | 304 | 288 | 288 | 385 | 2650 | 2360 | 3090 | 2830 | 3036.55 | 3032.01 | 3028.53 | 3044.81 |
| CFMW-042 | 402 | DRY | DRY | 395 | 2410 | DRY | DRY | 2780 | 3052.4 | DRY | DRY | 3063.57 |
| CFMW-043 | 510 | 423 | 477 | 535 | 2280 | 2050 J- | 2730 | 2020 J- | 3061.92 | 3057.52 | 3054.21 | 3066.89 |
| CFMW-044 | 430 | 220 | 233 | 69.5 | 2150 | 1670 J- | 2050 | 1400 J- | 3060.023 | 3056.413 | DRY | 3066.393 |
| CFMW-044a | 32.8 | 125 | 80.8 | 119 | 1720 | 2280 | 2720 | 2250 J+ | 3056.396 | 3052.876 | 3049.866 | 3062.866 |
| CFMW-044b | 5.9 J | 8.2 J | 9.8 J | 10.5 | 153 | 142 | 176 | 138 J+ | 3044.029 | 3051.379 | 3039.809 | 3051.199 |
| CFMW-045 | 365 | 392 | 381 | 450 | 2300 | 1920 J- | 2550 | 2150 J- | 3029.97 | 3025.2 | 3022.33 | 3039.2 |
| CFMW-045a | 56 | 34.8 | 52.9 | 63.2 | 2980 | 1650 J- | 3520 J+ | 3400 J+ | 3024.374 | 3022.884 | 3020.734 | 3031.334 |
| CFMW-047 | 120 | 145 | 171 | 119 | 2160 | 1960 | 2470 | 1920 | 3017.43 | 3017.72 | 3016.03 | 3022.96 |
| CFMW-049 | 93.2 | 82.9 | 87.5 | 89.7 | 861 | 834 | 980 J+ | 720 J- | 3017.793 | 3019.443 | 3018.193 | 3029.713 |
| CFMW-049a | 47.1 | 71.5 | 8 J | 58.6 | 470 J- | 433 | 439 | 405 J- | 3017.691 | 3019.511 | 3018.341 | 3030.051 |
| CFMW-050 | 51.7 | 51.6 | 72.4 | 106 | 811 | 809 | 945 | 744 J- | 3017.34 | 3019.16 | 3017.99 | 3027.19 |
| CFMW-053 | 363 | 386 | DRY | 239 | 1990 | 1870 | DRY | 1610 J- | 3052.447 | 3038.577 | 3035.137 | 3063.427 |
| CFMW-053a | 2 U | 2 U | 2 U | 2 U | 15 U | 537 | 428 J+ | 487 J- | 3023.761 | 3021.971 | 3020.411 | 3028.561 |
| CFMW-054 | 327 | 382 | 391 | 302 | 1920 | 1610 | 2070 | 1880 | 3038.9 | 3035.11 | 3031.32 | 3041.01 |
| CFMW-056 | 2 U | 2 U | 2 U | 2 U | 138 | 107 | 242 | 194 | 3014.789 | 3015.919 | 3017.499 | 3026.289 |
| CFMW-056a | 2 U | 3.3 J | 2 U | 2 U | 405 | 400 J- | 258 | 569 | 3021.119 | 3022.379 | 3023.729 | 3032.369 |
| CFMW-056b | 2 U | 2 U | 2 U | 2 U | 156 | 194 | 271 | 188 | 3067.499 | 3065.929 | 3065.959 | 3073.819 |
| CFMW-057 | 2 U | 2 U | 2 U | 2 U | 66.6 J | 127 J- | 137 | 204 J- | 3011.127 | 3012.647 | 3014.427 | 3023.437 |
| CFMW-057a | 2 U | 2 U | 2 U | 2 U | 15 U | 180 J | 425 | 322 J- | 3016.224 | 3017.494 | 3018.954 | 3028.254 |
| CFMW-059 | 2 U | 2 U | 2 U | 2 U | 59.5 J | 114 | 120 | 124 | 3049.001 | 3048.601 | 3050.411 | 3056.431 |
| CFMW-059a | 2 U | 2 U | 2 U | 2 U | 147 | 198 J | 233 | 185 J- | 3046.128 | 3047.758 | 3050.278 | 3055.848 |
| CFMW-061 | 7.7 J | 4 J | 2 U | 2 U | 780 | 669 J- | 786 | 601 J+ | 3013.558 | 3015.028 | 3014.838 | 3018.868 |
| CFMW-064 | 42.7 | 62.4 | 13.5 | 60.1 | 303 | 311 J- | 344 | 288 J+ | 3014.741 | 3016.511 | 3016.431 | 3020.031 |
| Minimum | 8 | 13 | 8 | 16 | 16 | 17 | 7 | 23 | 27 | 5 | 33 | 0 |
| Maximum | 13 | 12 | 13 | 13 | 9 | 5 | 33 | 17 | 0 | 1 | 0 | 62 |

Orange shading indicates minimum concentration across sampling rounds
Purple shading indicates maximum concentration across sampling rounds

# APPENDIX B

Standard Operating Procedures

Date: May 5, 2000
Revision: April 6, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to explain the quality control (QC) measures taken to ensure the integrity of the samples collected and to establish the guidelines for the collection of QC samples. The objective of the QC program is to ensure that water-quality data of known and reliable quality are developed.

Valid water-chemistry data are integral to adequately characterize water-quality conditions, therefore, the data will typically be confirmed by the implementation of QC samples to verify the collection of representative samples. Without checks on the sampling and analytical procedures, the potential exists for contradictory or incorrect results. The acceptance of water-quality data by regulatory agencies and in litigation-support investigations depends heavily on the proper QC program to justify the results presented. The QC sampling requirements must be determined by the project manager and be clearly defined in the work plan. If data validation (for in-house purposes or for compliance with the United States Environmental Protection Agency [USEPA] regulations) is stipulated as part of the hydrogeologic investigation, QC sampling must be conducted.

## 2.0 QUALITY CONTROL SAMPLES

2.1 Samples taken for analysis of compounds require the use of quality control samples to monitor sampling activities and laboratory performance. Types of quality control samples may include replicate (sometimes referred to as a duplicate) and/or replicate split, trip blank, field equipment blank, matrix spike and matrix spike duplicate, and fortification. A discussion pertaining to each quality control sample follows:

a. Replicate and Replicate Split - Replicate sample analysis is done to check on the reproducibility of results either within a laboratory or between laboratories. A replicate sample is called a split sample when it is collected with, or turned over to, a second party (e.g., regulatory agency, consulting firm) for an independent analysis. Replicate samples are aliquots (equal portions) from a sample in a common container.

To collect a replicate sample, water from the bailer or pump will be distributed first to fill one container and then to fill the second container. Adequate water should be available to fill the bottles completely before they are capped. If the water is insufficient to fill all the bottles at once, then incrementally fill each bottle with water from two or more bailer volumes or pump cycles.

For some test substances, water may have to be accumulated in a common container and then decanted slowly into the sample bottles. The work plan should be checked for a description of how replicate samples are to be collected. Additionally, in the case of wells that recover slowly and produce insufficient water to fill all the replicate sample containers, the containers should be filled incrementally and kept on ice in the cooler in between filling periods.

b. Trip Blank - A trip blank sample is a 40-ml vial that is filled with "clean" (e.g., distilled/deionized) water in the laboratory, and travels unopened with the sample bottles. (The USEPA now uses the phrase "demonstrated analyte free water.") It is opened in the laboratory and analyzed along with the field samples for the constituent(s) of interest to detect if contamination has occurred during field handling, shipment, or in the laboratory. Trip blanks are primarily used to check for "artificial" contamination of the sample caused by airborne volatile organic compounds (VOCs) but may also be used to check for "artificial" contamination of the sample by a test substance or other analyte(s). Two sealed laboratory filled 40-ml vials will be submitted per trip blank set. A trip blank set will be included in each cooler containing VOC samples, or other analyte(s) of interest, per day.

c. Field Equipment Blank - A field equipment blank (field blank) sample is collected to check on the sampling procedures implemented in the field. A field blank is made with "clean" (e.g., distilled/deionized/demonstrated analyte free) water by exposing it to sampling processes (i.e., the clean water must pass through the actual sampling equipment). For example, if samples are being collected with a bailer, the field blank would be made by pouring the clean water into a bailer which has been decontaminated and is ready for sampling, and then pouring from the bailer into the sample containers. If a metals equipment blank is to be made, and the water was filtered, then the sample must be filtered (i.e., exposed to the sampling process). One equipment blank would be incorporated into the sampling program for each day's collection of samples and analyzed for the identical suite of constituents as the sample.

A special type of field blank may be needed where ambient air quality may be poor. This field blank sample would be taken to determine if airborne contaminants will interfere with constituent identification or quantification. This field blank sample is a sample bottle that is filled and sealed with "clean" (e.g., distilled/deionized/demonstrated analyte free) water in the analytical laboratory, and travels unopened with the sample bottles. It is opened in the field and exposed to the air at a location(s) to check for potential atmospheric interference(s). The field blank is resealed and shipped to the contract laboratory for analysis.

d. Matrix Spike and Matrix Spike Duplicate - Spikes of compounds (e.g., standard compound, test substance, etc.) may be added to samples in the laboratory to determine if the ground-water matrix is interfering with constituent identification or quantification, as well as a check for systematic errors and lack of sensitivity of analytical equipment. Samples for spikes are collected in the identical manner as for standard analysis, and shipped to the laboratory for spiking. Additional volume is required for MS/MSD samples. Matrix spike duplicate sample collection, and laboratory spiking and analysis is done to check on the reproducibility of matrix spike results and should be collected, when possible, from a location expected to be relatively free from contamination

e. Fortification - A fortification, which is performed in the field, is used to check on the laboratory's ability to recover the test substance (analyte) added as well as its stability between fortification and analysis.

A field fortification (spike) is prepared by filling the container(s) with field or distilled/deionized/demonstrated analyte free water (as specified by the laboratory) to a predetermined volume (as specified by the laboratory) and adding the spike (supplied by the laboratory). The predetermined volume of water is measured with a clean (decontaminated) graduated cylinder. Field spikes will be prepared following the collection, labeling, and sealing of nonspiked samples in a separate cooler. The spike is kept at a safe distance from the sampling point (e.g., in the hotel room).

f. Temperature Blank - A temperature blank is a container of water shipped with each cooler of samples requiring preservation by cooling to 6EC (ice). The temperature of the blank is measured at the time of sample receipt by the laboratory.

2.2 The work plan must be referred to for details regarding the type of QC samples to be collected and the QC sample collection method.

## 3.0 PROCEDURE

3.1 Implement QC sampling as outlined above, depending on the type of QC sample(s) specified in the work plan.

3.2 Ensure unbiased handling and analysis of replicate and blank QC samples by concealing their identity by means of coding so that the analytical laboratory cannot determine which samples are included for QC purposes. Attempt to use a code that will not cause confusion if additional samples are collected or additional monitoring wells are installed. For example, if there are three existing monitoring wells (MW-1, 2 and 3), do not label the QC blank MW-4. If an additional monitoring well were installed, confusion could result.

3.3 Label matrix spike and field fortification (spike) QC samples so that the analytical laboratory knows which samples are to be spiked in the laboratory and which samples were fortified (spiked) in the field, respectively. In certain situations, the field fortification will be "blind" or undisclosed to the laboratory to independently verify their analytical ability.

3.4 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," and placed in its appropriate container (holder) in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory. Consult the site work plan to determine if a particular ice is specified as the preservative for transportation (e.g., the USEPA prefers the use of wet ice because they claim that blue ice will not hold the samples at 4° Centigrade/Celsius).

3.5 Document the QC samples on the appropriate field form and in the field notebook. On the chain-of-custody form, replicate and blank QC samples will be labeled using the codes (Number 3.2, above), and matrix spike and field fortification QC samples will be identified as such (Number 3.3, above).

3.6 Follow standard shipping procedures for samples (i.e., retain one copy of the chain-of-custody form, secure the cooler with sufficient packing tape and a custody seal, forward the samples via overnight [express] mail, by courier or hand deliver to the designated analytical laboratory preferably within 24 hours but no later than 48 hours after sampling). However, check the site work plan for information on the analyte(s), as some have to be analyzed immediately (e.g., CN).

END OF PROCEDURE

Date: May 5, 2000
Revision: April 7, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide procedures and standards for record keeping and maintenance, for all field activities conducted by Roux Associates, Inc. (Roux Associates).

Strict quality assurance/quality control (QA/QC) is necessary to properly and accurately document and preserve all project-related information. Quality assurance is implemented to corroborate that quality control procedures are followed. Quality control provides a means to monitor investigation activities (e.g., sampling and laboratory performance) as a check on the quality of the data.

Valid data and information are integral to all aspects of Roux Associates' field activities. These aspects include, but are not necessarily limited to, activities that involve: drilling; sediment, sludge, and soil sampling (lithologic, and soil-quality and analysis); well construction and development; aquifer testing and analysis; water-quality sampling and analysis (surface water and ground water); free-product sampling and analysis; air-quality sampling and analysis; geophysical testing; demolition activities; waste removal operations; engineering installations; etc. The data will be confirmed by QA/QC methods established and set forth in the work plan/scope of work. Without checks on the field and analytical procedures, the potential exists for contradictory results, and associated incomplete or incorrect results from the interpretation of potentially questionable data.

Documentation will be entered in a bound field notebook and must be transcribed with extreme care, in a clear and concise manner, as the information recorded will become part of the permanent legal record. Field notes are considered the legal record of site activities, and as such they must be taken in a standard and consistent manner. If abbreviations are used, then they must first be spelled out for clarity (i.e., to avoid ambiguity and misunderstanding). All entries must be dated and initialed, and the time (military time) of the entry included. Field notebooks and forms must be assigned to an individual project and properly identified (i.e., client name, project number, location and name of site, individual recording information, dates, times, etc.). Change of possession of field notebooks or forms must be documented with the date and time, and initialed by both individuals. Following each day's entries, the field notebook or form must be photocopied in the event that the original documentation is lost or stolen. All field notebooks must have the company name and address legibly printed in indelible ink along with the message "If found, then please forward to Roux Associates, Inc. at the above address - REWARD OFFERED."

Information must be recorded while onsite because it may be difficult to recall details at a later date. Furthermore, information must be documented immediately as it provides unbiased information which will be used for writing the report when the field activities are completed. Project-related documentation is an irreplaceable, important record for

other individuals who may become involved in the project, and provides the project manager with a complete history of project-related activities. Written information must be accompanied by maps, sketches, and photographs where appropriate, especially if these supplemental sources of information assist in the documentation process. A new page must be used in the field notebook for each new day's entries (i.e., unused portions of a previous page must have an "X" placed through it). The end of the day's records must be initialed and dated.

As part of record keeping and QA/QC activities, state and federal regulatory agencies should be contacted to check if special or different protocols are required and/or if particular or unconventional methods are required for the given field activity. Thus, the record keeping and QA/QC activities implemented by Roux Associates are based on technically sound standard practices and incorporate Roux Associates own, extensive experience in conducting environmental field activities.

## 2.0 MATERIALS

In order to track investigation activities, specific materials are required. These materials include the following:

a. A bound, waterproof field notebook.

b. Appropriate Roux Associates' or project-specific forms (e.g., daily log, geologic log, monitoring well construction log, well sampling data form, location sketch, chain of custody, telephone conversation record, meeting notes, etc.).

c. Appropriate labels (e.g., sample, Roux Associates' Custody Seal, etc.)

d. Approved work plan/scope of work.

e. Health and safety plan (HASP).

f. Appropriate Roux Associates' SOPs.

g. Black pens, and indelible markers.

h. Digital camera.

## 3.0 DOCUMENTATION

3.1 Before the Roux Associates personnel leave the field, they must ensure that their field notes include comprehensive descriptions of the hydrogeologic conditions, and all investigation-related activities and results (onsite and offsite). This will safeguard against the inability to reconstruct and comprehend all aspects of the field investigation after its completion, and will serve to facilitate the writing of an accurate report. Properly documented information provides the QA/QC tracking (back-up) required for all Roux Associates' projects. General types of information

that must be recorded (where pertinent to the investigation being conducted) include, but may not necessarily be limited to, the following:

a. List of Roux Associates personnel on site.

b. Name, date, and time of arrival on site by Roux Associates personnel, including temporary departures from, and returns to, the site during the work day.

c. Client and project number.

d. Name and location of study area.

e. Date and time of arrival on site by non-Roux Associates personnel (names and affiliation) and equipment (e.g., subcontractors and facility personnel, and drilling equipment, respectively, etc.), including temporary departures from, and returns to, the site during the work day, and departure at the end of the work day.

f. List of non-Roux Associates personnel (e.g. subcontractors, client representatives) on site.

g. Weather conditions at the beginning of the day as well as any changes in weather that occur during the working day.

h. Health and safety procedures including level of protection, monitoring of vital signs, frequency of air monitoring, and any change (i.e., downgrade or upgrade) in the level of protection for Roux Associates and other on-site personnel (e.g., subcontractors, facility personnel, etc.).

i. Health and safety procedures not in compliance with the HASP (for all on-site personnel).

j. Site reconnaissance information (e.g., topographic features, geologic features, surface-water bodies, seeps, areas of apparent contamination, facility/plant structures, etc.).

k. Air monitoring results (i.e., photoionization detector [PID], etc. measurements).

l. Task designation and work progress.

m. Work-related and site-related discussions with subcontractors, regulatory agency personnel, facility personnel, the general public, and Roux Associates personnel.

n. Delays, unusual situations, problems and accidents.

o. Field work not conducted in accordance with the work plan/scope of work, and rationale and justification for any change(s) in field procedures including discussions with personnel regarding the change(s) and who authorized the change(s).

p. QA/QC procedures not conducted in accordance with the QA/QC procedures established in the work plan/scope of work and rationale and justification for any change(s) in QA/QC procedures including discussions with personnel regarding the change(s) and who authorized the change(s).

q. Equipment and instrument calibration information, results and/or problems.

r. Decontamination and calibration procedures.

s. Activities in and around the site and work area by any and all on-site personnel which may impact field activities.

t. Sketches, maps, and/or photographs (with dates and times) of the site, structures, equipment, etc. that would facilitate explanations of site conditions.

u. Contamination evidenced as a result of work-related activities (e.g., visible contaminants [sheen] in drilling fluids or on drilling equipment; sheen on, or staining of, sediments; color of, or separate [nonaqueous] phase on, water from borehole or well; vapors or odors emanating from a borehole or well; etc.). Logbook entries should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. Avoid using nontechnical or subjective terms (e.g., , oily, strong-smelling).

v. Date and time of final departure from the site of all personnel at the end of the work day.

3.2 Pens with permanent ink will be used to record all data. Data or other information that has been entered incorrectly will be corrected by drawing a line through the incorrect entry and **initialing and dating** the linedthrough entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.

3.3 In addition to the general types of information that must be recorded (as presented in Section 3.1), task-specific information must also be properly documented. Task-specific information which is required is provided in each respective task-oriented SOP, and the documentation procedures outlined in each SOP must be followed.

END OF PROCEDURE

Date: May 5, 2000
Revision: April 16, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sample handling and management which will allow consistent and accurate results. Valid chemistry data are integral to investigations that characterize media-quality conditions. This SOP is designed to ensure that once samples are collected, they are preserved, packed and delivered in a manner which will maintain sample integrity. The procedures outlined are applicable to most sampling events and any required modifications must be clearly described in the work plan.

## 2.0 CONSIDERATIONS

Sample containers, sampling equipment decontamination, quality assurance/quality control (QA/QC), sample preservation, and sample handling are all components of this SOP.

### 2.1 Sample Containers

Prior to collection of a sample, considerations must be given to the type of container that will be used to store and transport the sample. The type and number of containers selected is usually based on factors such as sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. In most cases, the overriding considerations will be the analytical methodology, or the state or federal regulatory requirements because these regulations generally encompass the other factors. The sample container selected is usually based on some combination of the following criteria:

a. Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizer to leach into the sample.

In some instances, however, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of the glass containers in an aqueous matrix, plastic bottles (e.g., nalgene) must be used for samples collected for metals analysis. A separate, plastic container should accompany glass containers if metals analysis is to be

performed along with other analyses. Likewise, other sample characteristics may dictate that glass cannot be used. For example, in the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds and create adsorptive sites on the container's surface.

b. Volume of the Container

The volume of sample to be collected will be dictated by the analysis being performed and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual laboratories may provide larger volume containers for various analytes to ensure sufficient quantities for duplicates or other QC checks.

To facilitate transfer of the sample from the sampler into the container and to minimize spillage and sample disturbance, wide-mouth containers are recommended when not precluded by method requirements. Aqueous volatile organic samples must be placed into 40-milliliter (ml) glass vials with polytetrafluoroethylene (PTFE) (e.g., TeflonTM) septums. Non-aqueous volatile organic samples for “low-level” volatile analysis should be collected in the same type of vials or using EnCore samplers provided by the laboratory. Non-aqueous volatile organic samples for “mid or high-level” volatile analysis may be collected in 4-ounce (oz) wide-mouth jars provided by the laboratory. These jars should have PTFE-lined screw caps.

c. Color of Container

Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. If amber containers are not available, then containers holding samples should be protected from light (i.e., place in cooler with ice immediately after filling).

d. Container Closures

Container closures must screw on and off the containers and form a leak-proof seal. Container caps must not be removed until the container is ready to be filled with the sample, and the container cap must be replaced (securely) immediately after filling it. Closures should be constructed of a material which is inert with respect to the sampled material, such as PTFE (e.g., TeflonTM). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE sheeting. If soil or sediment samples are being collected, the threads of the

container must be wiped clean with a dedicated paper towel or cloth so the cap can be threaded properly.

e. Decontamination of Sample Containers

Sample containers must be laboratory cleaned by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample. Sample containers must be carefully examined to ensure that all containers appear clean. Do not mistake the preservative as unwanted residue. The bottles should not be field cleaned. If there is any question regarding the integrity of the bottle, then the laboratory must be contacted immediately and the bottle(s) replaced.

f. Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the laboratory waiting to be packed for shipment or in the field waiting to be filled with sample, care must be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near solvents, gasoline, or other equipment that is a potential source of cross-contamination. When under chain of custody, sample bottles must be secured in locked vehicles, and custody sealed in shuttles or in the presence of authorized personnel. Information which documents that proper storage and transport procedures have been followed must be included in the field notebook and on appropriate field forms.

2.2 Decontamination of Sampling Equipment

Proper decontamination of all re-usable sampling equipment is critical for all sampling episodes. The SOP for Decontamination of Field Equipment and SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for decontamination of various types of equipment.

2.3 Quality Assurance/Quality Control Samples

QA/QC samples are intended to provide control over the proper collection and tracking of environmental measurements, and subsequent review, interpretation and validation of generated analytical data. The SOPs for Collection of Quality Control Samples, for Evaluation and Validation of Data, and for Field Record Keeping and Quality Assurance/Quality Control must be referred to for detailed guidance regarding these respective procedures. SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for QA/QC procedures.

2.4 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Generally, this is accomplished under the following two scenarios:

a. Sample bottles are preserved at the laboratory prior to shipment into the field.

b. Preservatives are added in the field immediately after the samples are collected.

Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample could be collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable; however, field sampling teams must always be prepared to add additional preservatives to samples if the aforementioned situations occur. Furthermore, care must be exercised not to overfill sample bottles containing preservatives to prevent the sample and preservative from spilling and therefore diluting the preservative (i.e., not having enough preservative for the volume of sample).

When samples are preserved after collection, special care must be taken. The transportation and handling of concentrated acids in the field requires additional preparation and adherence to appropriate preservation procedures. All preservation acids used in the field should be trace-metal or higher-grade.

2.5 Sample Handling

After the proper sample bottles have been received under chain-of-custody, properly decontaminated equipment has been used to collect the sample, and appropriate preservatives have been added to maintain sample integrity, the final step for the field personnel is checking the sample bottles prior to proper packing and delivery of the samples to the laboratory.

All samples should be organized and the labels checked for accuracy. The caps should be checked for tightness and any 40-ml volatile organic compound (VOC) bottles must be checked for bubbles. This can be achieved by gently tapping the bottom of the voa to dislodge potential air bubbles. Each sample bottle must be placed in an individual "zip-lock" bag to protect the label, and placed on ice. Clear packing tape may also be used to protect the integrity of the sample label. The bottles must be carefully packed to prevent breakage during transport. Use of bubble wrap is recommended. When several bottles have been collected for an

individual sample, they should not be placed adjacent to each other in the cooler to prevent possible breakage of all bottles for a given sample. If there are any samples which are known or suspected to be highly contaminated, these should be placed in an individual cooler under separate chain-of-custody to prevent possible cross contamination. Sufficient ice (wet or blue packs) should be placed in the cooler to maintain the temperature at 4 degrees Celsius (°C) until delivery at the laboratory.

Consult the work plan to determine if a particular ice is specified as the preservation for transportation (e.g., the United States Environmental Protection Agency does not like the use of blue packs because they claim that the samples will not hold at 4°C). If additional coolers are required, then they should be purchased.

The chain-of-custody form should be properly completed, placed in a "zip-lock" bag, and placed in the cooler. One copy must be maintained for the project files. The cooler should be sealed with packing tape and a custody seal. The custody seal number should be noted in the field book. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time. If overnight mail is utilized, then the shipping bill must be maintained for the files and the laboratory must be called the following day to confirm receipt.

## 3.0 EQUIPMENT AND MATERIALS

3.1 General equipment and materials may include, but not necessarily be limited to, the following:

a. Sample bottles of proper size and type with labels.

b. Cooler with ice (wet or blue pack).

c. Field notebook, appropriate field form(s), chain-of-custody form(s), custody seals.

d. Black pen and indelible marker.

e. Packing tape, "bubble wrap", and "zip-lock" bags.

f. Overnight (express) mail forms, and laboratory addres or courier contact information

g. Health and safety plan (HASP).

h. Work plan/scope of work.

i. Pertinent SOPs for specified tasks and their respective equipment and materials.

3.2 Preservatives for specific samples/analytes as specified by the laboratory. Preservatives must be stored in secure, spillproof glass containers with their content, concentration, and date of preparation and expiration clearly labeled.

3.3 Miscellaneous equipment and materials including, but not necessarily limited to, the following:

a. Graduated pipettes.

b. Pipette bulbs.

c. Litmus paper.

d. Glass stirring rods.

e. Protective goggles.

f. Disposable gloves.

g. Lab apron.

h. First aid kit.

i. Portable eye wash station.

j. Water supply for immediate flushing of spillage, if appropriate.

k. Shovel and container for immediate containerization of spillage-impacted soils, if appropriate.

## 4.0 PROCEDURE

4.1 Examine all bottles and verify that they are clean and of the proper type, number, and volume for the sampling to be conducted.

4.2 Label bottles carefully and clearly with project name and number, site location, sample identification, date, time, and the sampler's initials using an indelible marker.

4.3 Collect samples in the proper manner (refer to specific sampling SOPs).

4.4 Conduct preservation activities as required after each sample has been collected. Field preservation must be done immediately and must not be done later than 30 minutes after sample collection.

4.5 Conduct QC sampling, as required.

4.6 Seal each container carefully and place in an individual "zip lock" bag.

4.7 Organize and carefully pack all samples in the cooler immediately after collection (e.g., bubble wrap). Insulate samples so that breakage will not occur.

4.8 Complete and place the chain-of-custody form in the cooler after all samples have been collected. Maintain one copy for the project file. If the cooler is to be transferred several times prior to shipment or delivery to the laboratory, it may be easier to tape the chain-of-custody to the exterior of the sealed cooler. When exceptionally hazardous samples are known or suspected to be present, this should be identified on the chain-of-custody as a courtesy to the laboratory personnel.

4.9 Add additional ice as necessary to ensure that it will last until receipt by the laboratory.

4.10 Seal the cooler with packing tape and a custody seal. Record the number of the custody seal in the field notebook and on the field form. If there are any exceptionally hazardous samples, then shipping regulations should be examined to ensure that the sample containers and coolers are in compliance and properly labeled.

4.11 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

4.12 Maintain the shipping bill for the project files if overnight mail is utilized and call the laboratory the following day to confirm receipt.

END OF PROCEDURE

Date: March 2, 2015

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for measuring water levels using (electronic water-level meter). An m-scope is an electronic sounding device used to measure the depth to ground water below an established (surveyed) measuring point (MP). Measuring the depth to water (DTW) below the surveyed MP provides information for calculating ground-water elevations needed to construct ground-water elevation maps and determine the direction of ground-water flow.

M-scopes can be less accurate than a steel tape because the wire can kink, measurement increment marks can shift, and the tip may have been cut off and replaced without proper documentation. Thus, it is mandatory that a m-scope be inspected and calibrated before use.

## 2.0 DECONTAMINATION

The m-scope must be pre-cleaned (decontaminated) using a non-phosphate, laboratory-grade solution and rinsed with copious amounts of distilled or deionized water. This process is repeated before each measurement and following the final measurement.

## 3.0 CALIBRATION

The m-scope must be calibrated before being used to measure water levels. Calibration is accomplished by measuring the water level with the m-scope followed by a measurement using a steel tape. This dual measurement procedure is continued until the individual is confident that measurements taken using both devices are similar and the m-scope is reliable. The calibration procedure is documented in the field notebook or on an appropriate field form, and initialed and dated. If the probe is not working (i.e., does not detect water), the probe is to be returned to the supplier for repair; It is not to be repaired in the field.

## 4.0 PROCEDURE

4.1 Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

4.2 If the well is not vented, then remove the cap and wait several minutes for the water level to equilibrate. Take several measurements to ensure that the water level measured is in equilibrium with the aquifer (i.e., not changing substantially).

4.3 The manufacturer's model must be noted because some have switches, lights, beepers, or a combination of the above.

4.4 The 1-foot or 5-foot marked intervals on the electrical line must be checked to ensure that they have not shifted, and the bottom of the probe has not been cut. Check on a periodic basis that the cord has not kinked.

4.5 The water-level measurement is taken by lowering the probe into the well until the instrument-specific detection method (e.g., light, beeper, or both) is activated by contacting the water.

4.6 The electrical line is held at the MP and, using a ruler (e.g., carpenter's folding ruler) or an engineer's scale, the distance from the "held" point to the nearest marked interval is measured. The distance measured is added to, or subtracted from, the marked interval reading. The result is the DTW.

4.7 Measurements will be taken accurately and to the nearest 0.01 foot.

4.8 After measuring all wells in an area, always re-measure at least one well, preferably the first well measured, to see if the static water level has changed (e.g., due to pumping in the area, tidal effects, etc.). If a significant change has occurred, it may be necessary to re-measure other wells.

4.9 If there are previous water-level measurements available for the wells, then have these data available to compare the measurements with those just taken. Use these data to determine if water levels are similar or if they have changed. If water levels have changed, then check if the changes are consistent (i.e., all up or all down) and make sense.

4.10 Water-level elevations are calculated by subtracting the DTW from the MP and a water-elevation map is constructed (contoured) on a well location map. This also provides a check to evaluate if the water levels make sense (or anomalies are evidenced). Re-measure the well(s) where anomalies are found as a check on the initial measurement(s).

4.11 If anomalies persist or water-level trends are different from the historical database, then check to see if hydrogeologic conditions and/or stresses have changed (e.g., discharge areas, pumping and/or injection wells, etc.).

4.12 All pertinent data will be documented in the field notebook, and initialed and dated.

END OF PROCEDURE

Date: May 5, 2000
Revision: May 5, 2015

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for purging a well prior to the collection of a groundwater sample. Purging (evacuating) a well involves the removal of the standing column of water in the well to allow "fresh" (representative) formation water to enter the well. Two conventionally used methods for well purging include: 1) discharge of a specified number of casing volumes of water (which is more commonly used); and 2) pumping until specific indicator parameters (e.g., specific conductance, pH, temperature) stabilize. Wells must be purged prior to sampling to ensure the collection of representative formation ground water for water-quality analysis. Note: This SOP is not applicable low-flow sampling. If low-flow sampling is specified within the scope of work refer to SOP 4.4. There are several purging strategies that may be used, depending on specific conditions encountered for given well sampling situations. The same purging method will be used each time to maintain consistency. The selected purge technique will be based on site-specific field conditions, sampling objectives, and Roux Associates, Inc. experience and knowledge, and regulatory agency(ies) guidelines (e.g., some states permit purging a low-yield well to dryness while others insist that some water remains in the well).

## 2.0 EQUIPMENT AND MATERIALS

2.1 The following equipment may be needed to purge a monitoring well before sampling:

a. Bailers.

b. Appropriate pump(s): centrifugal pumps, electrical submersible pumps, peristaltic pumps, positive gas-displacement devices, bladder pumps, hand-operated diaphragm or bilge pump(s).

c. Teflon™ tape, electrical tape.

d. Interface probe, water level meter or m-scope with with 0.01-foot measurement increments.

e. Appropriate discharge hose and valves.

h. Appropriate discharge tubing (e.g., polypropylene) if using a peristaltic pump.

i. Appropriate compressed gas if using bladder-type or gas-displacement device.

j. Extension cord(s), portable generator (and fuel), or battery pack depending upon the type of equipment

k. Non-absorbent cord (e.g., polypropylene, nylon, etc.), cord.

l. Tripod(s).

m. Field book

n. Multi-gas meter (for sampling locations with vapor concerns)

o. Flow meter.

2.2 Bailers or centrifugal pumps are recommended for shallow, small diameter monitoring wells. For deep wells, or large diameter wells, a submersible pump is recommended.

## 3.0 DECONTAMINATION

Each piece of equipment that is used to evacuate wells (e.g., bailers, pumps, hoses) will be decontaminated thoroughly prior to the introduction of the equipment into the well and prior to leaving the site. Disposable items (e.g., cord, tubing) will be changed between each well purged and discarded in an appropriate manner. A clean pair of new, disposable nitrile gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.

## 4.0 PROCEDURE

4.1 Prior to initiating the purge, the amount of water standing in the water column (water inside the well riser and screen) should be determined. The depth to water (DTW) is measured and subtracted from the sounded (total) depth of the well to calculate the length of the column of standing water in the well (in feet).

4.2 The volume of the standing water in the well is calculated by multiplying the length of standing water by a coefficient which equates the diameter of the well to gallons per linear foot. (Refer to the attached table from the Water Well Handbook for the coefficient or use the following equation [V=(7.48 gal/ft3)(r2h), where V is volume of water in gallons, r is the radius of the well casing in feet, and h is the height of the water column in the well in feet].)

4.3 With respect to volume, an adequate purge is normally achieved when three to five well volumes have been removed (as per -typical regulatory agency requirements).

4.4 If wells are screened in low permeability formations, then the well may go dry prior to removing the specified volume of water. For wells with slow recovery, attempts should be made to avoid purging the well dry. This can be accompnished by slowing the purge rate. In situations where a well has been

purged dry (evauated) this generally constitutes an adequate purge and the well should be sampled following sufficient recovery.

4.5 Evacuation will occur from the top of the water column to ensure that "fresh" formation water enters the well through the bottom portion of the screen, and replaces the standing water that is being removed (i.e., only representative formation water is in the well).

4.6 The volume of water purged from the well must be measured and can be calculated directly by discharging into containers of known volume or can be calculated by multiplying rate of flow by time.

4.7 If a submersible or centrifugal pump is used, then the intake is set just below the dynamic (pumping) water level in the well. The rate of flow in gallons per minute (gpm) can be measured using a calibrated bucket (e.g., 5-gallon) if the rate is relatively low, or a 55-gallon drum if the rate is relatively high, and a watch capable of measuring time in second intervals. A precalibrated flow meter may also be used if available.

4.8 After the specified number of casing volumes have been evacuated from the well, the pump intake should be lifted slowly until it breaks suction to confirm that any standing water above the intake has been purged.

4.9 If a bailer is used, then the bailer is lowered only deep enough to remove water from the top of the water column and a 5-gallon bucket is used to measure the volume of water evacuated.

4.10 If purging is not executed by evacuating a specified number of well volumes, then purging is performed by pumping or bailing the well until specific indicator parameters (e.g., specific conductance, pH, temperature) stabilize. The volume of water removed is documented on an appropriate field form or in the field notebook.

4.11 Water purged from the well will be disposed of in accordance with the appropriate method outlined in the site SAP.

4.12 If historic site data indicate that explosive gases could be present and accumulate in the well, then an multi-gas meter (explosimeter) will be used to check vapor concentrations in wells at the site prior to beginning the purging procedure. Vapor concentrations in a well that exceed the 25 percent lower explosive limit (LEL) will require specific precautionary measures to allow purging the well without danger of explosion or fire (e.g., use of cotton cord for bailers or lowering pumping devices, non-electric powered pumps). These conditions will be addressed in the site health and safety plan (HASP) and/or SAP.

END OF PROCEDURE

Date: January 10, 2011
Revision: May 7, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sampling monitoring wells for dissolved constituents in groundwater using low flow (low stress) techniques. Low flow purging and sampling results in the collection of groundwater samples from monitoring wells that are representative of groundwater conditions in the geological formation by minimizing stress on the geological formation, and minimizing the disturbance of sediment in the bottom of the well. This procedure also minimizes aeration of the groundwater during sample collection, which improves the representativeness of the sample for VOC analysis.

As part of the SOP for the sampling of groundwater monitoring wells, sample collection equipment and devices must be considered, and equipment decontamination and pre-sampling procedures (e.g., measuring water levels, and purging wells) must be implemented. The sampling objectives will be provided in specific investigation work plans that will be approved by the applicable regulatory agency. Unless otherwise specified in an approved work plan, all groundwater purging and sampling should typically be performed using low stress (low flow) sample collection techniques.

## 2.0 EQUIPMENT AND MATERIALS

2.1 In order to sample groundwater from monitoring wells, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. Adjustable rate, positive displacement groundwater sampling pump (e.g., low-flow centrifugal submersible pump or bladder pump constructed of stainless steel, Teflon or other inert material).

c. Teflon or Teflon-lined polyethylene tubing with ¼-inch or 3/8-inch inner diameter to collect samples for organic analysis. Teflon or Teflon-lined polyethylene tubing, PVC, Tygon or polyethylene tubing with ¼-inch or 3/8-inch inner diameter to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

d. Appropriate power source (compressor or compressed gas tank, controller, generator, etc.).

e. Monitoring instrument for water quality indicator parameters (Horiba U-22 or equivalent) including temperature, dissolved oxygen, turbidity, specific conductance, pH and redox potential (Eh).

f. Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

g. Electronic interface probe with a minimum of 0.01 foot accuracy.

h. Decontamination supplies including Non-phosphate laboratory-grade detergent, distilled/deionized water and potable water.

i. Roux Associates' low flow well sampling/purging data form and field notebook.

j. Well construction data logs, field data from previous sampling event, and site map with well locations.

k. Well security keys.

l. Plastic sheeting.

m. Paper towels, clean rags.

n. Teflon™ tape, .

o. Calculator.

p. Black pen and water-proof marker.

q. Tools (e.g., wrenches, screwdrivers, hammer, pliers, flashlight, etc.) or alternatives recommended in the JSAs.

r. Disposable Nitrile gloves.

s. Laboratory-supplied sample containers with labels.

t. Cooler(s).

u. Ice (wet, blue packs).

v. Masking, duct, and packing tape.

w. Chain-of-custody form(s) and custody seal(s).

x. Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) or equivalent summary.

y. Site health and safety plan (HASP).

z. Packing material (e.g., bubble wrap)

aa. "Zip-lock" plastic bags.

bb. Overnight (express) mail forms (or schedule courier pickup if available).

## 3.0 DECONTAMINATION

3.1 Make sure all equipment is decontaminated and cleaned before use (refer to the Roux SOP-9.1 for Decontamination of Field Equipment for detailed decontamination methods; a summary of pump decontamination procedures is provided below). Use new, clean materials when decontamination is not appropriate (e.g., tubing, disposable gloves). Document, and initial and date the decontamination procedures on the appropriate field form and in the field notebook.

A. Before sampling:

The manufacturer recommendations on pump disassembly for cleaning, if any, should take precedence to the disassembly recommendations presented below.

1) Wear disposable Nitrile and cut proof gloves.

2) Pre-rinse: Operate the pump first in an appropriate container with potable water for 5 minutes.

3) Wash: Operate the pump in an appropriate container with a non-phosphate, laboratory-grade detergent such as Alcanox and potable water solution for 5 minutes.

4) Rinse: Operate the pump in an appropriate container for 5 minutes with potable water.

5) Disassemble pump (refer to manufacturer's manual).

6) Wash pump parts: Place the disassembled parts of the pump into an appropriate container with non-phosphate detergent solution. Scrub the disassembled pump parts with an appropriate brush.

7) Rinse pump parts with potable water.

8) Rinse the following parts with distilled/deionized water: inlet screen, shaft, suction interconnector, motor lead assembly, and stator housing.

9) Rinse impeller with potable water.

B. After each sample collection, decontaminate by:

1) Wear disposable Nitrile gloves.

2) Pre-rinse: Operating the pump first with potable water for 5 minutes.

3) Wash: Operate the pump in an appropriate container with a non-phosphate, laboratory-grade detergent such as Alcanox and potable water solution for 5 minutes.

4) Rinse: Operate the pump in an appropriate container for 5 minutes with potable water

5) Final Rinse: Operate the pump in an appropriate container to pump out 1 to 2 gallons of distilled/deionized water

6) Wipe pump-related equipment (e.g., electrical lines, cables) first with a clean cloth and detergent solution and then rinsing or wiping with a clean cloth and distilled/deionized water or potable water.

3.2 Note that the decontamination procedures for pumps are the minimum that must be performed. Check the work plan to determine if additional chemicals specified by individual state regulatory agencies also must be used for decontamination procedures (e.g., hexane, nitric acid, acetone, isopropanol, etc.).

## 4.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., water quality meter, photoionization detector, flame ionization detector) according to the Manufacturer's calibration instructions. Document, initial and date the calibration procedures on the appropriate field form and in the field notebook.

## 5.0 PROCEDURE

5.1 As practicable under field conditions, start at the well that is known or believed to have the least contaminated groundwater and proceed systematically to the well that is known or believed to have the most contaminated groundwater.

5.2 Document, initial and date well identification, pre-sampling information, and problems encountered on the appropriate field form and in the field notebook as needed.

5.3 Inspect the protective casing of the well and the well casing, and note any items of concern such as a missing lock, or bent or damaged casing(s).

5.4 Place plastic sheeting around the well to protect sampling equipment from potential cross contamination.

5.5 When vapor concerns are present, measure the VOCs at the rim of the unopened well utilizing a photoionization detector (PID) or flame ionization detector (FID) instrument and record the reading in the field notebook.

5.6 Remove the well cap or plug and, if necessary, clean the top of the well off with a clean rag. Place the cap or plug on the plastic sheeting. If the well is not vented, allow several minutes for the water level in the well to equilibrate. Never inhale the vapors.

5.7 Measure the depth to water (DTW) to 0.01 ft from the measuring point (MP) on the well (top of well casing) using an electronic interface probe or water level meter. Calculate the water-level elevation. Document, initial and date the information on the appropriate field form and in the field notebook.

5.9 Decontaminate the interface probe or water level meter with a non-phosphate, laboratory-grade detergent solution followed by a distilled/deionized water rinse.

5.10 Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well at midpoint of the immerged well screen or at the most permeable zone within the immerged well screen. The pump intake is to be kept at least two feet above the bottom of the well to prevent disturbance and re-suspension of any sediment or a sinking separate phase product (DNAPL) present in the bottom of the well.

If separate-phase product was identified in a measurable quantity, then the tubing should be installed using PVC with a tethered cap inserted into the well to bypass the LNAPL. The sample tubing should be inserted through the PVC, pushing out the cap at a depth below the LNAPL in order to sample the groundwater below the LNAPL.

5.11 Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the electronic interface probe in the well.

5.12 Purge well: Start pumping the well at 200 to 500 milliliters per minute (mL/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should be, if needed, reduced to the minimum capabilities of the pump to ensure stabilization of the water level. The flow rate should, however, be sufficient to maintain pump suction and to avoid cascading or air bubble formation in the tubing. Record each adjustment made in the pump rate and the water level measured immediately after each adjustment.

5.13 Record the physical appearance of the water (i.e., color, turbidity, odor, etc.) on the appropriate field form and in the field notebook, as it is purged. Note any changes that occur during purging.

5.14 Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, redox potential, and dissolved oxygen) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows:

±0.1 for pH

±3% for specific conductance and temperature

±10 mV for redox potential

±10% for DO and turbidity

And turbidity to be less than 50 NTU prior to sampling

The pump must not be removed from the well between purging and sampling.

ADDRESSING POTENTIAL PROBLEMS

Insufficient Yield

If the formation cannot produce enough water to sustain purging, then the well should be pumped to "near-dry" conditions (i.e., leaving some water in the well). Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should be avoided to the extent possible in all cases. When preparing to conduct a sampling round, review drilling, well development and previous sampling information (if available) to identify low-yielding wells in order to purge them first, and potentially allow time for the well to recover for sampling.

Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. However, depending on the rate of recovery and the time needed to complete the sampling round, one of the following procedures may have to be implemented:

1) The well may have to be sampled over a period of more than one day.
2) The well may not yield enough water to collect a complete suite of samples and only select (most important) samples will be collected.
3) The well may not recover, which will preclude sampling.

Regardless of the option that must be followed, the sampling procedure must be fully documented in the field notebook.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fail to stabilize after 4 hours or after 5 well volumes have been purged, one of four options should be considered:

1) Continue purging in an attempt to achieve stabilization.
2) Discontinue purging, do not collect samples, and document attempts to reach stabilization in the field notebook.
3) Discontinue purging, collect samples, and document attempts to reach stabilization in the field notebook.
4) Secure the well, purge and collect samples the next day (preferred)

The key indicator parameter for VOCs is dissolved oxygen.

The key indicator parameter for all other samples is turbidity.

Regardless of the option that is followed, the sampling procedure must be fully documented in the field notebook.

5.15 Collect Samples: Collect samples at a flow rate between 100 and 250 mL/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft.

VOC samples must be collected first. If a bladder pump is used, best practice would have it to match one compression stroke to the fill one VOC sampling vial.

Remove each appropriate container's cap only when ready to fill each with the water sample, and then replace and secure the cap immediately.

5.16 During sample collection, make sure that the pump discharge line or the bailer does not contact the sample container. Fill each appropriate, pre-labeled sample container by allowing the ground water to flow from the tubing gently down the inside of the container to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in an ice-filled (wet ice or blue pack) cooler for storage. If wet ice is used it is recommended that it be repackaged in zip-lock bags to help keep the cooler dry and the sample labels secure. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

5.17 Fill containers for VOCs until a convex surface is observed and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that there are no bubbles by turning the container upside down and tapping it gently.

5.18 Consult the work plan if filtered sampled should also be collected for dissolved metals analysis.

5.19 Collect quality control (QC) samples as required in the work plan to monitor sampling and laboratory performance.

5.20 Note and record the "final" physical appearance of the water (after purging and sampling) on an appropriate field form and in the field notebook.

5.21 Remove pump and tubing.

5.22 Measure the total depth of the well from the MP with an interface probe. Document, initial and date the information on the appropriate field form and in the field notebook.

5.23 Wipe the well cap/j-plug with a clean rag, replace the well cap/j-plug and protective cover. Lock the protective cover.

5.24 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

5.25 Decontaminate field equipment following Roux SOP-9.1 for Decontamination of Field Equipment. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard rags, gloves, etc. in a manner consistent with site conditions.

5.26 Complete all necessary field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

5.27 Samples will be delivered according to the QAPP schedule.

## 6.0 REFERENCES

U.S. Environmental Protection Agency – Region I. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. Revised January 19, 2010.

END OF PROCEDURE

Date: May 5, 2000
Revision: May 5, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for surface-water sampling. Project situations for the collection of surface-water samples vary widely. Since there is no universal sampling procedure, the specific procedure and required equipment will be dependent upon the data objectives of the sampling program and should be identified in the work plan or verified with management prior to sampling. Section 7.0 describes a more rigorous procedure for selecting sample locations which may be required in certain situations.

The objective of surface-water sampling is to collect samples which are representative of the entire surface-water body. Frequently this objective can be quite easy and routine such as one "grab" sample for a small stream or pond with uniform conditions. Other times, the nature of the site-specific conditions make collection of a representative sample more difficult. Consideration of such variables as flow velocity, turbulence, access, health and safety, water composition, tidal fluctuation, surface runoff, factory outfalls, tributaries, etc. is essential in the proper work plan design and sample collection procedures.

Surface-water bodies are constantly subjected to hydraulic forces and a changing environment which brings about variations in the chemical character of the water. Where flow is completely controlled by large storage reservoirs or is maintained at a nearly steady rate by large, constant ground-water inflows, a single sample or observation may suffice to characterize the quality for many days, weeks, or longer. Normally, however, one sample cannot be safely extrapolated for more than a day or two and for some streams not more than a few hours. Thus, the frequency of sampling is an important consideration for the sampling procedure.

Theoretically, a sample representing the overall composition of a surface-water body can be obtained by compositing several depth-integrated samples of equal volume taken at places with equal flow across the cross section. Due to the large number of samples which may be required, it is highly desirable to find a location in which the water composition is uniform with depth and cross section. Again, where uniform sections can be found, the sampling procedure may often be simplified to the extent that a single "grab" sample may be obtained that is representative of the surface-water body.

The United States Geological Survey (USGS) has long followed a practice of collecting samples once daily, as this appears to be the minimum frequency necessary to adequately define the water quality for the majority of water uses. Once-daily sampling has been considered as a standard for the usual comprehensive chemical-quality investigation for surface water. Less frequent sampling schedules are often used, however, and the value of weekly, monthly, or quarterly sampling in reconnaissance or unit basin studies should not be minimized. In general, a surface-water sampling schedule that, at a minimum, coincides with the frequency of ground-water sampling allows for continuity over the sampling period.

## 2.0 CONSIDERATIONS

Collecting samples from surface-water bodies require special considerations regarding sampling location and general safety.

2.1 The location of a surface-water sampling point is the first consideration for a surface-water sampling program. The general sampling location will be selected based on the requirements of the investigation. The specific sampling location should be selected where flow and turbulence are uniform and access is favorable (i.e., a bridge or shallow section for a river or pond, respectively).

The sampling location should avoid tributaries, parking lot runoff, factory outfalls, and obstructions unless these inputs are of specific interest. Sampling from the boundaries of the surface-water body should generally be avoided, except where these regions are of direct interest. Sampling must proceed from downstream locations to upstream locations (unless site-specific conditions preclude this order) in order that disturbance related to sampling does not affect downstream sample quality. If sediment samples will be collected at the same locations as liquid samples, then the liquid samples must be collected first.

2.2 Health and safety is a key aspect of all sampling procedures. The health and safety plan (HASP) must be referred to regarding the implementation of health and safety procedures and the selection of an adequate sampling location. A USGS gauging station or a bridge are often the most desirable sampling locations because they eliminate the need for entering the water body. If entering the water body is necessary, then the water velocity, depth, sediment type and uniformity, tidal stage, and water chemistry must be evaluated. When entering a water body or working from a vessel (e.g. raft, boat) the sampler must use a safety harness and life jacket, and a buddy system must be employed. If sampling lagoons or surface impoundments containing known or suspected hazardous substances, personnel should refer to the HASP to determine the necessary precautions to ensure the safety of sampling personnel. The sampler should not get too close to the edge of the impoundment, where bank failure may cause him/her to lose his/her balance. Depending upon the geographic location and season, considerations such as water temperature, snakes, rats, ticks, etc. may also be important considerations when selecting a suitable sampling location. 3.0 EQUIPMENT AND MATERIALS

In order to sample surface water, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. A work plan which outlines sampling requirements.

b. A health and safety plan.

c. Decontamination supplies (including as necessary: non-phosphate, laboratory-grade detergent; bucket; brushes; distilled/deionized water; potable water; regulatory-required reagents [e.g., acetone, nitric acid, etc.]; aluminum foil; etc.).

d. Field notebook and field form(s).

e. Maps (site map, sampling plan/location map, topographic map ).

f. Cooler and ice (wet or blue packs).

g. Sample bottles (including as necessary: appropriate field blanks, trip blanks, duplicates, preservatives, extra bottles for breakage, proper size and type for analyte, labels, etc.).

h. Plastic sheeting.

i. Meters (as necessary: pH, conductivity, turbidity, eH, dissolved oxygen, iron, manganese, etc.), thermometer, and

j. Calibration equipment/materials for all meters or devices.

k. Wading rod and current meter.

l. Sampler (as necessary: , bailer, pond sampler, weighted-bottle sampler, Wheaton dip sampler, Kemmerer depth sampler, Bacon Bomb sampler, etc.).

m. Disposable sampling gloves.

n. Health and safety equipment (as necessary: , rubber boots, hip waders, chest waders, safety harness, rope, life jacket, life preserver, air horn, two-way communication, etc.).

o. Measuring tape (100-foot, weighted).

p. Non-absorbent cord (e.g., polypropylene) to lower samplers.

q. Camera and film.

r. Filtering apparatus, filters, pre-filters.

s. Paper towels, clean rags.

t. Black pen and indelible marker.

u. Tools (e.g., screwdrivers, hammer, pliers, flashlight, pen knife, etc.)

v. Masking and packing tape.

w. Packing material (e.g., "bubble wrap") and "zip-lock" plastic bags.

x. Chain-of-custody form(s) and custody seals.

y. Overnight (express) mail forms.

## 4.0 DECONTAMINATION

Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as cord, tubing, and gloves will be changed between each use and discarded in an appropriate manner. If a non-disposable item is to be reused during a sampling event, it will be thoroughly cleaned according to the field equipment decontamination SOP. Appropriate field, equipment and trip blanks will be collected as outlined in the work plan to demonstrate proper decontamination procedures.

## 5.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers, pH and conductivity meters, etc.). Refer to the specific SOPs for field analysis for each respective piece of equipment. Equipment such as current meters must have the manufacturer's manual maintained with the instrument and must be referred to for use, repair, maintenance, trouble-shooting, or calibration, if required. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

## 6.0 PROCEDURE

6.1 Identify each location to be sampled based upon requirements of the work plan. If any of the considerations outlined in Section 2.0 impact the proposed sampling method, then contact the project manager to get authorization to modify as necessary. When possible, use stakes, flags, or buoys to identify and/or mark all sampling location.

6.2 Record the site and sample location, weather conditions, date, and time of the selected sampling point in the field notebook and on any field forms being used, and initial the entry.

6.3 Describe the surface-water body characteristics including as pertinent: width (feet [ft]), depth (ft), flow (none, low, intermediate or flood; or measured velocity, if possible), turbidity (clear, turbid, very turbid), turbidity or flow variations across the surface-water body, tributary locations and distances, surface runoff impacts, and adjacent land use. A photograph of each sampling location should be included as part of the documentation.

6.4

6.5 Prepare sample containers for collection by organizing, labeling, and verifying proper preservation methods.

6.6 Ensure all sampling equipment has been thoroughly decontaminated and is operational and has been calibrated to the manufacturer’s specifications.

6.7 Place plastic sheeting on ground to protect sampling materials from potential contamination.

6.9 Collect the sample utilizing the selected sampling method and immediately place into pre-labeled, laboratory-supplied containers. Fill each appropriate, pre-labeled sample container carefully to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in a ice-filled (wet ice or blue pack) cooler for storage. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

6.10 "Top-off" containers for volatile organic compounds (VOCs) and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that no bubbles are present by turning the container upside down and tapping gently.

6.11 Filter water samples collected for dissolved metals analysis prior to preservation to remove the suspended sediment from the sample. If water samples are to be collected for total metals analysis, then collect a second set of samples without field filtering. Refer to the field filtering SOP for specific procedures.

6.12 Add the appropriate preservative to each container, if required, prior to, or after (preferred), the collection of the sample, unless the appropriate preservative(s) have already been added to the container(s) by the laboratory before shipment.

6.13 Collect quality control (QC) samples to monitor sampling and laboratory performance as required in the work plan. Refer to the SOP for collection of QC samples for a detailed discussion of proper methods.

6.14 Field parameters (e.g., temperature, pH, conductivity, turbidity, etc.) will typically be measured immediately prior to collecting samples for laboratory analysis. Whenever possible, sufficient volume should be collected in the initial sample to complete all laboratory and field parameters.

6.15 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," and placed in its appropriate container in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

6.16 Thoroughly clean bailers, hoses, and samplers as discussed in the field equipment decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with accepted procedures.

6.17 Complete field forms, field notebook entries, and the chain of custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

6.18 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

## 7.0 SELECTING SAMPLE LOCATIONS

In certain situations the work plan will require a more rigorous method to determine the number and location of surface-water samples. The following calculations may be used to determine where to sample and how many samples are to be collected:

a. Calculate the mixing length (L), using the following data:

stream velocity (u), in feet per second (ft/sec)

channel width (w), in feet (ft)

channel depth (d), in feet (ft)

with the equation: $$L = \frac{2.6\,(u)(w^2)}{(d)}$$

$$L = \frac{2.6\,(\quad ft/sec)(\quad ft^2)}{(\quad ft)}$$

b. Respond to the following three questions:

1. Is the mixing length, L, less than 1 mile?

2. Is the mixing length less than the distance to the nearest upstream tributary?

3. Is the stream homogeneous in turbidity?

If all three answers are Yes, then collect only one sample at a depth of 1 foot.

If the answer to any of the above is No, then calculate the width of the mixed zone.

c. Calculate the width of the mixed zone (w) using the following data:

L = 5280 ft or the distance to the nearest upstream tributary (whichever is less)

d = depth, in ft

u = velocity, in ft/second (ft/sec)

with the equation:

$$w^2 = \frac{(L)(d)}{(2.6)(u)}$$

Collect samples at distances across the streams that are less than the mixed zone width, w.

END OF PROCEDURE

Date: May 5, 2000
Revision: May 7, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the field filtration of groundwater samples for dissolved metals analysis prior to sample preservation. Filtering is implemented when the water sample contains suspended fine-grained materials (fines) that cannot be prohibited from entering the water sample by well development or well design. However, as fines are not always distinctly visible in the water sample, all water samples to be analyzed for dissolved metals will undergo filtration. Groundwater samples from bedrock formations to be analyzed for dissolved metals must also be filtered.

It should be noted that certain regulatory agencies insist that groundwater samples for metals analysis are not filtered. In this case, the analytical results are actually representative of total metals (i.e., dissolved and suspended). Nevertheless, if it is desired to quantify the concentrations of dissolved metals in groundwater, filtration will need to be performed.

Within this framework, filtration refers to the filtering of water either directly, or at the end of a filtration series, through a 0.45 micrometer (micron) membrane filter. The presence of a large quantity of fines may require the prefiltering of the sample with a larger-size membrane filter prior to the 0.45 micron filter to avoid clogging the 0.45 micron filter.

Filtration must be done as soon as possible after a water sample is collected, preferably at the same time that the water is produced. If there is a delay between the time that the water sample is collected and the time that filtration occurs, then the time lag and reason for the delay must be documented. The filtering equipment and membrane must be suitable for the intended analysis. Where permitted by regulatory agencies, disposable in-line filters and disposable funnel-type filters may be used. Depending upon the sampling needs, sterile disposable filtering devices may be preferable since they eliminate the need for field decontamination. Materials known to adversely affect the analytical procedure must not be used. The site sampling and analysis plan (SAP) must be referred to for these and other site specific filtration conditions.

In the event that surface water is being analyzed for dissolved metals, the filtration process described below should be used.

## 2.0 MATERIALS AND EQUIPMENT

4.1 To field filter groundwater samples, specific equipment and materials are required. The equipment and materials listed below may be needed in addition to the materials and equipment listed in various sampling SOPs.

a. Non-phosphate, laboratory-grade detergent.

b. Distilled/Deionized water.

c. Potable water.

d. Field forms (e.g., daily log, sampling, etc.) and field notebook.

e. Filtration apparatus (e.g., disposable plastic filtering apparatus, disposable in-line filters, Gelman apparatus, Buchner funnel, etc.), filters, prefilters.

f. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

g. Teflon™ tape.

h. Vacuum pump (e.g., hand-operated or electric).

i. Appropriate tubing and fittings.

j. Disposable gloves.

k. Sample jars with appropriate preservative (e.g., nitric acid) and labels.

## 3.0 DECONTAMINATION

3.1 Decontamination is not necessary if sterile, disposable plastic filtering equipment is utilized. If applicable, it may be useful to collect a distilled water field blank through a representative disposable filter to demonstrate proper "decontamination." If re-usable filtering equipment is being used, the following is the minimum decontamination procedure:

a. Wear disposable gloves while cleaning filtering equipment to avoid contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and distilled or deionized water in a bucket.

c. Remove vacuum tubing from flask.

d. Remove filter membrane from funnel.

e. Disassemble filtering apparatus (flask and funnel) and scrub each piece of equipment with a brush and solution.

f. Rinse with potable water.

g. Rinse with copious amounts of distilled or deionized water.

h. Allow to dry and wrap equipment with a suitable material (e.g., clean plastic bag) in preparation for the next use.

3.2 The decontamination procedure must consider regulatory agency(ies) specifications which must be provided in the site SAP, and may include decontamination variations such as nitric acid rinses, acetone rinses, etc. For standard decontamination procedures, refer to ROUX-SOP 9.1 Field Equipment Decontamination.

## 4.0 PROCEDURE

4.1. Ensure that the filtering equipment is disposable and dedicated or is properly decontaminated before each use.

4.2. Assemble the filtering apparatus (funnel and flask), and connect the vacuum pump in case it is needed to augment gravity filtration.

4.3. Place a clean (new) 0.45-micron pore-size filter in the funnel. Use larger, pore-size filters if prefiltering is required (i.e., if significant suspended sediment is present that would quickly clog the 0.45-micron filter and prevent continuous filtration or result in excessive time for filtration).

4.4. Obtain the water sample using an appropriate, decontaminated sample-collection device (e.g., bailer, pump).

4.5. Pass the unpreserved water sample through the 0.45 micron filter into the flask. If the sample contains significant sediment, then pass it through a prefilter before using the 0.45 micron filter. Apply a vacuum using the vacuum pump if needed to facilitate filtering.

4.6. Transfer the filtered water sample to the appropriate, prelabeled sample container containing the preservative (e.g., nitric acid) being careful not to overfill the container and dilute the preservative.

4.7. Follow standard operating procedures for sample documentation, shipping, and tracking (i.e., record keeping).

4.8. Decontaminate all reusable filtering (and sampling) equipment that came in contact with the water sample. Properly disposal of all non-reusable equipment in a manner appropriate with site conditions.

END OF PROCEDURE

Date: May 5, 2000
Revision: April 16, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for measuring the thickness of floating separate-phase organic liquids in monitoring wells, tanks drums, or other containers. Measuring the thickness of floating, separate-phase organic liquids requires special health and safety considerations, equipment, and procedures.

Separate-phase layers can either be "floaters" or "sinkers". "Floaters" (non-aqueous phase liquids [NAPLs]) are separate-phase liquids that are less dense than water and float on the ground-water surface. "Sinkers" (dense non-aqueous phase liquids [DNAPLs]) are separate-phase liquids that are more dense than water and tend to migrate downward through aquifers due to gravitational forces until a low permeability layer is encountered (i.e., they accumulate at the bottom of the aquifer). For the purpose of this SOP, only measuring the thickness of floating (LNAPL) separate-phase liquids will be addressed.

The objectives for measuring separate-phase organic liquids may include the following: 1) determination of the thickness of the free product in a well, tank or drum; 2) estimation of the volume of free product to be removed from a well before sampling, or from a tank or drum before removal; and 3) calculation of the "true" (non-free product depressed) elevation of the water table.

## 2.0 CONSIDERATIONS

The primary considerations when measuring the thickness of floating separate-phase liquids are health and safety, and proper equipment selection.

### 2.1 Health and Safety

All separate-phase products must be assumed to possess health and safety hazards equivalent to the most hazardous suspected on-site source. For example, if fuel oil is being measured in wells where polychlorinated biphenyls (PCBs) are known (or suspected) to be present, then the potential for PCBs to be present in the fuel oil must be considered. When measuring the thickness of flammable materials, it is imperative that all possible sources of ignition be eliminated. Minimum requirements (NO EXCEPTIONS) include: no smoking or open flames, use of intrinsically safe downhole monitoring equipment, use of static free bailing cord (e.g., absorbent cord [cotton]), and use of properly vented and grounded product collection containers. When product collection containers will be stored onsite, the local fire code official must be consulted regarding product storage requirements (e.g. venting, grounding, labeling, permits, secondary containment, etc.). A detailed, comprehensive explanation of health and safety procedures must be outlined in the site health and safety plan (HASP).

2.2 Equipment Selection

There are several methods which may be employed to measure the thickness of separate-phase petroleum product in a monitoring well, tank or drum. The actual method to be utilized should be outlined in the work plan. Considerations in selecting a method shall include: the type and consistency of the product; the level of accuracy desired; the expected depth and thickness of the product; and the diameter of the well or port.

Measurements of floating separate-phase product thicknesses can be performed using 1) an electronic oil/water interface probe; 2) a graduated, clear acrylic bailer; or 3) a weighted steel measuring tape (or graduated "stick") in conjunction with oil and water paste.

An oil/water interface probe is capable of providing rapid and accurate (±0.01 foot) results under most field situations. However, viscous product or oil/water emulsions may interfere with performance by coating the probe and/or disguising the interface. In these situations, a clear, acrylic bailer may be used in wells, or oil and water paste in a tank or drum.

A clear, acrylic bailer may be used if simply the presence or absence of product or an approximate product thickness is desired. In certain situations (e.g., viscous product or product/water emulsions) a clear acrylic bailer may be the best available method. However, when product thicknesses are greater than approximately three feet, a bailer will be unable to provide approximate product thickness measurements. If the oil/water interface probe will not work, and the product thickness is too great to be measured by a bailer, then the best available technique may be oil and water paste.

A graduated "stick" or weighted steel tape in conjunction with oil and water paste may be appropriate for measuring residual water or product in a tank or drum. This method is not recommended for use in monitoring wells because of possible cross-contamination from the paste itself. In certain situations where no other method can provide the necessary data, oil and water paste may be used in monitoring wells containing product. This method is less accurate than an oil/water interface probe, but frequently more accurate than a clear, acrylic bailer.

It should be noted that erroneous data may be collected by all three methods when measurements are collected through the fill ports of tanks which are equipped with drop tubes. Whenever possible, product thickness measurements should be collected from ports with unobstructed access to the tank contents. When measurements must be collected from a fill port with a drop tube, it should be understood that there may be significant differences between the drop tube measurements and the actual thicknesses of the water and product in the tank.

## 3.0 CALIBRATION

### 3.1 Oil/Water Interface Probe

There is no specific calibration procedure for an oil/water interface probe. However, you should verify that the unit operates properly prior to taking it out in the field by testing it in a jar containing product and water. This jar should be stored in a flammable liquid cabinet and be dedicated to oil/water interface probe testing. Since most oil/water interface probes have a heavy probe assembly and a rigid graduated tape, kinking, stretching or twisting of the tape is not a significant concern. In order to ensure proper operation, the unit should be kept warm prior to use (e.g. cab of truck).

### 3.2 Clear Acrylic Bailer

There is no specific calibration procedure for an acrylic bailer. However, since you only get one chance to measure the thickness correctly, you should verify that the check valve operates properly with distilled water. Based on previous data, if available, you should ensure that the length of the bailer is sufficient to measure the entire thickness of the product.

### 3.3 Oil/Water Paste

There is no specific calibration procedure for using oil and water paste. However, these pastes may not behave reliably if they are old or have been exposed to extreme temperatures. The pastes should be tested prior to taking them out in the field to confirm they work. The stick measure or weighted steel tape should be carefully examined to confirm that it is properly graduated and has not been damaged or modified.

## 4.0 DECONTAMINATION

4.1 Complete decontamination of a clear acrylic bailer which is dedicated to the measurement of separate-phase product thicknesses can be very difficult. Thus, bailers should be used on a one time basis. Decontamination should involve removal of gross contamination before entering and exiting the site or moving to different areas of separate-phase product accumulation. Special care must be taken to make sure that a “product bailer” never enters a “clean” well which does not contain separate-phase product. This can be ensured by measuring separate-phase thickness in all wells before starting bailing operations. The oil/water interface probe must be thoroughly cleaned according to the field equipment decontamination SOP before entering each well. If historical data are available, then the order of measuring separate-phase thickness should be from the cleanest well to the dirtiest well to further reduce the potential for cross-contamination. If samples are also being collected for constituent or characterization analysis, then a disposable, dedicated bailer may be necessary for product collection.

## 5.0 EQUIPMENT AND MATERIALS

Depending on the method used to measure the thickness of separate-phase organic liquids, both method-specific and general equipment and materials are needed.

5.1 Regardless of the method used, general equipment and materials will include, but may not necessarily be limited to, the following:

a. Site Health and Safety Plan (HASP).

b. Appropriate health and safety equipment, as specified in the HASP.

c. Roux Associates' field forms and field notebook.

d. Non-phosphate, laboratory-grade detergent.

e. Distilled/deionized water.

f. Potable water.

g. Paper towels, clean rags.

h. Plastic sheeting.

i. Sorbent pads.

j. Well location and site map.

k. Well keys.

l. Disposable gloves.

m. Calculator.

n. Black pen and indelible marker.

o. Tools (e.g., pipe wrench, screw drivers, hammer, pliers, flashlight, pen knife, etc.).

p. Buckets and brush for decontamination.

5.2 Clear Acrylic Bailer - the following will also be needed:

a. Clear acrylic bailer

b. Non-static cotton cord

c. Steel tape (10 foot)

5.3 Oil/Water Interface Probe - the following will also be needed:

a. Oil/water interface probe

5.4 Oil/Water Paste - the following will also be needed:

a. Oil paste

b. Water paste

c. Graduated stick or weighted steel tape

## 6.0 PROCEDURE

### 6.1 Oil/Water Interface Probe

6.1.1 Make sure the bottom five (5) feet of the probe and measuring tape have been decontaminated according to the field equipment decontamination SOP before entering each well.

6.1.2 Based on previous data, if any, ensure that non-product wells are measured prior to product wells to reduce the possibility of cross-contamination.

6.1.3 Measure VOCs at the rim of the unopened well with a photoionization detector (PID) or flame ionization detector (FID) instrument and record the reading in the field notebook.

6.1.4 Remove the well cap or plug and clean the top of the well with a clean rag. Place the cap or plug on clean plastic on the ground to protect it from potential contamination.

6.1.5 Slowly lower the thoroughly decontaminated probe to the product surface. A distinct tone or beep will indicate the presence and level of product. The depth to product (DTP) from the measuring point will be recorded in the field notebook and on appropriate field forms. Continue lowering the probe until the tone or beep indicates the presence of water. The oil/water interface is best measured by lowering the probe about six inches into the water and then raising it to the interface. The depth to water (DTW) from the measuring point will be recorded in the field notebook and on appropriate field forms. The product thickness is the difference between the DTW and DTP.

6.1.6 Replace locking and/or protective caps on the well.

6.1.7 Thoroughly clean the probe and the portion of the tape which entered the product according to the field equipment decontamination SOP.

6.2 Clear Acrylic Bailer

6.2.1 Make sure all equipment is cleaned of gross contamination before entering and exiting the site or moving to different areas of product accumulation.

6.2.2 Measure VOCs at the rim of the unopened well with a photoionization detector (PID) or flame ionization detector (FID) instrument and record the reading in the field notebook.

6.2.3 Remove the well cap or plug and clean the top of the well with a clean rag. Place the cap or plug on clean plastic on the ground to protect it from potential contamination.

6.2.4 Slowly lower a clear, decontaminated bottom-filling acrylic bailer into the well until the bottom of the bailer contacts the fluid surface.

6.2.5 Using a reference point on the bailer line, slowly lower the bailer into the fluid a distance less than the bailer length so that at its deepest point the top of the bailer remains above the air/fluid contact.

6.2.6 Slowly raise the bailer out of the well.

6.2.7 The thickness of the floating free product will be approximated by placing a tape measure along side the bailer. The data will be documented in the field notebook and on appropriate field forms.

6.2.8 Dispose of the product in an appropriate manner as specified in the work plan. This may include draining the product back into the well or tank, or containerization if the measurement is in conjunction with bailing for removal purposes.

6.2.9 Replace locking and/or protective caps on the well.

6.2.10 Thoroughly clean the bailer as described in Section 6.2.1. Discard the cotton cord in an appropriate manner. Wrap decontaminated bailer in a suitable material (e.g., clean plastic bag, aluminum foil).

6.2.11 If the free product is extensive or thicker than the height of the bailer, then an electronic interface probe should be used to measure product thickness.

6.3 Oil/Water Paste - (Generally not applicable for monitoring wells)

6.3.1 Make sure all equipment is decontaminated and cleaned before use according to the field equipment decontamination SOP.

6.3.2 Secure access to the tank or drum to be measured only after the contents are known and properly addressed in the HASP. Attempt to estimate the

depth and thickness of product and the depth to water so the entire stick or weighted steel tape does not have to be coated with oil and water paste.

6.3.3 Coat one side of the stick or steel tape with oil paste and the other with water paste. Since these are typically different colors, confusion should not result. Depending upon information needs, lower the tape to just below the water interface or to the bottom of the tank or drum.

6.3.4 If only DTP and DTW data is required, then the top of the tape is held at an even-foot increment at the measuring point (MP). This is called the "held" value, and is recorded as such. If the depth to the bottom of the tank is also required, then the held value can't be specifically selected at an even-foot increment.

6.3.5 The steel tape or graduated stick is removed and the "water cut" and "product cut" levels are recorded. The difference between the "held" value and the "product cut" value is the DTP. The difference between the "held" value and the "water cut" is the DTW. The difference between the "product cut" and the "water cut" is the product thickness. If the diameter of a horizontal tank is desired, then the difference between the "held" value (to the bottom of the tank) and the depth of the fill pipe is required.

6.3.6 All pertinent data will be recorded in the field notebook and on appropriate field forms.

6.3.7 Make sure all equipment is decontaminated before use in the next tank, drum, or container according to the field equipment decontamination SOP. All disposable materials must be discarded in a manner consistent with site conditions.

END OF PROCEDURE

Date: June 12, 2017

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to describe the field methods to be used for conducting pneumatic slug tests to determine the hydraulic conductivity of the formation materials surrounding the screened interval of a monitoring well. This method involves measuring the response of a static water-level to either the injection or withdrawal of pressurized air or nitrogen from the well.

During testing, water-level changes from the static with time are measured and recorded. A pressure transducer and a data logger are to be used to collect slug test data as they provide a means for collecting substantial, meaningful data over a short period of time, which is needed for analysis.

The pneumatic slug tests will generate data that will be used to determine the hydraulic conductivity at each well. This data will be used for evaluation of groundwater flow beneath the Site.

## 2.0 CONSIDERATIONS

In order for a pneumatic test to be conducted, the entire length of screen of the monitoring well must be submerged beneath the level of standing water in well. If the water level is below the top of the screen, mechanical slug testing will be performed. Procedures for conducting mechanical slug tests are outlined in the SOP titled "Standard Operating Procedure 4.9 for Conducting Mechanical Slug Tests."

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. Field notebook, field forms (i.e., Daily Log and Pumping Test Form).

c. Electronic sounding device (water-level indicator).

d. Pneumatic Slug Test Manifold Assembly consisting of:

   i. Inlet and release valves.

   ii. Pressure regulator.

   iii. Tubing: 250 psi gas lines.

   iv. Pressure and vacuum gauge.

   v. Air-tight transducer probe port.

vi. Metal band clamps.

e. Data loggers and pressure transducers.

f. Compressed air.

g. Power inverter for vehicle 12V outlet.

h. Teflon® tape.

i. Adapter to attach pneumatic manifold assembly to the well casing.

j. Portable personal computer with (PC) Aqtesolv and Win-Situ software downloaded and appropriate cables.

k. Extra batteries for meters.

l. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

m. Disposable Nitrile sampling gloves and cut-proof gloves.

## 4.0 PROCEDURE

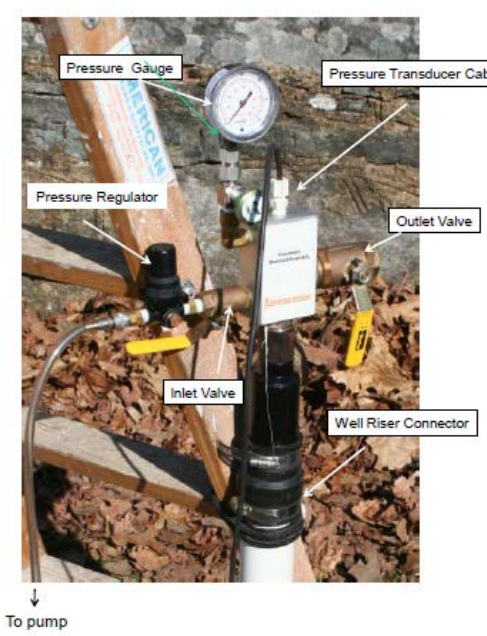
4.1 Study the well boring log to define the length of the screen, depth of well, well casing radius and well boring radius.

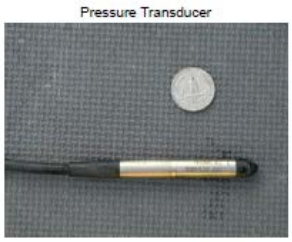
4.2 Measure water levels (the depth to water below the predetermined measuring point on the well casing) in the test well to an accuracy of 0.01 foot several times prior to the slug test. The entire length of screen must be saturated in order to continue the test. If the water level is below the top of the screen, mechanical slug testing will be performed. Procedures for conducting mechanical slug tests are outlined in the SOP titled "Standard Operating Procedure 4.9 for Conducting Mechanical Slug Tests."

4.3 Enter all pertinent data concerning the well to be tested on the Slug Test form and Daily Log form, and in the field notebook.

4.4 Measure the total depth of the test well to an accuracy of 0.01 foot, document the measured depth. Compare the measured depth to the as-built total depth of the well to ensure no appreciable sanding or silting (clogging) has occurred. If appreciable clogging has taken place, then the well may need to be redeveloped to re-establish good hydraulic connection between the well and the aquifer. Wells must respond quickly to changes in water levels.

4.5 Install the Pneumatic Slug Test Manifold Assembly with an adapter on well casing. Use Teflon® tape to seal the connection. Figures presenting the components to the pneumatic setup (Ram's Horn Educational, LLC., 2010-2012) is provided below:



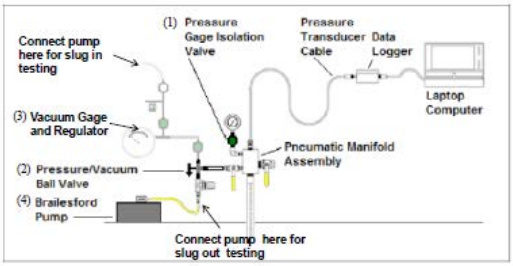










Modified Geoprobe
System Pneumatic Slug Test Kit
for Slug-out and Slug-In




Modified after Bartlett et al. (2004)

Determine the length of pressure transducer cable needed so that the pressure transducer can be placed just below the depth for the desired displacement (i.e. if desired displacement is 1-foot, place transducer at 1.5 feet below the static water level. Connect the pressure transducer to the data logger and laptop computer. Zero the pressure transducer in air. Insert the pre-cleaned pressure transducer into the assembly unit while monitoring the pressure until the pressure transducer is at the desired depth below the static water level. Seal the pressure transducer cable and rezero the pressure transducer. The transducer must be placed so that when the water level is depressed with air pressure the transducer is always below the

water and above the top of the screened interval. When performing the initial slug test, allow the pressure transducer to equilibrate in the well for approximately 15 minutes, then check the calibration and rezero if necessary. The pressure transducer must be rezeroed before each test.

4.6 Set up the data logger with the correct recording intervals and time-steps for measurements. The data logger should be set to take measurements at the smallest increment possible, typically four measurements each second or every 0.25 seconds.

4.7 Tighten the airtight fitting on the transducer cable by hand to seal the connection. Attach the transducer cable to the data logger connected to a 115 volt power supply (such as the power inverter from vehicle 12V outlet).

4.8 Check to make sure the release valve is closed, inlet valve is opened and the pressure regulator is closed.

4.9 Attach the compressed air to the quick connect at the pressure regulator. Open the valve for the compressed air to pressurize the well headspace. Prior to performing the first two-test sequence, watch the air pressure gauge and adjust the regulator to set the air pressure in the headspace to 1 foot below the static level. When performing the second sequence, watch the air pressure gauge and adjust the regulator to set the air pressure in the headspace to 2 feet below the static level.

4.10 Close inlet valve and leak check system. Monitor transducer response on computer screen and air pressure on gauge to verify that the system is stable.

4.11 Start the data logger to begin recording the data directly before initiating the pneumatic slug test. Allow 5 to 10 seconds to pass before test initiation.

4.12 Quickly open the release valve to initiate the pneumatic slug test.

4.13 Observe on screen that the data logger is recording the water-level data while water levels rise and the aquifer returns to static or near-static conditions (within 5%).

4.14 Review the data to determine if a meaningful test has been conducted. Repeat the test once more with the same displacement value to confirm reproducibility of the data. If water levels return to static or near static conditions within one hour, conduct another test using a different level of displacement.

4.15 Transfer the data from the transducer and data logger to the shared network each day to ensure that the data is backed up.

4.16 Secure the test well prior to leaving (i.e., replace cap and/or cover, and lock).

4.17 All reusable sampling equipment must be thoroughly cleaned in accordance with the Roux SOP 9.1 decontamination procedures. Discard any gloves, plastic, etc. in an

appropriate manner that is consistent with site conditions and regulatory requirements, and if applicable, in accordance with any site-specific investigation-derived waste management plan.

END OF PROCEDURE

REFERENCES

Ram's Horn Educational, LLC., 2010-2012. Pneumatic Slug Test Course Notes, v.1.03

Date: June 12, 2017

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to describe the field methods to be used for conducting mechanical slug tests in order to determine the hydraulic conductivity of the formation materials surrounding the screened interval of a monitoring well. This method involves measuring the response of a static water-level to either the insertion or removal of a solid cylinder (slug) into the well.

During testing, water-level changes from the static water level are measured and recorded with time. A pressure transducer and a data logger are to be used to collect slug test data as they provide a means for collecting substantial, meaningful data over a short period of time, which is needed for analysis.

The mechanical slug tests will generate data that will be used to determine the hydraulic conductivity at each well where a pneumatic slug test can't be completed, such as wells screened across the water table and not fully submerged. This data will be used for evaluation of groundwater flow beneath the Site.

## 2.0 CONSIDERATIONS

Mechanical slug tests will be completed at monitoring wells that do not meet the qualifications for a pneumatic slug test. In order for a pneumatic test to be conducted, the entire length of screen of the monitoring well must be submerged beneath the level of standing water in well and the screen length must be known.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. Field notebook, field forms (i.e., Daily Log and Slug Test Form).

c. Electronic sounding device (water-level indicator).

d. Solid plastic slug (such as water-filled PVC). The diameter and length of the slug should be determined based on the diameter of the well and the proposed displacement volume for the test.

e. New non-adsorptive polypropylene rope of sufficient strength.

f. Data loggers and pressure transducers.

g. Portable personal computer (PC) with Win-Situ software downloaded and appropriate cables.

h. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

i. Disposable Nitrile sampling gloves and cut-proof gloves.

## 4.0 PROCEDURE

4.1. Study the well boring log to define the depth of well, well casing radius, and well boring radius.

4.2. Measure water levels (the depth to water below the predetermined measuring point on the well casing) in the test well to an accuracy of 0.01 foot several times prior to the slug test. If the water level is below the top of the screen, mechanical slug testing will be performed. If the entire length of screen is saturated, consider using the pneumatic slug testing technique.

4.3. Enter all pertinent data concerning the well to be tested on the Slug Test Form and Daily Log form, and in the field notebook.

4.4. Measure the total depth of the test well to an accuracy of 0.01 foot and document the measured depth. Compare the measured depth to the as-built total depth of the well to ensure no appreciable sanding or silting has occurred. If appreciable silting has taken place, consult with the project manager to confirm the test is still warranted. Wells must respond quickly to changes in water levels.

The below slug test reference tables provided by USEPA (USEPA, 2015) should be used to select the appropriate slug dimensions to achieve the target head change.

**TABLE 1**
**Volume of Slug Required to Raise/Lower the Head Level a Targeted Length within a Specific Well Diameter**

| Well Diameter (inches) | 1-Foot Displacement Volume (cubic feet) | 2-Foot Displacement Volume (cubic feet) |
|---|---|---|
| 2 | 0.033 | 0.044 |

**TABLE 2**
**Slug Displacement Volume in Cubic Feet Based on Slug Diameter and Length**

| Length (ft) | 1.5-inch Diameter | 2-inch Diameter | 3-inch Diameter |
|---|---|---|---|
| 2 | 0.025 | 0.044 | 0.098 |

| | | | |
|---|---|---|---|
| 3 | 0.037 | 0.065 | 0.147 |
| 4 | 0.049 | 0.087 | 0.196 |

4.5. Use a PVC or plastic slug that will displace the head of water within the well between the range of 0.5 to 3.0 feet. The slug should have the ability to be completely submerged within the water column throughout the test. Ensure that the slug is the appropriate volume and size based upon the above well measurements and applicable guidance documents.

4.6. Determine the length of pressure transducer cable needed so that the pressure transducer can be placed 2-feet below where the slug will be inserted during the test. Connect the pressure transducer to the data logger and laptop computer. Zero the pressure transducer in air. Insert the pre-cleaned pressure transducer into the well while monitoring the pressure. Secure the pressure transducer cable outside of the well to ensure the transducer depth will not shift during testing and re-zero the pressure transducer.

4.7. Set up the data logger with the correct recording intervals and time-steps for measurements. The data logger should be set to take measurements at the smallest increment possible, typically four measurements each second or every 0.25 seconds.

4.8. Attach new non-adsorptive polypropylene rope to the slug that will allow the slug to be completely submerged within the well. Ensure that the rope is properly secured to the slug so that the slug does not drop down the well. Ensure the rope is secured outside the well.

4.9. Lower the slug into the well just above the static water level. Do not breach the static water level yet.

4.10. Start the data logger to begin recording the data directly before initiating the mechanical slug-in test. Allow 5 to 10 seconds to pass before test initiation.

4.11. Lower the slug below the static water level rapidly but do not let go of the rope and fully drop into the well. The slug should be entirely submerged throughout the duration of the test but should not rest upon the pressure transducer.

4.12. The water level will rise following the immediate introduction of the slug. Observe on screen that the data logger is recording the water-level data while water levels fall and the aquifer returns to static or near-static conditions (within 5%). Once the water level has stabilized, turn off the data logger and reprogram it for the slug-out test.

4.13. Start the data logger to begin recording the data directly before initiating the mechanical slug-out test. Allow 5 to 10 seconds to pass before test initiation.

4.14. Quickly pull the slug completely out from the water column.

4.15. The water level will fall following the immediate removal of the slug. Observe on screen that the data logger is recording the water-level data while water levels rise and the aquifer returns to static or near-static conditions (within 5%). Once the water level has stabilized, turn off the data logger and reprogram it for the next slug test.

4.16. Review the data to determine if a meaningful test has been conducted. Repeat the test once more with the same displacement value to confirm reproducibility of the data. If water levels return to static or near static conditions within one hour, conduct another test using a different level of displacement.

4.17. Transfer the data from the transducer and data logger to the shared network each day to ensure that the data is backed up.

4.18. Secure the test well prior to leaving (i.e., replace cap and/or cover, and lock).

4.19. All reusable sampling equipment must be thoroughly cleaned in accordance with the Roux SOP 9.1 decontamination procedures. Discard any gloves, plastic, etc. in an appropriate manner that is consistent with site conditions and regulatory requirements, and if applicable, in accordance with any site-specific investigation-derived waste management plan.

END OF PROCEDURE

REFERENCES

USEPA, December 2015. Slug Tests Standard Operating Procedures, SOP#2046.

Date: February 14, 2018

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to describe the field methods to be used for conducting sediment porewater sampling in order to characterize sediment porewater quality. The specific procedure and equipment selection will be dependent upon the data objectives of the sampling program. The sampling requirements should be carefully designed and fully described in a work plan.

Sediment porewater is the water residing in the interstitial spaces between soil or sediment particles beneath surface water. Porewater samples can be analyzed for chemical, physical, biological, and toxicological characterization purposes. Depending upon hydrologic conditions, the sediment porewater quality can represent the quality of water that is discharging from groundwater to surface water, or vice versa.

## 2.0 CONSIDERATIONS

Collecting porewater samples from surface water bodies and impoundments requires special considerations regarding general safety. In most instances, sediment porewater sampling will require entering the water. Therefore, the health and safety plan (HASP) must be referred to regarding the implementation of health and safety procedures (for compliance with the Occupational Safety and Health Administration [OSHA] and for general safety for sampling personnel). If entering the water body is necessary, then the water velocity, depth, sediment type and uniformity, tidal stage, and water chemistry must be evaluated. If any potential hazard is identified, then the sampler must use a safety harness and life jacket, and a buddy system must be employed. A raft or boat (vessel) may be necessary to collect samples. Depending upon the geographic location and season, considerations such as water temperature, biological hazards, etc. may be important. Thus, the site-specific HASP must address all possible contingencies and allow flexibility for revision if unanticipated conditions arise.

Multiple sediment porewater sampling methods should be considered based on Site-specific field conditions. This SOP specifically describes sampling with the use of active samplers, but additional methods such as laboratory centrifugation of bulk sediment should be considered dependent on the proposed porewater volume to be collected, and the proposed sampling location.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE) (including rubber boots, hip waders, chest waders, safety harness, rope, life jacket, life preserver, air horn, two-way communication, etc.), as specified in the site Health and Safety Plan (HASP).

b. Field notebook and appropriate field form(s).

c. PushPoint™ or similar active sampler consisting of a pointed tubular stainless-steel tube with a screened zone at one end and a sampling port at the other. The length of the stainless-steel tube depends on water depth. Extensions may be utilized when in deep water. The length of the screened zone depends on the site-specific study design. Filters may be placed over the screened zone if required by the data quality objectives (DQOs) of the study. Samplers must be new, verified, and certified clean disposable equipment or pre-cleaned non-disposable equipment.

d. Teflon® or other similar flexible tubing (1/4-inch O.D.).

e. Siliclastic® tubing or other similar tubing.

f. Teflon® or other similar transfer cap assembly.

g. 1-liter amber glass containers (including as necessary: appropriate field blanks, trip blanks, duplicates, extra bottles for breakage, proper size and type for analyte, labels, etc.). Determine in advance the minimal sample volume requirements with each sample.

h. 40ml glass vials with Teflon® septa (for volatile organic compound [VOC] analysis) (including as necessary: appropriate field blanks, trip blanks, duplicates, extra bottles for breakage, proper size and type for analyte, labels, etc.).

i. High capacity filter cartridges (barrel-type) (for dissolved metals analysis).

j. Peristaltic pump.

k. Specific conductance meter (Myron™ Ultrameter or equivalent).

l. Flange made of any material that will not cross contaminate the intended sample. The flange must include a cutting ring to enhance sealing. The flange size is dependent upon the volume of porewater to be collected, with larger volumes requiring larger flanges.

m. Disposable Nitrile sampling gloves and cut-proof gloves.

n. Waders (if water is shallow enough to wade) or sampling platform/boat (in deep water).

o. Black pen and indelible marker.

p. Paper towels, clean rags.

q. Masking and packing tape.

r. Packing material (e.g. “bubble wrap”) and “zip-lock” plastic bags.

s. Chain-of-custody form(s) and custody seals.

t. Overnight (express) mail forms and/or courier contact information.

## 4.0 DECONTAMINATION

When possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as cord, tubing, and gloves will be changed between each use and discarded in an appropriate manner. If a non-disposable item is to be reused during a sampling event, it will be thoroughly cleaned according to the field equipment decontamination SOP. Appropriate field, equipment and trip blanks will be collected as outlined in the work plan to demonstrate proper decontamination procedures.

## 5.0 PROCEDURE

4.1. Determine the sampling location. Samples should be taken from sediments below bodies of water and which possibly contain contaminants of concern. The general sampling location will be selected based on the requirements of the investigation. Samples should be collected progressively from the least suspected contaminated areas to the most suspected contaminated areas.

4.2. Determine the water depth at sample locations in order to select an appropriate method of access to the sampling location. Wading is the preferred method to access sample locations. However, wading may disrupt bottom sediments, which could negatively impact the quality of collected samples. To avoid this, the investigator should enter the area downstream of the proposed sampling location and face upstream while collecting samples. If wading is not feasible due to stream depth, the sample may be collected from a boat or other platform.

4.3. Place the flange at the desired sampling point with the push-point removed to allow water to escape from under the flange. The flange should be flush with the sediment surface by working the flange rim into the sediment, as shown in Figure 1A below. It is possible that some site-specific conditions will dictate deviations from the procedures outlined in this SOP, for example, in instances where the substrate is composed of coarse grained (gravel to cobbles) which may limit the ability to insert the sampling probe or use the flange to isolate the probe. If porewater is collected from deep in the sediments, a flange may not be necessary.

4.4. Place the porewater sampling device (with the guard rod inserted) through the compression adaptor. The sampling device should form a tight seal with the flange to prevent intrusion of surface water. Once the device is inserted to the desired depth (dependent upon objectives of specific investigation), the guard rod can be removed, as shown in Figure 1B below. Take care not to disturb the sampling area by standing as far away from the sampling point as possible and leaning forward towards the point (if wading).

4.5. Attach the sample tubing to the sampling port of the porewater device. Siliclastic tubing may be used to splice the Teflon® sample tubing to the push-point

sampler. The Teflon® tubing should be pushed tightly to the sampler at the center of the splice.

4.6. Attach the other end of sample tubing to a sample withdrawing device such as a peristaltic pump, as shown in Figure 1C below.

4.7. Prior to attaching the sampler and pump to sampling container, the air and surface water should be purged from the porewater device and sample tubing by running the pump.

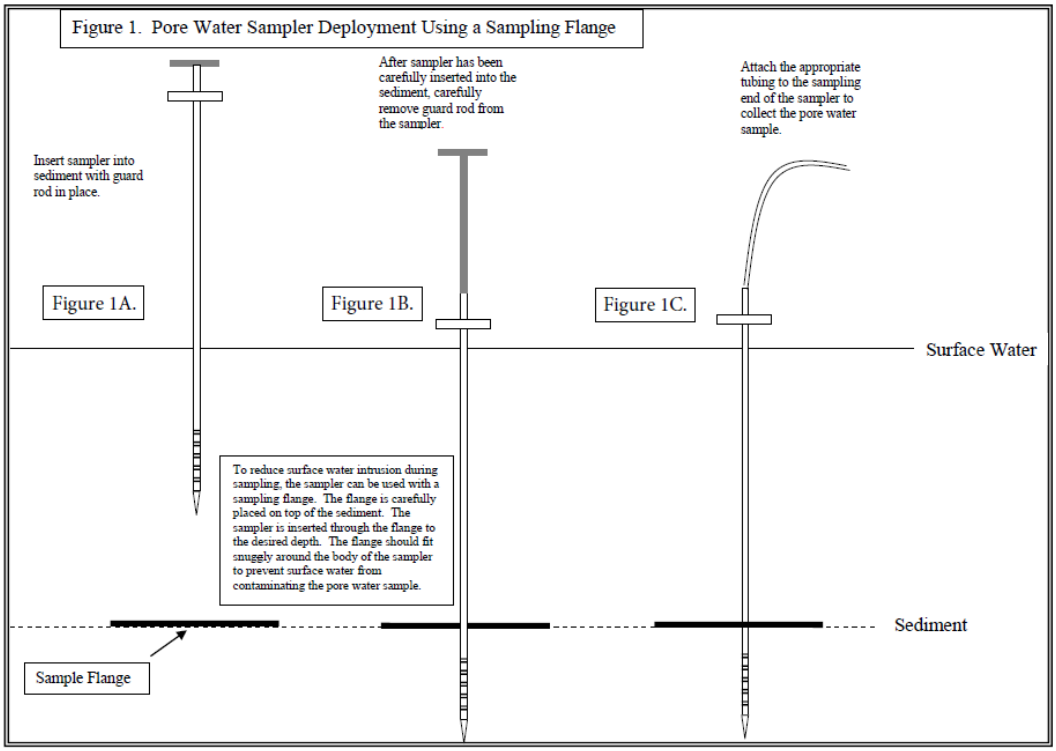



Figure 1. Porewater sample method steps.[1]

4.8. To ensure that the sample does not come in contact with the pump head tubing during sampling, attach a Teflon® transfer cap assembly onto the neck of a pre-cleaned 1-liter amber glass container, creating a vacuum in the container. This method cannot be used for the collection of samples for VOC analysis because it agitates the sample.

4.9. Turn on the pump and fill the sampling container with porewater to the required volume. If the site sampling and analysis plan requires field filtering, then refer to SOP 4.5 “For Filtration of Groundwater and Surface Water Samples.”

[1] USEPA, February 2013. Pore Water Sampling Operating Procedures, SESDPROC-513-R2. Figure 2.

4.10. For samples for VOC analysis: Samples must be collected using either stainless steel or Teflon® equipment and 40 ml glass vials with Teflon® septa. To avoid agitating the sample, fill the Teflon® tubing by running the pump for a short amount of time. Once the tubing is full, remove the porewater sampler, pinch the tubing off at the pump, and disconnect the pump head from the tubing. The sample can then drain into sampling vials via gravity. The vial should be filled so that there is a meniscus at the top of the vial and no bubbles or headspace in the vial after it is capped. After the cap is tightly secured, the vial should be tipped upside down and gently tapped to see if any bubbles become dislodged. If so, the vial must be refilled. If bubbles persist after refilling, a new vial should be used and the sample re-collected.

4.11. Surface water and porewater conductivity can be measured and used as an indicator parameter to evaluate whether surface water intrusion is present in the porewater sample. Where significant differences in parameters such as conductivity exist between the surface water and porewater, a check can be made at the end of sampling to assess whether surface water intrusion as occurred by measuring the porewater parameters at the beginning and conclusion of sampling.

4.12. In general, the volume of pore water that can be collected at a given location is limited. Collecting large volumes of pore water will ultimately result in the collection of water from the overlying water body. Often, minimum required volumes must be negotiated with the laboratory to limit the volumes withdrawn.

4.13. A quality control / background sample should be collected from a location not impacted by the contaminants of concern and submitted for analysis with the other samples. In streams and other bodies with moving water, this quality control sample should be collected upstream from the other sampling locations. For impounded bodies of water such as small lakes and ponds, it may not be possible to obtain an unbiased control from the same water body. In this situation, a quality control sample can be collected from a similar body of water located from near the sampled body of water, if it is likely that this location has not been impacted.

4.14. Equipment blanks should be collected if equipment is field cleaned and then reused or, in some cases, to document that low level contaminants were not introduced by sampling equipment.

4.15. Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," and placed in its appropriate container (holder) in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory. Quality control and equipment blanks should be kept separately from samples.

4.16. Thoroughly clean all reusable sampling equipment as discussed in the field equipment decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with accepted procedures.

4.17. Complete field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

4.18. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

END OF PROCEDURE

REFERENCES

USEPA, February 2013. Pore Water Sampling Operating Procedures, SESDPROC-513-R2.

Date: January 9, 2011
Revision: May 12, 2015

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from split-spoon, Geoprobe™ core samples, and Sonic core samplers during drilling, hand auger samples, grab samples from stockpiled soils, surface samples, test pit samples, etc.

## 2.0 CONSIDERATIONS

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth, the water content should be noted, since generally "soil sampling" is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a 0 to 6 inch depth interval. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. For samples at greater depths, a Geoprobe™ or other direct push sampling method, or a decontaminated bucket auger or power auger may be needed to advance the hole to the point of sample collection. If augering to depth, once the sampling depth is reached a clean bucket auger should be used to collect the sample. To collect samples at depths of greater than approximately six feet, the use of a drill rig (direct push, split spoon, etc) will usually be necessary. In some situations, such as an excavation or trench, sample locations are accessed with the use of a backhoe.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which outlines soil sampling requirements.

c. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

d. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

e. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

f. Stainless steel spoons or spatulas.

g. Disposable Nitrile sampling gloves and cut-proof gloves.

h. Laboratory-supplied sample containers with labels.

i. Cooler with blue or wet ice.

j. Plastic sheeting.

k. Black pen and indelible marker.

l. Zip-lock bags and packing material.

m. Tape measure.

n. Paper towels or clean rags.

o. Masking and packing tape.

p. Overnight (express) mail forms or schedule courier pickup.

## 4.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP (ROUX SOP 9.1). Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves and plastic sheeting will be changed after each use and discarded in an appropriate manner.

## 5.0 PROCEDURE

5.1 Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the ROUX SOP 9.1 decontamination procedures. If samples are to be collected at depth, then the boring must be advanced with thoroughly cleaned equipment to the desired sampling horizon and a different thoroughly cleaned sampler must be used to collect the sample.

5.2 Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon, extract the soil sample from the sampler, measure the recovery, and separate the wash from the true sample. Where allowed by regulatory agency(ies), disposable plastic spoons may be used. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised

When sampling shallow soils, if a thick, matted root zone, gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials.

When using direct push sampling methods, it is important to maintain the proper orientation of the sample when the sampling liners are removed from the sample tubes define precisely the depth at which an aliquot was collected. This is particularly important when multiple sample depths are collected from the same push.

When utilizing a split spoon sampling method, always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the boregole wall after removal of the drill string prior to inserting the split spoon.

When utilizing a backhoe to collect soil samples from a trench or excavation, measures should be taken to ensure that the bucket is decontaminated and that no paint, grease, and rust is present prior to sample collection.

5.3 Place the sample in a laboratory-supplied, pre-cleaned sample container. Cut-proof gloves should be worn at all times when handling glassware. This should be done as quickly as possible and this is especially important when sampling for volatile organic compounds (VOCs). Samples to be analyzed for VOCs must be collected prior to other constituents.

If samples are to be analyzed for VOCs, they should be collected in a manner that minimizes disturbance of the sample. ***Samples for VOC analysis must not be homogenized.***

5.4 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.

5.5 Using the remaining portion of soil from the sampler, log the sample in detail and record physical characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.). Refer to Soil Classification and logging SOP.

5.6 If soil samples are to be composited in the field, then equal portions from selected locations will be placed on a clean plastic sheet or in a Zip-lock bag and homogenized. make sure that each composite location (aliquot) consist of equal volumes,( i.e., same number of equal spoonfuls). Alternately, several samples may be submitted to the laboratory for compositing by weight. The method used is dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work

plan. Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.

5.7 After the sample has been collected, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler with ice, at 4°C. Store the sample cooler in a secure location.

5.8 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a Zip-lock bag to the laboratory. A signed and dated custody seal is placed on the cooler prior to shipment.

5.9 Samples collected from Monday to Friday are typically to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.10 The field notebook and appropriate forms should include, but not be limited to, the following: client name, site location, sample location, sample depth, sample identification, sample date and time collected, sampler's name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.

5.11 All reusable sampling equipment must be thoroughly cleaned in accordance with the ROUX SOP 9.1 decontamination procedures. Following the final decontamination (after all samples are collected), the sampling equipment is wrapped with plastic. Discard any gloves, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: May 5, 2000
Revision: May 5, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for stream-bed, pond, and lagoon sediment samples. The specific procedure and equipment selection will be dependent upon the data objectives of the sampling program. The sampling procedure can range from one grab sample to many samples at different horizontal and vertical locations. The sampling requirements should be carefully designed and fully described in the work plan.

The objective of sediment sampling is to collect samples which are representative of the area of interest. Frequently this objective can be quite easy and routine such as one "grab" sample for a small stream with uniform stream-bed conditions. Other times, the nature of the site-specific conditions make collection of a representative sample more difficult. Consideration of such variables as stream flow velocity, pond depth, lagoon contents, turbulence, access, health and safety, water composition, tidal fluctuation, surface runoff, factory outfalls, tributaries, etc. is essential in the development of the work plan.

In collecting sediment samples, care must be taken to minimize disturbance and sample washing as it is retrieved through the liquid column above. Sediment fines may be carried out of the sample during collection if the liquid above is flowing or deep. This may result in collection of a nonrepresentative sample due to the loss of contaminants associated with these fines. While a sediment sample is usually expected to be a solid matrix, the sampler should avoid placing the sample in the bottle then decanting off the excess liquid. If the sample is collected properly, then any liquid that enters into the bottle is representative of sediment conditions.

As with liquid sampling, a determination of tidal influence on the location being sampled should be made and its effect on the sample collection should be detailed in the work plan. At a minimum, the stage of the tide at the time of sample collection must be recorded. Consideration should be given to sampling at varied tidal stages when appropriate.

## 2.0 CONSIDERATIONS

Collecting sediment samples from surface-water bodies and impoundments requires special considerations regarding general safety and sampling location.

2.1 Health and safety is a key aspect of all sampling procedures and therefore must be addressed when selecting a sampling location. In most instances sediment sampling will require entering the water. Therefore, the health and safety plan (HASP) must be referred to regarding the implementation of health and safety procedures (for compliance with the Occupational Safety and Health

Administration [OSHA] and for general safety for sampling personnel). If entering the water body is necessary, then the water velocity, depth, sediment type and uniformity, tidal stage, and water chemistry must be evaluated. If any potential hazard is identified, then the sampler must use a safety harness and life jacket, and a buddy system must be employed. A raft or boat (vessel) may be necessary to collect samples. Depending upon the geographic location and season, considerations such as water temperature, snakes, rats, ticks, etc. may be important. Thus, the site-specific HASP must address all possible contingencies and allow flexibility for revision if unanticipated conditions arise.

2.2 The location of a sediment sampling point is the first consideration for a sediment sampling program. The general sampling location will be selected based on the requirements of the investigation. The specific sampling location should be selected where flow and turbulence are uniform, the sediment conditions seem representative, and access is favorable (i.e., shallow section with good footing).

The sampling location should avoid tributaries, parking lot runoff, factory outfalls, and obstructions unless these inputs are of specific interest. Sampling from the boundaries of the surface-water body should generally be avoided, except where these regions are of direct interest. For flowing surface-water bodies sampling should proceed from downstream locations to upstream locations so that disturbance related to sampling does not affect downstream sample quality. If liquid samples will be collected at the same locations as sediment samples, then the liquid samples must be collected first so that sediment sampling does not create turbulence that may alter water-quality conditions at the sampling location.

2.3 The factors that contribute to the selection of a sampling device include: 1) the width, depth, flow and the bed characteristics of the surface-water body to be sampled; 2) the required depth below the sediment surface; 3) whether the sample will be collected from the shore or a vessel; and 4) the objectives of the program. These factors must be addressed in the work plan.

The sampling of stream-bed sediments is generally accomplished through the use of one of the following samplers:

a. Scoop, spoon, or trowel.

b. Bucket auger.

c. Soil coring device.

d. Veihmeyer sampler.

e. Waste pile sampler.

f. Split spoon sampler.

g. Dredge (ponar).

h. Other commercially available sampler of proper construction material.

2.4 Sampling from on-shore or off-shore (wading or vessel) locations will be dependent on the site-specific sampling conditions as follows:

a. If liquid flow and depth is minimal and sediment is easy to reach, then a trowel or scoop may be used to collect the sediment sample. However, where the liquid above the sediment collection point is either flowing or greater than 4 inches in depth, a corer or other device that eliminates sample washing must be used to collect the sample in an attempt to minimize washing the sediment as it is retrieved. One of the coring devices listed above will allow the collection of an undisturbed core of sediment. It may be necessary to decant standing water from the top of the core. This should be done carefully and prior to transfer to the sample bottle. A decontaminated stainless-steel trowel, spoon, or spatula must be utilized to transfer the sample from the sampler directly into the sample container.

b. In some instances, the dimensions of the stream require that a vessel (e.g., a boat, raft, etc.) must be used. The device used for sample collection in this case will, again, depend upon the depth and flow of the liquid above the sample location and the stream-bed characteristics. Generally, trowels or scoops cannot be used in an off-shore situation. Instead, cores or dredges are more efficient means for sample collection. The vessel must be positioned just upstream of the desired sample location. As the corer or dredge is lowered it may be carried slightly downstream, depending upon the force of the flow. Upon retrieval, immediately transfer the contents of the corer or dredge directly into the sample bottle using a decontaminated stainless-steel trowel, spoon, or spatula.

## 3.0 EQUIPMENT AND MATERIALS

In order to sample stream-bed sediments, specific equipment and materials are required. The equipment and materials list may include, but necessarily be limited to, the following:

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which defines sampling requirements.

c. Decontamination supplies (including, as necessary: non-phosphate, laboratory-grade detergent; bucket; brushes; distilled/deionized water; potable water; regulatory-required reagents [e.g., acetone, nitric acid, etc.]; aluminum foil; etc.).

d. Field notebook and appropriate field form(s).

e. Maps (topographic and road/county).

f. Cooler and ice (wet or blue packs).

g. Sample bottles (including as necessary: appropriate field blanks, trip blanks, duplicates, extra bottles for breakage, proper size and type for analyte, labels, etc.).

h. Plastic sheeting.

i. Meters (pH, as modified for soil/sediment analysis), thermometer, and calculator.

j. Wading rod and current meter.

k. Calibration equipment/materials for all meters or devices.

l. Sampling devices (including as necessary: scoop, trowel, spatula, sampling trier, bucket auger, soil-coring device, Veihmeyer sampler, waste-pile sampler, split-spoon sampler, dredge sampler, and Ponar dredge).

m. Disposable sampling gloves.

n. Health and safety equipment (including as necessary: proper level of protection [OSHA], rubber boots, hip waders, chest waders, safety harness, rope, life jacket, life preserver, air horn, two-way communication, etc.).

o. Measuring tapes (100-foot, weighted and 10-foot, steel).

p. Digital camera.

q. Hand sledge hammer.

r. Pipe wrenches (14 inches long, 2 required).

s. Miscellaneous tools (e.g., screwdrivers, hammer, pliers, flashlight, pen knife, etc.).

t. Black pen and indelible marker.

u. Paper towels, clean rags.

v. Masking and packing tape.

w. Packing material (e.g., "bubble wrap") and "zip-lock" plastic bags.

x. Chain-of-custody form(s) and custody seals.

y. Overnight (express) mail forms and/or courier contact information.

## 4.0 DECONTAMINATION

When possible thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as cord, tubing, and gloves will be changed between each use and discarded in an appropriate manner. If a non-disposable item is to be reused during a sampling event, it will be thoroughly cleaned according to the field equipment decontamination SOP. Appropriate field, equipment and trip blanks will be collected as outlined in the work plan to demonstrate proper decontamination procedures.

## 5.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers and meters, etc.). Refer to the specific SOPs for field analysis for each respective piece of equipment. All equipment must have the manufacturer's manual maintained with the instrument and must be referred to for use, repair, maintenance, trouble-shooting, or calibration, if required. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

## 6.0 PROCEDURE

6.1 Identify each location to be sampled based upon requirements of the work plan. If any of the considerations outlined in Section 2.0 impact the proposed sampling method, then contact the Project Manager to get authorization to modify as necessary.

6.2 Record the site and sample location, weather conditions, date, and time of the selected sampling point in the field notebook and on any field forms being used, and initial the entry.

6.3 Describe the surface-water body or impoundment characteristics including: width (feet [ft]), depth (ft), flow (none, low, intermediate or flood; or measured velocity, if possible), turbidity (clear, turbid, very turbid), turbidity or flow variations, tributary locations and distances, surface runoff impacts, and adjacent land use. A photograph of each sampling location should be included as part of the documentation.

6.4 Prepare sample containers for collection by organizing, labeling, and verifying proper preservation methods.

6.5 Ensure all sampling equipment has been thoroughly decontaminated and is operational.

6.6 Place plastic sheeting on the ground or on the floor of the vessel to protect sampling materials from potential cross contamination.

6.7 Collect the sample utilizing the selected sampling method and immediately place into pre-labeled, laboratory-supplied containers. Fill each appropriate, prelabeled sample container carefully and cautiously to prevent: 1) excessive agitating; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling the sample and exposing the sampling team to contaminated sediment. Immediately place the filled sample container in a ice-filled (wet ice or blue pack) cooler for storage. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

6.8 Collect quality control (QC) samples to monitor sampling and laboratory performance as required in the work plan. Refer to the SOP for collection of QC samples for a detailed discussion of proper methods.

6.9 Analyze samples for field parameters (e.g., pH, etc.) immediately after collecting samples for laboratory analysis. Whenever possible, sufficient volume should be collected in the initial sample to complete all laboratory and field parameters.

6.10 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," and placed in its appropriate container (holder) in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

6.11 Thoroughly clean all reusable sampling equipment as discussed in the field equipment decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with accepted procedures.

6.12 Complete field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

6.13 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

END OF PROCEDURE

Date: January 10, 2011
Revision: May 12, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for screening soil samples for volatile organic vapors using a portable photoionization detector (PID). This SOP is applicable to soil samples collected from split-spoon, Geoprobe™ macro-core, Sonic cores and Shelby tube samplers during drilling, hand auger samples, and grab samples from stockpiled soils.

## 2.0 CONSIDERATIONS

The primary objective of photoionization screening of soil samples is to obtain a qualitative understanding of the distribution of volatile organic compounds (VOCs) in soil. The proper design of an organic vapor screening program requires an understanding of site hydrogeology, potential source areas, and potential constituents of concern. Sample locations and frequency must be fully defined in the work plan. The work plan should outline the type of lamp to be utilized in the PID based on the ionization potentials and response factors of the constituents of concern. The work plan must also clearly describe the heating or equilibration procedures to be employed if they differ from those described in this SOP. Regardless of the specific equilibration procedure employed, it is imperative that each sample be treated identically to allow the photoionization results from different locations to be compared. Observations such as water, clay, and organic content should be noted to facilitate interpretation of the data. Every effort should be made to collect a representative portion of soil from the sampling device.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which outlines photoionization screening requirements.

c. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

d. Field notebook, field form(s), maps, chain-of-custody forms.

e. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

f. Stainless steel spoons or spatulas.

g. Disposable plastic spoons.

h. Plastic sheeting.

i. Gallon size Zip-lock bags.

j. Photoionization detector (PID) with charging unit.

k. Calibration gases with regulator.

l. Indelible marker.

m. Masking tape.

n. Disposable Nitrile sampling gloves.

## 4.0 DECONTAMINATION

Where possible, thoroughly pre-cleaned and wrapped sampling equipment must be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and sample jars will be changed after each use and discarded in an appropriate manner. If only photoionization results are to be obtained, then split-spoon samples and hand augers may be cleaned with a non-phosphate laboratory grade detergent and water wash and potable water rinse or steam cleaning, and a final distilled water rinse. However, if samples are to be collected concurrently for laboratory analytical results, then all reusable sampling equipment must be thoroughly decontaminated according to the ROUX SOP 9.1 for decontamination of field equipment.

## 5.0 CALIBRATION

5.1 The PID must be calibrated according to the manufacturer's specifications at a minimum frequency of once per day prior to collecting photoionization readings. In addition, periodic checks (e.g., every 2 hours or every ten samples) with the standard gas will be conducted to confirm that the calibration has not drifted.

5.2 The time, date, and calibration procedure must be clearly documented in the field notebook and the calibration log.

5.3 If at any time the photoionization results appear erratic or inconsistent with field observations, then the unit must be recalibrated. If calibration is difficult to achieve, then the unit's lamp should be checked for dirt or moisture and cleaned, as necessary. During humid or wet conditions, the unit should be calibrated on a more frequent basis as determined by field personnel.

## 6.0 PROCEDURE

6.1 Allow the temperature of the unit to equilibrate to its surrounding. This should take about five minutes.

6.2 Extract the soil sample from the sampler, quickly measure the recovery, and separate the wash from the true sample by using a dedicated, stainless steel spatula. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

6.2 Place the sample in a 1-Gallon Zip-lock bag (as quickly as possible to avoid loss of VOCs) filling the bag half full, if possible. Seal the bag and ensure an adequate seal has been created by pressing on the bag and observing if air discharges from the bag.

6.3 Label the bag with the boring/ID number, depth of sample, date of collection and sampler's initials. In addition, the field personnel will ensure the following: samples are taken at appropriate depths; unrepresentative portions of the sample are discarded properly; that the soil sampler (i.e., split spoon) is decontaminated properly between use; and the driller uses proper methods during sample collection and does not use oil or grease on tools entering the borehole.

6.4 Log the sample in detail and record physical characteristics (color, odor, moisture, texture, density, consistency, organic content, and layering). Refer to ROUX SOP 5.5 for soil classification and logging procedures.

6.5 Ensure that the PID has been calibrated and that the calibration information is documented in the field book. Pierce the Zip-lock bag with the probe from the PID and measure the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

6.6 Record the PID reading in the field notebook, on an appropriate field form, and on the base map, if appropriate. All readings should be recorded in parts per million (ppm).

6.7 Dispose of any soil/geologic material/cutting in a designated waste storage container (e.g. drum) consistent with site disposal requirements.

6.8 If only field screening results are to be obtained, then reusable sampling devices may be cleaned with a non-phosphate laboratory grade detergent and water wash and a potable water rinse. The sampler will then be rinsed with distilled water, assembled and placed on plastic sheeting for reuse. A more rigorous decontamination procedure is required when samples are also being collected for laboratory analysis. Refer to the SOP for collection of soil samples for laboratory analysis for additional information.

END OF PROCEDURE

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. Consistency with description is essential for creating subsurface interpretations.

This SOP discusses the use of the Unified Soil Classification System (USCS) as a guideline for classifying and describing lithology encountered in boreholes, test pits, and surface sampling.

The Unified Soil Classification System (USCS) is based on numerical values of certain soil properties that are measured by laboratory tests (ASTM D 2487). It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit can be obtained only in the field.

## 2.0 MATERIALS/EQUIPMENT

a) Indelible pens

b) Tape measure or ruler

c) Field logbook

d) Squirt bottle/Spray bottle with water

e) Rock- or soil-color chart (e.g., Munsell)

f) Grain-size chart

g) Hand lens

h) Unified Soil Classification System index charts and tables to help with soil classification

i) Workplan or event-specific field instructions. Planned borehole depth, proposed well construction/specifications, and field sampling summary table, if available.

## 3.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination ROUX SOP 9.1. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and plastic sheeting will be changed after each use and discarded in an appropriate manner consistent with site conditions

4.0 PROCEDURE

This section covers several aspects of the soil characterization: instructions for completing soil boring logs.

4.1 Record the following general site information in the field book:

a. Boring/Well ID. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

b. Client/Project Name

c. Site Location.

d. Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

e. Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger, sonic). Information on the drilling equipment (e.g., CME 55, Mobile B61) should be noted.

f. Date and Time. Include Start time and End time.

g. Name and/or initials of the field personnel logging the soil.

4.2 Record the following technical data in the field book and/or log forms:

a. Depth Below Surface.

b. Sample Interval.

c. PID readings (if specified by work plan). Refer to ROUX SOP 5.4 for soil screening procedures.

d. Blow Counts.

e. Sample Recovery.

f. Soil Description.

g. Soil Classification.

4.3 Soil Classification

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on

insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Field descriptions should include as a minimum:

a. Color: The basic color of the soil.

b. Soil name: The basic name of the predominant constituent and a single word modifier indicating the major subordinate constituent.

c. Particle Size Distribution: An estimate of the percentage and grain-size range of each of the soil's subordinate constituents (trace, little, some). This parameter is critical for assessing hydrogeology of the site and should be carefully and fully documented.

d. Gradation or Plasticity: For granular soil (sands or gravels) that should be described as well-graded, poorly graded, uniform, or gap-graded. Cohesive soil (silts or clays) should be described as non-plastic, low plastic, medium plastic, or highly plastic.

e. Other Components: Examine the soil sample to identify other components that may be present including roots and root mass, vegetation, peat, organic matter, shells or fossils, accessory minerals slag, cinder or charcoal, trash, rubbish, fill, bricks, glass.

f. Moisture Content. The amount of soil moisture described as dry, moist, or wet/saturated.

g. Odor: The odor should only be described if it is organic or unusual. An organic odor will have distinctive decaying vegetation smell. Unusual odors, petroleum product, chemical, and the like should be noted.

h. Unusual characteristics: If staining or discoloration of soils is present it should be noted.

4.4 The soil logs should also include a complete description of any tests run in the borehole; placement and construction details of piezometers, wells, and other monitoring equipment; abandonment records; geophysical logging techniques used; and notes on readings obtained by air monitoring instruments.

4.5 Backfilling

When a boring is completed, the boring shall be abandoned with procedures specified in the workplan. The destruction of the hole shall be noted on the log Proper borehole abandonment procedures are documented in ROUX SOP 5.4.

END OF PROCEDURE

Date: May 19, 2015

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis using incremental sampling methodology (ISM). This SOP describes the procedure and equipment needed to collect and ISM soil samples prior to laboratory analysis. This SOP is largely based on the ITRC February 2012 technical and regulatory guidance document titled "*Incremental Sampling Methodology*"

## 2.0 CONSIDERATIONS

Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation. Variability in measured contaminant concentrations between discrete soil samples is due primarily to the particulate nature of soil and heterogeneity in the distribution of contaminants. The elements of ISM that control data variability are incorporated into (a) the field collection of soil samples and (b) laboratory processing procedures. ISM is designed to obtain a single aliquot for analysis that has all constituents in the same proportion as an explicitly defined volume of soil. Properly executed, the methodology provides reasonably unbiased, reproducible estimates of the mean concentration of analytes in the specified volume of soil.

ISM should be applied within a systematic planning framework. One of the first steps in such a framework is to have the investigation project team establish a working conceptual site model (CSM). Once the CSM has been agreed to, the project team defines the data quality objectives (DQOs) and determines the appropriate decision unit (DU) size(s) and location(s). DUs are based on project-specific needs and site-specific DQOs; both considerations specify and constrain the appropriate end use of the data. The size of a DU is site-specific and represents the smallest volume of soil about which a decision is to be made. The requirement to explicitly and appropriately define the DU that each incremental sample represents is a key component of ISM and is discussed in detail throughout this SOP.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which outlines soil sampling requirements including the site-specific DQOs and an explanation of the gridded area to be sampled using ISM.

c. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

d. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

e. Sampling device (Geoprobe, split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

f. Stainless steel spoons or spatulas.

g. Disposable Nitrile sampling gloves and cut-proof gloves.

h. Laboratory-supplied sample containers with labels.

i. Cooler with blue or wet ice.

j. Plastic sheeting.

k. Black pen and indelible marker.

l. Zip-lock bags and packing material.

m. Tape measure.

n. Paper towels or clean rags.

o. Masking and packing tape.

p. Overnight (express) mail forms or schedule courier pickup.

## 5.0 PROCEDURE

5.1 Determine the appropriate spatial extent of the decision unit (DU) that ensures total sample mass is sufficient to represent the heterogeneity of soil particles within the DU in proportion to all of the DU soil (i.e., population). Different types of objectives may dictate the dimensions of DUs. For example, the identification and investigation of small source-area DUs may be especially important for highly mobile chemicals that can pose significant vapor intrusion or leaching risks. In other situations, larger exposure-area DUs is appropriate to evaluate risks to specified receptors. The approach selected should be consistent with the understanding of the site reflected in the CSM and should support the objectives of the investigation.

Exposure areas for residential use can vary in size depending on the location of the site and local regulatory requirements. Consideration of lot-size exposure areas is generally adequate to evaluate long-term, chronic health risks. When *exposure* can be assumed to be relatively consistent across the lot, it is not necessary to investigate concentration trends at a property below the scale of the residential lot.

Exposure areas for commercial or industrial properties are site specific and could be an acre or more in size. Certain maintenance or construction activities at these types of properties may influence the depth of the exposure area. Designation of exposure

areas for these sites should be discussed ahead of time with the project risk assessor and should be based on areas of the site where exposure is likely to occur.

5.2 Determine the appropriate vertical extent of the DU. The depth (how far below ground) and interval (vertical dimension of the DU) of each DU must be carefully considered during planning stages. These attributes should be based on the project objectives and the CSM and should not be left to haphazard decisions in the field. It is important to remember that a correctly defined DU includes the requirement that all hypothetical increments within the DU have an equal likelihood of being sampled (e.g., a DU should not be defined to be 5 feet deep when only the first few centimeters are available to the sampling device).

5.3 Determine the sampling pattern strategy.

Systematic random sampling within grids – the DU is divided in a grid pattern, a random sampling location is identified within the first grid cell, and then samples (increments) are obtained from adjacent cells sequentially in a serpentine pattern using the same relative location within each cell.

Random sampling within grids - samples are obtained sequentially from adjacent grid cells, but the location of the sample within each cell is random.

Simple random sampling within the entire DU - the samples are taken from random locations across the DU (without gridding).

While all three sampling options are statistically defensible, collecting increments within the DU using simple random sampling is most likely to generate an unbiased estimate of the mean and variance according to statistical theory. Note that "random" does not mean wherever the sampling team feels like taking a sample: a formal approach to determining the random sample locations must be used.

5.4 Determine the ISM Field Sampling Implementation Method

Select the tool: The selection of the appropriate sampling tool for an ISM sample depends on the cohesiveness and composition of the soil substrate. The sampling tool should obtain cylindrical or core-shaped increments of a constant depth from the presented surface. The diameter of the sampling tool should be a minimum of three times the diameter (d) of the largest particle present in a coarse matrix ($d \geq 3$ mm), and 3d + 10 mm for a fine material. Caution should be taken to select tools that equally retain all of the particles over the entire depth of interest. In general, sampling tools should have a diameter of at least 16 mm. For less cohesive soils, attempts should be made to retain the entire, complete core increment.

Sampling devices can be used within a DU without decontamination but should be decontaminated or disposed of between DUs. If sampling tools will be used for two or more DUs, they should be cleaned of soil particles, decontaminated with the

appropriate solutions or solvents, and dried between DUs. Typically, rinse (decontamination) blanks can be used to evaluate the potential effects of cross contamination, if needed.

For deeper ISM soil samples, a drilling method may be required to collect soil samples. Direct push methods are preferred (e.g., geoprobe) for ease of sampling and cost.

Determine the number of soil increments:
In general, a minimum of 30 increments is sufficient for most DUs. The number of increments to be collected from each DU of a site investigation should be evaluated during systematic planning as part of the DQO process and documented in the sampling and analysis plan (SAP).

5.5 Establish DU Boundaries in the field. Depending on the size of the DU and terrain features, placement of markers (e.g., pin flags and posts) at the corners and or edges can assist with a visual delineation of the cells or subareas where increments are to be collected. That is, the markers can define lanes, grids, or collection points.

5.6 Collect soil from the decision units based on the ISM sampling plan. Soil collection should occur in two-person teams: ideally one person collects the increments, and the other holds the sample container and keeps track of the number of increments. Each sample increment location should be logged via GPS when possible. Combine all increments to form the complete subsurface ISM sample.

5.7 Place the sample in a laboratory-supplied, pre-cleaned sample container. Cut-proof gloves should be worn at all times when handling glassware.

5.8 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials. The sample should be placed in a cooler and stored with ice, at 4°C. Store the sample cooler in a secure location.

5.9 Using the remaining portion of soil to log the sample in detail and record physical characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.). Refer to Soil Classification and logging SOP.

5.10 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a Zip-lock bag to the laboratory. A signed and dated custody seal is placed on the cooler prior to shipment.

5.11 Samples collected from Monday to Friday are typically to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable,

samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.12 The field notebook and appropriate forms should include, but not be limited to, the following: client name, site location, sample DU designation, sample identification, sample date and time collected, sampler's name, and method of sample collection.

5.13 All reusable sampling equipment must be thoroughly cleaned in accordance with the ROUX SOP 9.1 decontamination procedures. Discard any gloves, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: February 22, 2018

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the testing of soil pH in the field. This SOP describes the procedure and equipment needed to test the pH in soils using a Hanna Instruments (HI) 99121 portable pH meter.

## 2.0 CONSIDERATIONS

The primary objective of pH screening of soil samples in the field is to obtain a qualitative understanding of the distribution of pH in soil. Sample locations and frequency must be fully defined in the work plan. Observations such as water, clay, and organic content should be noted to facilitate interpretation of the data.

## 3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which outlines soil sampling requirements including the site-specific DQOs and an explanation of the area to be sampled.

c. Field notebook, field form(s), and maps.

d. GPS.

e. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

f. Sampling device (Stainless steel hand auger, stainless steel trowel, etc.).

g. HI 99121 portable pH meter.

h. HI 1292D pH electrode.

i. pH buffer solutions.

j. HI 700663 cleaning solution for inorganic soil deposits.

k. HI 700664 cleaning solution for organic soil deposits.

l. HI 7051M soil preparation solution.

m. HI 721319 ground auger.

n. 3 x 1.5V AA alkaline batteries.

o. HI instruction manual.

p. Rugged carrying case.

q. Gallon sized Zip-loc bags.

r. Disposable Nitrile sampling gloves and cut-proof gloves.

s. Black pen and indelible marker.

t. Paper towels or clean rags.

## 4.0 DECONTAMINATION

4.1 At a minimum, the probe should be cleaned each morning prior to calibration. Clean the outside edges of the pH probe frequently as the unit becomes visibly dirty. Dirty probes can interfere with measurements. The outside edges of the probe can be wiped with a paper towel or Kimwipe. If the probe is extremely dirty, place the probe in a clean cup with HI 70063 cleaning solution for 15 minutes. If you are performing a regular cleanup, three minutes is sufficient. Never touch the bulb on the base of the probe during cleaning!

4.2 The probe should be rinsed with distilled water and HI 70063 cleaning solution after each measurement.

4.3 Disposable items such as sampling gloves, aluminum foil, and sample jars will be changed after each use and discarded in an appropriate manner.

## 5.0 CALIBRATION

5.1 The meter should be recalibrated after testing aggressive chemicals, as the pH electrode is replaced, and each day prior to use of the pH meter.

5.2 While pH Meter (HI 99121) is turned off, connect the pH probe (HI 1292 D).

5.3 Power on the pH Meter using the ON/OFF/MODE button and ensure the unit has sufficient battery to operate for the day. Battery percentage is displayed for a short moment after the unit is powered on.

5.4 When the unit is in measuring mode (default mode upon start up), press and hold the ON/OFF/MODE button until the word CAL populates the secondary display on the bottom of the screen. This will begin a 2-point calibration process.

5.5 The unit will autodetect the solution and the pH meter will display the message "USE 7.01." Place the pH probe in the 7.01 calibration solution and the unit will autodetect the solution. REC will display if the solution is compatible with the unit. WRNG will display if the solution is not compatible with the pH unit.

Repeat this step with either pH 4.01 or pH 10.01 calibration solutions, dependent upon site conditions.

5.6 The meter should display an "OK 2" message upon accepting of the 2-point calibration. The meter will then return to normal measuring mode.

5.7 The time, date, and calibration procedure must be clearly documented in the field notebook and the calibration log.

5.8 If, at any time, the pH results appear erratic or inconsistent, then the unit must be recalibrated. If calibration is difficult to achieve, then the unit's sensor should be cleaned, as necessary.

## 6.0 PROCEDURE

6.1 Power on the pH Meter using the ON/OFF/MODE button, the measurement mode is the default mode for the unit. If the pH probe is dry, place it in the H70300 storage solution for 1 hour. Always store the pH probe in a storage solution when not in use.

6.2 Obtain desired sampling interval (a large handful or enough to surround the pH probe bulb) and swirl the pH probe gently in the sample and wait for the reading to stabilize.

6.3 Log the sample in detail and record physical characteristics (color, odor, moisture, texture, density, consistency, organic content, and layering). Refer to ROUX SOP 5.5 for soil classification and logging procedures.

6.4 When you have a stabilized reading, you can press the HOLD button to freeze the reading on the screen.

6.5 Record the pH reading in the field notebook, notes section of the soil boring log, or field sample sheet, as appropriate.

6.6 Dispose of any soil/geologic material/cutting in a designated waste storage container (e.g. drum) consistent with site disposal requirements.

6.7 Decontaminate the probe with distilled water and HI 70063 cleaning solution before the next measurement.

END OF PROCEDURE

Date: January 9, 2011
Revision: April 17, 2015

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for measuring field parameters of groundwater samples. The parameters are measured in the field using a water quality meter (Horiba U-22 or equivalent). The water quality parameters include pH, temperature, conductivity, ORP, dissolved Oxygen and turbidity. The manufacturer's instrument manual for each water quality meter, which is maintained with the instrument, will be referred to for calibration, use, repair, maintenance, or trouble-shooting operations.

The pH will be measured in standard units (SU) and can be recorded with or without the SU designation. The conventional means of recording a pH value is without a unit designation (e.g., 7.0); however, the SU designation may be used provided the term is defined as standard units when first referenced. The pH is measured in the field to provide the pH of the water under ambient (in situ) conditions. The pH is a measure of the acidic (<7.0) or basic (>7.0) nature of the water and is used to assist in evaluating the mobility of contaminants. In addition, pH measurements can be used during well purging to help determine when sufficient groundwater has been purged (removed) from a well (i.e., the standing water in the well has been removed and replaced with "fresh" water from the aquifer).

Conductivity will be measured and recorded in micromhos/centimeter (µmhos/cm). Some water quality meters measure directly in µmhos/cm while others have to be converted to this unit. The specific conductivity is measured in the field as a measure of the total dissolved solids (TDS) in the water samples. TDS data can then be used as a qualitative measure of contamination and to assist in evaluating electrical resistivity and borehole geophysical data. In addition, specific conductivity measurements can be used during well purging to help determine when sufficient groundwater has been purged (removed) from a well (i.e., the standing water in the well has been removed and replaced with "fresh" water from the aquifer).

Temperature will be measured and recorded in degrees Celsius/Centigrade (° C). Temperature data is collected in the field to determine the temperature of the water sample under ambient (in-situ) conditions. Temperature data can be used to evaluate the mobility of compounds in groundwater and flow conditions. In addition, temperature measurements can be used during well purging to help determine when sufficient groundwater has been purged (removed) from a well (i.e., the standing water in the well has been removed and replaced with "fresh" water from the aquifer).

ORP will be measured and recorded in millivolts (mV). ORP data is collected in the field for monitoring and controlling chemical addition of oxidizing or reducing agents. In addition, ORP data can be used during well purging to help determine when sufficient

groundwater has been purged (removed) from a well (i.e., the standing water in the well has been removed and replaced with "fresh" water from the aquifer).

Dissolved Oxygen (DO) will be measured and recorded in mg/L. DO data is collected in the field for monitoring the amount of oxygen dissolved in a unit volume of water. In addition, DO data can be used during well purging to help determine when sufficient groundwater has been purged (removed) from a well (i.e., the standing water in the well has been removed and replaced with "fresh" water from the aquifer).

Turbidity will be measured and recorded in Nephelometric Turbidity Units (NTU). Turbidity data is collected to measure the presence of suspended particulates in water.

## 2.0 CALIBRATION

Prior to calibration, all water quality meters must be cleaned and the battery checked according to the manufacturer's instructions. Document, initial and date the pre-calibration procedure on the appropriate field form, and in the field notebook.

2.1 Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

2.2 Calibration of the water quality meter(s) is to be performed at the beginning and end of each day's use in accordance with the manufacturer's specific calibration instructions. At the end of each day, a calibration check is performed to verify that the instrument(s) remained in calibration throughout the day. This check is to be performed while the instrument(s) is in measurement mode, not calibration mode. Usual procedures are given below.

2.3 Recalibration must occur if: 1) the parameter being measured is outside the previous calibration range (if meter readings are zero or a negative number for DO, pH, conductivity or turbidity [negative value only]); 2) the procedure or use conditions warrant frequent calibrations; 3) four or more hours have elapsed; or 4) the instrument has been moved from one area to another (e.g., offsite or out of the study area).

2.4 The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor (see manufacturer's instructions for the volume to be used). Note that most instrument manual's state there is no calibration for the temperature sensor, but the temperature sensor must be checked to determine its accuracy. If the accuracy check date/information is not included with the instrument or the last check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the water quality measuring event.

2.5 A minimum of two standards should be used to bracket the instruments measurement range for all parameters except ORP (refer to manufacturer's instructions).

2.6 The following information is documented in the calibration logbook and /or field notebook at the time of calibration:

a. Date.

b. Water Quality meter identification.

c. Pre-cleaning and battery check.

d. Calibration results.

e. Initials of the individual performing calibration.

## 3.0 PROCEDURE

3.1 A warm-up period may or may not be necessary for the instrument, depending on instrument requirements. The manufacturer's instrument manual must be followed.

3.2 See SOPs 4.3 and 4.4 for information regarding well sampling/purging procedures. Follow instruction manual for proper set up and deployment of monitoring device.

3.3 The groundwater quality parameters will be continuously measured by the water quality meter utilizing a flow-through-cell. If the accumulation of sediment buildup in the cell is observed, continue pumping and disconnect the cell for cleaning, then reconnect after cleaning and continue monitoring activities. If air bubbles accumulation is observed in the cell, place the meter at a 45 degree angle with the port facing upward to help evacuate any air bubble buildup.

3.5 Pertinent data are documented in the field notebook and/or appropriate field form, initialed and dated.

3.6 Follow decontamination procedures documented in SOP 9.1 after each use to avoid potential cross contamination. Ensure that the electrodes are rinsed with distilled or deionized water and the unit stored properly in accordance with the manufacturer's instructions (e.g., capping and storing in a buffer such as altex electrode storage solution). The electrodes are not to be stored in potable water, or distilled or deionized water.

END OF PROCEDURE

Date: October 23, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide procedures and standards for photographic documentation of project activities conducted by Roux Associates, Inc. (Roux Associates). Field staff are encouraged to use photographic documentation to display site features or ongoing field work. The exact number of still or video images is left to the professional discretion of field staff in consultation with the Project Manager. This instruction addresses how the photgraphic images will be incorporated into the project file documentation.

All photography collected for project use should be in a digital format and only document the field activities and / or site features associated with the specific project. Digital cameras have become the primary means of gathering evidence and this medium has many advantages. These advantages include enhanced image resolution, the capability to immediately view the image after it is collected, and the ability to collect still images using a single piece of equipment. The digital camera reduces printing time and cost because the digital images do not need to be taken to a photo lab for developing; rather, the digital images can be viewed on the computer and printed as needed.

## 2.0 MATERIALS

In order to provide photo documentation of field activities and site features, specific materials are required. These materials include the following:

a. A bound, waterproof field notebook.

b. Digital camera or camera phone.

c. A standard reference marker (a ruler or other object with a known length).

d. Approved work plan/scope of work.

e. Health and safety plan (HASP).

f. Appropriate Roux Associates' SOPs.

g. Black pens, and indelible markers.

## 3.0 OPERATION

3.1 General Photographic Activities in the Field: The following sections provide general guidelines that should be followed to visually document field activities

and site features using digital cameras or cell phone cameras. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

a. The photographer should be prepared to take a variety of shots, from close-up to wide-angle. Many shots will be repetitive in nature or format, especially close-up site feature photographs.

b. The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. A flash may be used to adjust low lighting settings or to prevent shadows.

c. Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store less photographs per digital storage medium. When possible, the camera should be set to the highest resolution.

d. The photograph should include a standard reference marker if scale is difficult to determine in the photograph.

e. If photographs are being collected in unfamiliar locations or of unknown objects, Roux Associates personnel are encouraged to record the photographic activities in their assigned field notebook. The following information would provide the user reference for post-processing of the photo:

- Photographer name
- Date and time the photograph was taken (military time)
- Description of the location where the photo was taken
- A brief description of the activity/ item photographed, and other pertinent information about the photograph.

Pens with permanent ink will be used to record all data. Data or other information that has been entered incorrectly will be corrected by drawing a line through the incorrect entry and initialing and dating the lined through entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.

## 4.0 POST-OPERATION (ARCHIVING PHOTO)

4.1 At the end of each day's photographic session, the field personnel should ensure that the field logbook is complete. At the conclusion of the field day, the field

personnel should follow these procedures to ensure the proper achival of the digital photographs:

a. Upload the photos to the network drive in a folder that includes the corresponding date of the photographs, located in the proper project folder.

b. If a large amount a photographs are planned to be collected for the project, a log may be usedful in for storing pertinent information about the photos and may facilitate searching the photo database. Information that may be included in the photo log includes photograph date and time, location, photographer, and any other corresponding notes.

c. Once the above steps are completed, double check to save your edits before deleting the photos off the the camera to ensure storage space for future photo documentation.

END OF PROCEDURE

Date: October 26, 2015

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines and procedures necessary to navigate to waypoints and collect location data using a handheld Global Positioning System (GPS) receiver. A handheld GPS is a satellite-based electronic device that receives data from satellites to calculate a location. Accurate location positioning is required to help ensure quality and consistency in field sample collection and in data interpretation and analysis.

This document is a general use Standard Operating Procedure (SOP) to be used for handheld GPS units and is not to be used as a SOP for specific brands of GPS models.

## 2.0 EQUIPMENT AND MATERIALS

2.1 The following equipment may be needed to collect location data in the field using a handheld GPS device:

a. Trimble handheld GPS or similar unit

b. System batteries

c. PC interface cable, USB serial converter (if necessary)

d. Operation manual of the specific GPS unit

e. Field notebook and pen

## 3.0 PROCEDURE

GPS location data is collected for multiple points of interest with different data objectives required for the varying field responsibilities and tasks completed by Roux Associates. In order to properly collect location data, the following procedure should be followed:

3.1 Before entering the field, ensure that the battery is fully charged and that a spare battery is accessible in the field.

3.2 If it is necessary to navigate to previously known locations, be sure to load any shapefiles onto the device before heading into the field.

3.3 Note the manufacturer's model and the date of GPS use in the field book.

3.4 Power on GPS device, be sure to turn on satellite receiver and launch the data collector application that should be loaded onto the GPS. To provide reliable

location information, the receiver must receive good signal strength from at least 4 satellites.

3.5 Be sure to position yourself in an area with a clear view of the sky to provide the best opportunity for optimal satellite signal strength. Trees or tall buildings can interfere with satellite reception.

3.5 Launch the data collector software specific to the GPS receiver. If a previously loaded map exists, open the known map file. If not, open a new quickproject map in the proper coordinate system. The user must be sure the coordinate system and the datum are properly defined in the GPS receiver before data collection begins.

3.6 Collect the GPS data point using the collector software provided with the GPS receiver. Refer to the user manual for the specific software being used for guidance.

3.7 Note any discrepancies in data collection or location information in the field book. (i.e. the deleting of points, or low accuracy location information).

3.8 If an equipment malfunction occurs, consult the operation manual for troubleshooting guidance.

## 4.0 DATA ARCHIVAL

4.1 After the GPS points have been collected, the data points must be stored and archived on the appropriate network drive. Below is the suggested procedure to ensure all data is stored in the proper format to facilitate a streamlined process for post-processing the field data:

a. Attach the USB cord to the GPS and plug into the computer.

b. Power on the GPS and allow the driver to install on the computer. Once this is complete, navigate to the folder containing the GPS data that was recorded on the field date.

c. Copy and paste the GPS data on the network drive in the respective folder.

d. Include a metadata folder to quickly reference the shapefiles that were transferred into the folder. This metadata file should be a word document that includes information such as:

a. Type of GPS data (point, polygon, or line)

b. Time and date

c. Coordinate system

d. Other corresponding information pertaining to the location and importance.

END OF PROCEDURE

Date: October 27, 2015

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the measurement and calculation of discharge in surface water bodies that can be traversed by wading. Discharge measurements are performed for natural (rivers, streams) and engineered (outfalls, ditches, canals, impounded wetland outlets, etc.) surface water bodies. Flow data is used by Roux Associates scientists and engineers to understand the hydrologic conditions at a site.

## 2.0 CONSIDERATIONS

### 2.1 Health and Safety

Field staff working in and around potentially contaminated surface waters should receive annual OSHA training and annual medical monitoring. Personal protective equipment (PPE) must be worn when sampling in known contaminated waters where the potential for adverse health effects exists, or where the potential for contamination exists. All field staff should refer to the site-specific HASP before entering into potentially contaminated waters.

Field personnel safety must be considered when planning the location of discharge transects. Field investigation may occur during all stages of the hydrologic cycle, including high discharge/flood stage conditions. If high discharge conditions are determined unsafe by any field representatives or project managers, reschedule the discharge measuring event. It is recommended that field personnel use personal floatation devices when measuring discharge during high flow conditions.

### 2.2 Site Conditions

Before collecting discharge data, it is important to select a site with characteristics that support accurate flow measurements. Discharge measurements may be collected at any time of year as long as the guidelines outlined below are met.

The USGS recommends that cross sections with the following characteristics be chosen whenever possible:

a) The channel is reasonably straight, the streambed is stable, the streambed is free of large rocks, weeds, and physical obstructions that would create eddies, slack water, or turbulence that could influence velocity measurements.

b) Cross sections are roughly parabolic, trapezoidal, or rectangular in shape with even flow across the transect - no more than 5% of the total water

discharge should be in any one cell on the cross section, defined as the distance between two adjacent vertical measurement points on the cross section transect.

c) Ideally the water surface should be smooth, with steady, uniform, non-varying flow conditions.

d) Ideally the cross section should not be located in areas where intervening drainage areas meet.

e) Cross sections should not be immediately downstream of sharp bends or vertical drops.

## 3.0 EQUIPMENT AND MATERIALS

a. Field notebook

b. Black pen

c. Flexible metal, Kevlar, or fiberglass measuring tape

d. Flowmeter (Price AA, pygmy, Marsh McBirney, or equivalent)

e. Top-setting wading rod

f. Chest waders/ boots

g. Personal floatation devices (PFDs)

## 5.0 PROCEDURE

5.1 If possible, select a straight reach where the streambed is uniform and relatively free of boulders and aquatic growth. The flow should be uniform and free of eddies, dead water near banks, and excessive turbulence. If necessary and possible, modify the measuring cross section to provide acceptable conditions by building dikes to cut off dead water or removing rocks, weeds, and debris in the reach of the stream 1 to 2 meters upstream from the cross section.

5.2 After modifying the streambed, allow the flow to stabilize before starting the flow measurement.

5.3 Determine the width of the stream by stringing the surveying tape from bank to bank at right angles to the direction of flow.

5.4 Calculate the number and spacing of vertical profiles required for discharge measurement. If the stream width is 5 feet or less, space the profiles at 0.5 foot

increments. If the stream width is greater than 5 feet, divide the width by 21. This will give the spacing for 20 vertical profiles.

5.5 Beginning at the left bank, wade to the first vertical profile location and measure stream depth and velocity.

Depth: Measure the stream depth using the wading rod prior to measurement of velocity. The wading rod will be placed in the stream so the base plate rests on the streambed, and the depth of water will then be read from the graduated main rod.

Velocity: Stand at least 2 feet downstream of the surveying tape and to the side of the flowmeter. The required number of velocity measurements at each profile location is based upon the stream depth at that profile. If the depth is 2.5 feet or less, make a single measurement at 60% of the total depth. If the depth is greater than 2.5 feet, make velocity measurements at 20% and 80% of the total depth and average these two velocities together for the discharge calculation.

Use the vernier scale on the upper handle of the wading rod to position the flowmeter to the proper depth. Keep the wading rod vertical and the flow sensor perpendicular to the tape rather than perpendicular to the flow as velocity measurements are being taken. Record the stream velocity and depth measurements in field book.

5.6 Use survey flagging tape to make the location of the measurement.

5.7 Document time and any other relevant conditions (e.g. weather) in the field book.

5.8 Repeat the procedure steps 5.5 through 5.7 for each vertical profile across the transect.

6.0 CALCULATIONS:

Discharge is calculated using the measured width, depth, and velocity data from each profile. When performing calculations, all assumptions should be clearly listed in the file which the calculation is being performed. Date, site, and individual who collected the data should also be provided in the calculation file.

Use Equations 1 and 2 below to calculate the total discharge across the transect in cubic feet per second ($ft^3/s$).

6.1 EQUATION 1: Discharge of individual profile section (i.e., cell) (Q)

Discharge of a cell (Q) ($ft^3/s$) = width of cell (ft) x depth of cell (ft) x velocity (ft/s)

6.2 EQUATION 2: Discharge of a transect ($Q_{Total}$)

Total discharge for transect $ft^3/s$ ($Q_{Total}$) = (Q1 + Q2 + Q3 + … Qn)

END OF PROCEDURE

Date: January 9, 2011
Revision: May 5, 2015

## 1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for decontamination of all field equipment potentially exposed to contamination during field investigation activities (i.e. drilling, soil and water sampling).

The objective of decontamination is to ensure that all field samplingequipment is decontaminated (free of potential contaminants): 1) prior to being brought onsite to avoid the introduction of potential contaminants to the site; 2) between drilling and sampling events/activities onsite to eliminate the potential for cross-contamination between boreholes and/or wells; and 3) prior to the removal of equipment from the site to prevent the transportation of potentially contaminated equipment offsite.

The decontamination line is setup so that the first station is used to clean the most contaminated item. It progresses to the last station where the least contaminated item is cleaned. A site is typically divided up into the following boundaries: Hot Zone or Exclusion Zone (EZ), the Contamination Reduction Zone (CRZ), and the Support or Safe Zone (SZ). The decontamination line should be setup in the Contamination Reduction Corridor (CRC).

In considering decontamination procedures, state and federal regulatory agency requirements must be considered because of potential variability between state and federal requirements. Decontamination procedures must be in compliance with state and/or federal protocols in order that regulatory agency(ies) scrutiny of the procedures and data collected do not result in non acceptance (invalidation) of the work undertaken and data collected.

The equipment and materials list for decontamination activities may include, but not necessarily be limited to, the following:

a. A work plan and health and safety plan which outlines decontamination procedures and requirements.

b. Field notebook and field form(s).

c. Decontamination solutions, including as necessary: non-phosphate, laboratory-grade detergent; distilled/deionized water; potable water; cleaning solvents if needed [e.g., hexane, acetone, nitric acid).

d. Long and short handled brushes,

e. Bottle brushes

f. Drop cloth/plastic sheeting

g. Paper towels

h. Plastic or galvanized tubs or buckets

i. Pressure washers or steam cleaners

j. Solvent sprayers

k. Trash / bilge pumps

l. Aluminum foil

m. 55-gallon drums.

## 2.0 PROCEDURE FOR DRILLING EQUIPMENT

The following is a minimum decontamination procedure for drilling equipment. Drilling equipment decontamination procedures will be documented on an appropriate field form or in the field notebook, especially any variation from the method itemized below:

2.1 Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP). Prior to mobilization to a site, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinsates and other waste waters that might be considered RCRA hazardous waste or may require special handling.

2.2 The drill rig and all associated equipment should be properly decontaminated by the contractor before arriving at the site.

2.3 The augers, drilling casings, rods, samplers, tools, and any piece of equipment that can come in contact (directly or indirectly) with the soil, requires proper decontamination on-site prior to commencing drilling. The project work plan or HASP, and appropriate regulatory requirements, should be consulted to determine site-specific decontamination requirements.

2.4 The same decontamination procedures used prior to drilling will be followed between boreholes (at a fixed on-site location[s], if appropriate) and before leaving the site at the end of the investigation.

2.5 All on-site steam cleaning or (decontamination) activities will be monitored and documented by a member(s) of the staff of Roux Associates, Inc. and should be performed on a decontamination pad that meets the following specifications:

1. The pad should be constructed in an area known or believed to be free of surface contamination.

2. A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced disposable) or repairable.The pad should be regularly inspected to ensure there are no leaks.

3. Water should be removed from the decontamination pad frequently.

2.6 If drilling activities are conducted in the presence of thick, sticky oils (e.g., PCB oil) which coat drilling equipment, then special decontamination procedures may have to be utilized before steam cleaning (e.g., hexane scrub and wash).

2.7 Containment of decontamination fluids may be necessary (e.g., rinseate from steam cleaning) or will be required (e.g., hexane), and disposal must be in accordance with state and/or federalregulatory requirements.

## 3.0 PROCEDURE FOR SOIL-SAMPLING EQUIPMENT

The following is a minimum decontamination procedure for soil-sampling equipment (e.g., split spoons, stainless-steel spatulas). Soil-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

3.1 Safety first. Obtain JSA and PPE, as specified in the site HASP.

3.2 Wear disposable gloves while cleaning equipment to avoid cross-contamination and change gloves as needed.

3.3 Steam clean the sampler or rinse with potable water. If soil-sampling activities are conducted in the presence of thick, sticky oils (e.g., PCB oil) which coat sampling equipment, then special decontamination procedures may have to be utilized before steam cleaning and washing in detergent solution (e.g., hexane scrub and wash).

3.4 Prepare a non-phosphate, laboratory-grade detergent solution and distilled or potable water in a clean bucket.

3.5 Disassemble the sampler, as necessary and immerse all parts and other sampling equipment in the solution.

3.6 Scrub all equipment in the bucket with a brush to remove any adhering particles.

3.7 Rinse all equipment with copious amounts of potable water followed by distilled or deionized water.

3.8 Place clean equipment on a clean plastic sheet (e.g., polyethylene)

3.9 Reassemble the cleaned sampler, as necessary.

3.10 After equipment has been cleaned, all individuals involved in equipment handling should don clean gloves, or wrap the equipment with a suitable material (e.g., plastic bag, aluminum foil).

As part of the decontamination procedure for soil-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

## 4.0 PROCEDURE FOR WATER-SAMPLING EQUIPMENT

The following is a decontamination procedure for water-sampling equipment (e.g., bailers, pumps). Water-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

4.1 Safety first. Obtain the JSAs and PPE, as specified in the site HASP.

4.2 Decontamination procedures for bailers follow:

a. Wear disposable gloves while cleaning bailer to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a bucket.

c. Disassemble sampling equipment. Discard all used sampling tubes and cords in an appropriate manner. Disconnect all power sources from electrical equipment (i.e. pumps). Scrub each piece of equipment with a brush and solution.

d. Rinse all sampling equipment with copious amounts of potable, distilled or deionized water, Reassemble equipment as per the manufacturer's instructions.

f. Air dry.

g. Wrap equipment with a suitable material (e.g., clean plastic bag, aluminum foil).

4.3 Decontamination procedures for pumps follow:

a. Wear disposable gloves while cleaning pump to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a clean bucket, clean garbage can, or clean 55-gallon drum.

c. Flush the pump and discharge hose (if not disposable) with the detergent solution, and discard disposable tubing and/or cord in an appropriate manner.

d. Flush the pump and discharge hose (if not disposable) with potable water.

e. Place the pump on clear plastic sheeting.

f. Wipe any pump-related equipment (e.g., electrical lines, cables, discharge hose) that entered the well with a clean cloth and detergent solution, and rinse or wipe with a clean cloth and potable water.

g. Air dry.

h. Wrap equipment with a suitable material (e.g., clean plastic bag).

As part of the decontamination procedure for water-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

END OF PROCEDURE

Date: May 5, 2000
Revision: May 10, 2015

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish the guidelines and procedures for drilling (soil borings, wells, or piezometers) and conducting sampling activities in unconsolidated formations. There are several drilling techniques available which include: direct push (Geoprobe® or cone penetrometer testing [CPT]), hollow-stem auger, cable tool, hydraulic rotary, cased-hole rotary, air rotary, and sonic. Formation (sediment/soil) sample collection techniques include disturbed (drill cuttings), intact (split-spoon), and undisturbed (Shelby-tube or Denison-core). Borehole abandonment (closure) procedures will also be addressed in this SOP.

The objective of drilling is to collect accurate subsurface information and to prepare a borehole for potential completion as a well or piezometer. Consequently, the lithologic data is the all important, most essential information that can be collected. The lithologic data characterizes subsurface conditions, describes hydrogeologic coefficients qualitatively and/or quantitatively, and identifies optimum locations for screen zones if wells are constructed.

Data can be obtained through the physical examination and testing of formation samples, as well as knowledge regarding ground-water levels. Thus, drill fluid mix, fluid loss, rate of drilling, lengths of split-spoon and Shelby-tube/Denison-core recovery, etc. must be monitored by the on-site hydrogeologist or geologist.

## 2.0 DRILLING TECHNIQUE-SELECTION

Verify that the drilling technique is the one specified in the investigation work plan, and that the drilling equipment mobilized by the driller is in good condition and proper working order. Do not permit the driller to use a drilling rig that appears to be substandard, in disrepair, etc., and/or is questionable as to whether or not the rig has the capabilities to accomplish the goals of the drilling program. The drilling rig must be capable of:

a. Penetration of all anticipated subsurface materials and formations at a desired rate, and construction of a borehole of desired diameter (for the anticipated well, if applicable, including the placement of a gravel or sand pack through a tremie pipe and necessary formation sealing material such as bentonite or cement).

b. Identification of lithology for development of a geologic log of all unconsolidated formations and materials penetrated, including physical characteristics and visual description of color, grain sizes, sorting and mineralogy.

c. Collection of samples of aquifer fluids during the drilling process and prior to well construction, while at the same time minimizing potential for cross-contamination. The method used should prevent cross-contamination between surface soils and ground water or between different hydrogeologic units.

d. Collection of intact and/or undisturbed soil samples from the center line or sidewall of the borehole. This objective requires the drilling to be halted while soil samples are taken from the bottom or side of the incomplete borehole.

e. Completion of the borehole into a well (monitoring or observation) or piezometer during the initial construction process (i.e., constructing a well or piezometer as the borehole is drilled, or constructing a well or piezometer in the borehole immediately after the drilling tools are removed).

f. Implementation of borehole geophysical logging (when applicable and possible) to enable more accurate vertical and horizontal extrapolation of borehole data to the lithology of the hydrogeologic system.

g. Completion of a well or piezometer, if applicable, in the borehole following a time lapse for interpretation of geologic or geophysical data from the borehole.

2.1 Drilling will not commence unless a utility mark-out/one call has been conducted at the drilling location(s) in accordance with state and local requirements.

## 3.0 DRILLING TECHNIQUE – DESCRIPTION

3.1 Direct Push – The direct push technology includes several types of drilling rigs and drilling equipment that advances a drill string by pushing or hammering without rotating the drill string. Direct push rigs include both Geoprobe® and CPT rigs. Geoprobe® rigs are typically limited to drilling in unconsolidated soil up to approximately 100 feet below ground surface (bgs) under compatible conditions. Formation samples are collected in plastic sleeves. Advantages include: access and maneuverability due to the rig's small size; fluids are not introduced into the subsurface during drilling; and sampling is relatively inexpensive. Disadvantages include: limitation to drilling depth; limitation to unconsolidated or soft rock drilling; and limitation to small diameter wells. CPT rigs also provide a continuous profile of the soil strata as the rig's sensing equipment is advanced.

3.2 Hollow-Stem Auger - This drilling method is used in unconsolidated materials with the exception of very dense, compacted materials and when cobbles or larger materials are present. Penetration may be up to 150 feet below land surface (bls) depending on the size of the rig, drilling conditions, and the diameter of the auger flight; however, depths up to 250 feet bls have been achieved under compatible

conditions. A major advantage of this technique is that normally no fluids are introduced into the formation. If the auger flights can be removed, and the integrity of the borehole maintained, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If the auger flights must remain in the borehole, then only radiation geophysical logs can be run. Casing, screen, and sampling devices can then be lowered through the hollow stem by removing the removable plug at the bottom of the auger flights, and gravel packing and cementing can be accomplished within the hollow stem. However, this can be difficult especially below the water table. Auger flight outside diameters (OD) range from 5 inches (in.) to 12 in.

3.3 Cable Tool (Percussion) - This drilling method is slow because the borehole is advanced by lifting and dropping a heavy string of drilling tools. Cuttings accumulate in the drill casing and are removed by a sand bailer. A steel casing is driven in as the hole is deepened. Cable-tool rigs can be used in unconsolidated sediment and bedrock to depths of hundreds or thousands of feet and often employ telescoping techniques for drilling deep boreholes. Electrical geophysical logs cannot be run through the steel cased borehole, but radiation logs (e.g., gamma, neutron, etc.) can be run. Well casing and screen can be installed within the cased hole after which the outer casing is pulled back (removed). Because the boring is cased as it is being drilled, cross-contamination between various depths is practically eliminated. The method provides an excellent means to collect, representative formation samples.

3.4 Hydraulic Rotary - This drilling method uses a rotating bit to drill (advance) the borehole. Drill cuttings are removed using a recirculating drilling fluid (mud or water). Although setting up the drilling equipment is slow, the drilling process is reasonably fast. In the mud-rotary method, drilling mud forms a cake on the borehole wall which prevents excessive loss of fluid to the formation being drilled. The hydrostatic pressure combined with the weight and density of the mud slurry keeps the hole open. This allows the drill rods to be removed from the borehole and geophysical logs (electric and radiation) to be run in the open borehole.

In reverse hydraulic rotary drilling, the drilling fluid moves downward through annular space and then upward inside the drill pipe. If the drilling fluid does not contain mud, then sufficient water flow is required as make-up water because the borehole wall is not sealed; therefore, significant water loss can occur to the formation being drilled. The borehole is held open by hydrostatic pressure only. A serious obstacle to this drilling method occurs when the static water level is less than 15 feet below land surface because of insufficient hydrostatic head difference between the borehole and the water table. However, the problems of excessive water loss and shallow depths to water may be overcome by using mud as the drilling fluid.

In mud-rotary drilling, the drilling fluid (mud or polymer) moves downward through the drill pipe and then upward through the annular space. Therefore, the borehole is held open by hydrostatic pressure and the mud cake lining the wall of the borehole. The mud-rotary method can be used to construct moderate to deep wells in unconsolidated (and consolidated material), while the reverse rotary technique can be used to construct moderate to deep wells in unconsolidated materials. The principal disadvantage may be the difficulty in removing mud cake from the formation at the screened zone. Extensive well development may be required to remove the mud cake.

3.5 Cased-Hole Rotary - Several new rotary drilling techniques have been developed in which a steel casing is advanced with an air-rotary or mud-rotary drill. This technique is highly desirable for use in exploratory drilling at monitoring sites because water and soil samples may be collected under conditions which preclude contamination from shallower depths. Furthermore, this technique is extremely effective in boulder or cavernous zones which would inhibit or preclude drilling using other techniques. Drilling results are comparable to cable-tool drilling but with greatly enhanced speeds. In all the cased-hole techniques, the main benefit is that the only portion of the borehole which is open, is at the bottom of the drill casing; thus, no soil or water from shallower depths can move down and impact the depth drilled and/or sampled. Electrical geophysical logs cannot be run through the steel-cased borehole, however, radiation logs (e.g., gamma, neutron, etc.) can be run.

Presently, there are three cased-hole rotary techniques which include:

a. The drill-thru casing hammer technique in which the casing is advanced by percussion with a casing hammer or vibratory driver similar to the method used in a borehole drilled by the air-rotary method. The casing hammer can also pull out the casing (air drilling only).

b. The Odex™ Drilling System (European system) which “pulls” the casing using a fixture attached to an air-hammer type drill bit (air drilling only).

c. The Barber™ Drilling System in which drilling is done with a top-head drive and a rotary table that spins casing into the ground. Casing can be fitted with a carbide “shoe” to cut boulders and an air hammer can be used above the bit. Air or mud rotary can be used to lift cuttings.

Two potential problems may be encountered using the cased-hole rotary technique which include: 1) “sand heave” when drilling stops (which can be quickly drilled or bailed out) and 2) possible aeration of water in the cased borehole if volatiles are being tested (which can be overcome by pumping or bailing the standing water

out before sampling). The minimum drill casing diameter is 6 inches and depth is limited to approximately 450 feet.

3.6 Air Rotary - This drilling method uses a rotating bit to drill, and high-velocity compressed air to remove cuttings from the borehole. A pneumatic down-hole hammer is often used to add percussion to the rotary drilling action. This drilling method is very fast and, although it is most suitable for penetrating hard bedrock, it can be used in unconsolidated formations. The borehole may be cased or uncased depending on geologic conditions. If an open borehole is drilled, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If a cased borehole is drilled, then only radiation geophysical logs can be run.

Four potential problems may be encountered when using the air-rotary technique:

a. When a prolific aquifer is tapped, the compressed air may not be able to lift the water to the surface.

b. Aeration of water in the borehole (and finished well) immediately prior to sampling can interfere with a number of inorganic and organic water-quality parameters.

c. Low yield water entry zones may not be identified because the air pressure prevents water from entering the borehole. Care should be taken to prevent overdrilling of the borehole.

d. Air rotary drilling can induce the migration of volatile organics to the surface or adjacent structures causing potential aesthetic or health and safety concerns.

If the air-rotary technique is used then the following special procedures will be implemented:

a. The type of air compressor and lubricating oil will be documented on an appropriate field form and in the field notebook and a 1-pint sample of the oil will be retained for characterization in the event organic compounds are detected in a well sample.

b. An air line oil filter will be required and changed per manufacturer's recommendations during operation with documentation of this maintenance on an appropriate field form and in the field notebook. More frequent oil filter changes will be made if oil is visibly detected in the filtered air.

c. The use of any additive will be prohibited, except approved water (e.g., potable water) for dust control and cuttings removal.

3.7 Sonic - This drilling method uses a rotating bit to drill, and high-frequency resonant vibrations created by a Sonic drill head. The drill head contains the mechanism necessary for rotary motion as well as an oscillator, which causes a high frequency force to be superimposed on the drill string. The frequency can be varied to suit operating conditions and is generally between 50 and 120 hertz (cycles per second). The vibrations are sent down the drill string to the drill bit, magnifying the amplitude of the drill bit, which (in overburden) fluidizes the soil particles at the bit face. The drill bit is physically vibrating up and down in addition to being pushed down and rotated. These three combined forces allow for relatively fast and easy penetration through most geological formations. The oscillator is driven by a hydraulic motor and uses out of balance weights to generate high sinusoidal forces that are transmitted to the drill bit. An internal spring system isolates these vibrational forces from the rest of the drill rig. Typically, Sonic drilling uses a drilling fluid (i.e., potable water) to facilitate the advancement of the drill bit. The amount of drilling fluid used should be limited during soil collection as to minimize wash-out of the sample. The use of Sonic as a drilling technology offers a number of advantages over conventional drilling methods. Since the borehole is cased as it is being drilled, borehole collapse is unlikely and cross contamination between various depths is practically eliminated. In some applications, this may reduce or eliminate the need for formal double casing. The sonic core sampling system is perhaps one of the best in its ability to provide continuous, highly representative and relatively undisturbed core samples. The sonic drilling and sampling system is ideal for use in unconsolidated formations where dense layers of gravel, cobble, and/or boulders may be present. Sonic drilling also offers the benefit of significantly reduced Investigation Derived Waste (IDW) (e.g. drill cuttings), as the sonic cores are the only wastes generated during the drilling process.

## 4.0 DECONTAMINATION

Drilling equipment decontamination procedures are outlined in the field equipment decontamination SOP. Proper decontamination in accordance with regulatory guidelines must be clearly documented in the field notebook.

## 5.0 PROCEDURE FOR DRILLING

5.1 Safety first. Obtain the appropriate work permit, Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

5.2 Document all drilling-related activities (e.g., starting, stopping, footage, problems, decontamination, etc.) on the daily log form and in the field notebook. Record dates and times of activities, and names of Roux Associates personnel providing oversight.

5.3 Monitor and record drill fluid mix, speed of rotation, pressure on the drill fluid, rate of drilling, and length of drill rods or casing in the borehole.

5.4 Confirm that the drill rods and core barrel are straight, or discontinue drilling.

5.5 Pay particular attention to the advancement of the boring because differences in the rate of drilling may be indicative of differences in subsurface geologic conditions (e.g., sand and gravel versus clay).

5.6 Maintain a continuous dialogue with the driller to track and keep informed of all drilling activities (e.g., the speed of the drill and drilling pressure, difficult and easy drilling conditions, etc.).

5.7 Collect formation samples as described below in Section 6.0. Sample jars must be labeled appropriately (e.g., project number and name, site location, boring number, date, sample interval, blow counts, and initials of Roux Associates personnel collecting sample).

5.8 Record geologic information in the geologic log form and in the field notebook. Refer to ROUX SOP 5.5 for soil classification and logging.

5.9 Refer to ROUX SOP 5.1 for collection of soil samples for laboratory analysis. Handle carefully to avoid breakage. Handle and tubes or cores carefully to prevent disturbance.

## 6.0 PROCEDURE FOR FORMATION SAMPLING

6.1 Safety first. Obtain the appropriate work permit, JSA and PPE, as specified in the site HASP.

6.2 Intact formation sampling will be implemented using split-spoon samplers (which are driven), Shelby-tube or core samplers (which are pushed), or Denison-core samplers (which are rotated) depending on the drilling technique employed. Formation samples will be retained in suitable size (e.g., 1-pint or 0.5-pint) jars for physical descriptions and potential physical and chemical analysis. The appropriately labeled jars and tubes will be stored in a safe place to avoid breakage, agitation, and freezing. Intact formation samples will be collected as described in the work plan at specified intervals (e.g., at 5-foot increments below land surface) and at each major change in subsurface materials. Hydrogeologic information will be recorded on a geologic log form and in the field notebook. Detailed descriptions of the type(s) of intact sample(s) collected, sampling intervals and conditions, and objective(s) of the sample collection will be provided in the work plan.

6.3 Disturbed formation samples (drill cuttings) will be examined continuously throughout the entire depth of the borehole. If applicable to the study and/or stated in the work plan, borehole cuttings will be collected from the circulating auger flights which lift cuttings to land surface (hollow-stem auger technique), from the sand bailer (cable-tool technique), from the recirculating drilling fluid (mudflume) which transports cuttings to land surface (mud-rotary and related techniques), or from the compressed air used to carry cuttings to land surface (air-rotary and related techniques). Formation samples will be retained in appropriate size (e.g., 1-pint or 0.5-pint), properly labeled jars and stored in a safe place to avoid breakage, agitation, and freezing. Hydrogeologic data will be recorded on a geologic log form and in the field notebook.

6.4 The soil cores from the wells drilled at the site are used for lithologic identification. Split-spoon samples may be collected continuously from boreholes for cluster wells; single well and/or piezometer boreholes may be split-spooned throughout drilling or at specified intervals or changes in lithology. The conditions for sampling will be specified in the work plan.

6.5 Before collecting and retaining soil and/or sediments collected with the split-spoon sampler, the top several inches will be removed from the sampler and discarded to eliminate any sediment that may have caved into the bottom of the borehole.

6.6 Sediment sampling equipment such as split-spoon samplers, spatulas, etc. (but not including Shelby-tube or Denison-core samplers, which area not re-usable) will be decontaminated before and between uses. (Refer to the SOP 9.1 for Decontamination of Field Equipment for a detailed description of minimum and special decontamination procedures.) Decontamination of sediment sampling equipment will take place prior to the collection of the first sample and following the collection of each subsequent sample.

## 7.0 MONITORING WELL DESIGN CONSIDERATIONS – DOUBLE CASED WELLS

7.1 When there is reason to believe that interconnection of two aquifers by well construction may cause cross-contamination, the installation of a double cased well may be necessary. In the construction of a double cased well, a highly contaminated soil zone may also be cased off so that drilling may continue below the casing with reduced danger of cross contamination.

a. To install a double cased well, a pilot borehole should be installed through the overburden and/or the contaminated zone into the clay confining layer or bedrock. An outer casing (sometimes called overburden or pilot casing) should then be placed into the borehole and sealed with grout. The

borehole and outer casing should extend into tight clay a minimum of two feet and into competent bedrock a minimum of 1 foot.

b. The total depths into the clay or bedrock will vary, depending on the plasticity of the clay and the extent of weathering and\or fracturing of the bedrock. The size of the outer casing should be of sufficient inside diameter to contain the inner casing.

c. The outer casing should be grouted by the tremie, displacement, grout shoe, or Halliburton method from the bottom to the ground surface. The grout should be pumped into the annular space between the outer casing and the borehole wall. A minimum of 24 hours should be allowed for the grout plug (seal) to cure before attempting to drill through it. The grout mixture should be a cement/bentonite, mixture. The use of a pure bentonite grout for a seal is not acceptable, because the bentonite grout is not rigid enough to withstand the stresses of drilling. When drilling through the seal, care should be taken to avoid cracking, shattering, or washing out the seal.

d. If caving conditions exist so that the outer casing cannot be sufficiently sealed by grouting, the outer casing should be driven into place and a grout seal placed in the bottom of the casing.

## 8.0 BOREHOLE ABANDONMENT OR CLOSURE

8.1 Safety first. Obtain the appropriate work permit, JSA and PPE, as specified in the site HASP.

8.2 Boreholes must be decommissioned after the completion of sampling if the borehole will not be converted to a soil vapor point or a monitoring well or piezometer. The abandonment of any borehole (or boring) will be in accordance with local, state and/or Federal regulations.

8.3 Boreholes less than 10 feet deep that remain open and do not approach the water table may be decommissioned by pouring 30% solids bentonite grout from the surface or pouring bentonite pellets from the surface, hydrating the pellets in lifts. Boreholes deeper than 10 feet, or any borehole that intercepts groundwater, must be decommissioned by pressure grouting with 30% solids bentonite grout, either through a re-entry tool string or through tremie pipe introduced to within several feet of the borehole bottom

8.4 For each abandoned borehole, the procedure will be documented on an appropriate field form or in the study notebook. Documentation may include, where appropriate, the following:

a. Borehole designation.

b. Location with respect to the replacement borehole, if replaced (e.g., 30 ft north and 40 ft west of Borehole B-1). A location sketch should be prepared.

c. Open depth prior to grouting and any other relevant circumstances (e.g., formation collapse).

d. Drill casing left in the borehole by depth, size, and composition.

e. A copy of the geologic log.

f. A revised diagram of the abandoned borehole using a supplemental geologic log form.

g. Additional items left in hole by depth, description, and composition (e.g., lost tools, bailers, etc.).

h. A description and daily quantities of grout used to compensate for settlement.

i. The date of abandonment.

j. The level of water or mud prior to grouting and the date and time measured.

k. Any other state or local well abandonment reporting requirements.

END OF PROCEDURE

# APPENDIX C

RI/FS Schedule

CFAC RI/FS Schedule Updated April 30, 2018

| ID | Deliverable | Task Name | Duration | Start | Finish | Company | Predecessors |
|---|---|---|---|---|---|---|---|
| 1 | | AOC is executed by all parties | 1 day | Mon 11/30/15 | Mon 11/30/15 | EPA/CFAC | |
| 2 | | Historical Records Review | 160 days | Mon 2/8/16 | Fri 9/16/16 | Roux | |
| 3 | X | Draft Health and Safety Plan (HASP) | 30 edays | Mon 11/30/15 | Wed 12/30/15 | Roux | 1 |
| 4 | X | Final Health and Safety Plan (HASP) | 25 days | Thu 12/31/15 | Wed 2/3/16 | Roux | 3 |
| 5 | | Site is clear of Snow / Field Work Begins | 1 day | Mon 4/4/16 | Mon 4/4/16 | | |
| 6 | | Pre-Intrusive Task 1 - Site Reconnaisance | 10 days | Mon 4/4/16 | Fri 4/15/16 | Roux | 5SS |
| 7 | | Pre-Intrusive Task 2 - Geophysical Survey | 5 days | Mon 4/18/16 | Fri 4/22/16 | Roux | 6 |
| 8 | | Pre-Intrusive Task 3 - Soil Gas Survey | 7 days | Mon 4/18/16 | Tue 4/26/16 | Roux | 7SS |
| 9 | | **SAP Addendum** | **75 days** | **Mon 4/18/16** | **Fri 7/29/16** | **Roux** | |
| 10 | X | Draft SAP Addendum | 40 days | Mon 4/18/16 | Fri 6/10/16 | Roux | 6 |
| 11 | | EPA Review of Draft SAP Addendum | 15 days | Mon 6/13/16 | Fri 7/1/16 | EPA | 10 |
| 12 | X | Final SAP Addendum | 20 days | Mon 7/4/16 | Fri 7/29/16 | Roux | 11 |
| 13 | | **Source Area Investigation - Phase I Site Characterization Field Activities** | **120 days** | **Mon 5/9/16** | **Fri 10/21/16** | **Roux/Hydrometrics** | |
| 14 | | GPR Utility Mark-Outs | 5 days | Mon 5/9/16 | Fri 5/13/16 | Roux | |
| 15 | | Clearing / Grading for Drill Rig Access | 4 days | Wed 5/11/16 | Mon 5/16/16 | Roux | |
| 16 | | Sonic Rig 1 | 75 days | Mon 5/16/16 | Fri 8/26/16 | Roux | 8FS+10 days |
| 17 | | Sonic Rig 2 | 50 days | Mon 5/16/16 | Fri 7/22/16 | Roux | 8FS+10 days |
| 18 | | Geoprobe | 20 days | Mon 5/16/16 | Fri 6/10/16 | Hydrometrics | 8FS+10 days |
| 19 | | Landfill GPR Survey Field Work | 3 days | Mon 7/25/16 | Wed 7/27/16 | Roux | |
| 20 | | Test Pitting | 5 days | Mon 8/15/16 | Fri 8/19/16 | Roux | |
| 21 | | Additional Monitoring Well redevelopment activities | 10 days | Mon 10/10/16 | Fri 10/21/16 | Hydrometrics | |
| 22 | | Background Area Investigation | 5 days | Mon 6/13/16 | Fri 6/17/16 | Hydrometrics | 18 |
| 23 | | Operational Grid Area Investigation | 30 days | Mon 6/20/16 | Fri 7/29/16 | Hydrometrics | 22 |
| 24 | | Site-Wide Surface Water Sampling - Event 1 | 5 days | Mon 9/5/16 | Fri 9/9/16 | Roux/Hydrometrics | 16FS+5 days |
| 25 | | Site-Wide Groundwater Sampling - Event 1 | 15 days | Mon 9/12/16 | Fri 9/30/16 | Roux/Hydrometrics | 24 |
| 26 | | Site-Wide Surface Water Sampling - Event 2 | 5 days | Mon 12/5/16 | Fri 12/9/16 | Roux/Hydrometrics | 24SS+90 edays |
| 27 | | Site-Wide Groundwater Sampling - Event 2 | 15 days | Mon 12/12/16 | Fri 12/30/16 | Roux/Hydrometrics | 26 |
| 28 | | Site-Wide Surface Water Sampling - Event 3 | 5 days | Mon 3/13/17 | Fri 3/17/17 | Roux/Hydrometrics | 27SS+90 edays |
| 29 | | Site-Wide Groundwater Sampling - Event 3 | 15 days | Mon 3/20/17 | Fri 4/7/17 | Roux/Hydrometrics | 28 |
| 30 | | Site-Wide Surface Water Sampling - Event 4 | 5 days | Mon 6/12/17 | Fri 6/16/17 | Roux/Hydrometrics | 28SS+90 edays |
| 31 | | Site-Wide Groundwater Sampling - Event 4 | 15 days | Mon 6/19/17 | Fri 7/7/17 | Roux/Hydrometrics | 30 |
| 32 | | Investigation Derived Waste Management/Disposal | 390 days | Mon 4/4/16 | Fri 9/29/17 | Roux | 5SS |
| 33 | | **Phase 1 Site Characterization Data Summary Report** | **251 days** | **Mon 10/3/16** | **Mon 9/18/17** | **Roux** | |
| 34 | | Data Validation Completion | 35 days | Mon 10/3/16 | Fri 11/18/16 | Data Validator | 25 |
| 35 | X | Draft Phase I Site Characterization Summary Report to EPA/MDEQ | 71 days | Mon 11/21/16 | Mon 2/27/17 | Roux | 34 |
| 36 | | EPA review of Draft Phase I Data Summary Report | 30 days | Mon 3/6/17 | Fri 4/14/17 | EPA | 35 |
| 37 | X | Response to EPA/MDEQ Comments on Draft Phase I Data Summary Report | 100 days | Mon 4/17/17 | Fri 9/1/17 | Roux/EPA | 36 |
| 38 | X | Final Submission of Phase I Summary Report to EPA/MDEQ | 10 days | Tue 9/5/17 | Mon 9/18/17 | Roux | 37 |
| 39 | | **Screening Level Ecological Risk Assessment (SLERA)** | **361 days** | **Mon 5/2/16** | **Mon 9/18/17** | **Roux** | |
| 40 | | Completion of SLERA Field Work | 5 days | Mon 5/2/16 | Fri 5/6/16 | Roux | |
| 41 | X | Draft SLERA Summary Report | 71 days | Mon 11/21/16 | Mon 2/27/17 | Roux | 34 |
| 42 | | EPA review of Draft SLERA Report | 30 days | Mon 3/6/17 | Fri 4/14/17 | EPA | 41 |
| 43 | X | Response to EPA/MDEQ Comments on Draft SLERA Summary Report | 100 days | Mon 4/17/17 | Fri 9/1/17 | Roux/EPA | 42 |
| 44 | X | Final Submission of SLERA Report to EPA/MDEQ | 10 days | Tue 9/5/17 | Mon 9/18/17 | Roux | 43 |
| 45 | | **2017 Additional Field Activities** | **85 days** | **Mon 4/17/17** | **Fri 8/11/17** | **Roux** | |
| 46 | | Preparation of 2017 field activities plan/SAP Mods | 30 days | Mon 4/17/17 | Fri 5/26/17 | Roux | 36 |
| 47 | | Pnuematic Slug Testing | 15 days | Mon 7/10/17 | Fri 7/28/17 | Roux | 31 |
| 48 | | Asbestos Landfill Soil Sampling | 10 days | Mon 7/31/17 | Fri 8/11/17 | Roux/Hydrometrics | 47 |
| 49 | | **Groundwater and Surface Water Sampling Data Summary Report** | **101 days** | **Mon 7/10/17** | **Mon 11/27/17** | **Roux** | |
| 50 | | Validation of Round 4 sampling data | 25 days | Mon 7/10/17 | Fri 8/11/17 | Data Validator | 31 |
| 51 | X | GW/SW Summary Report to EPA/MDEQ | 76 days | Mon 8/14/17 | Mon 11/27/17 | Roux | 50 |
| 52 | | **Baseline Human Health Risk Assessment Work Plan** | **184 days** | **Mon 9/18/17** | **Fri 6/1/18** | **Roux** | |
| 53 | X | Draft BHHRA Work Plan to EPA/MDEQ | 60 edays | Mon 9/18/17 | Fri 11/17/17 | Roux/EHS Support | 38 |
| 54 | | EPA review of Draft BHHRA Work plan | 35 days | Mon 11/20/17 | Fri 1/5/18 | EPA | 58 |
| 55 | X | Response to EPA/MDEQ Comments on BHHRA Work Plan | 70 days | Mon 1/8/18 | Fri 4/13/18 | Roux | 54 |
| 56 | X | Final Submission of BHHRA WP to EPA/MDEQ | 35 days | Mon 4/16/18 | Fri 6/1/18 | Roux | 55 |
| 57 | | **Baseline Ecological Risk Assessment Work Plan** | **184 days** | **Mon 9/18/17** | **Fri 6/1/18** | **Roux** | |
| 58 | X | Draft BERA Work Plan to EPA/MDEQ | 60 edays | Mon 9/18/17 | Fri 11/17/17 | Roux/EHS Support | 44 |
| 59 | | EPA reivew of Draft BERA Work Plan | 35 days | Mon 11/20/17 | Fri 1/5/18 | EPA | 58 |
| 60 | X | Response to EPA/MDEQ Comments on BERA Work Plan | 70 days | Mon 1/8/18 | Fri 4/13/18 | Roux | 59 |
| 61 | X | Final Submission BERA Work Plan to EPA/MDEQ | 35 days | Mon 4/16/18 | Fri 6/1/18 | Roux | 60 |
| 62 | | **Phase II Remedial Investigation Sampling and Analysis Plan** | **117 days** | **Tue 11/28/17** | **Wed 5/9/18** | **Roux** | |
| 63 | X | Draft Phase II Sampling and Analysis Plan to EPA/MDEQ | 67 days | Tue 11/28/17 | Wed 2/28/18 | Roux | 51 |
| 64 | | EPA reivew of draft Phase II Sampling and Analysis Plan | 25 days | Thu 3/1/18 | Wed 4/4/18 | EPA | 63 |
| 65 | X | Response to EPA/MDEQ Comments on Phase II Sampling and Analysis Plan | 15 days | Thu 4/5/18 | Wed 4/25/18 | Roux | 64 |
| 66 | X | Final Phase II Sampling and Analysis Plan | 10 days | Thu 4/26/18 | Wed 5/9/18 | Roux | 65 |
| 67 | | **South Percolation Pond Expedited Risk Assessment** | **115 days** | **Mon 10/30/17** | **Fri 4/6/18** | | |
| 68 | | South Percolation Pond Risk Expedited Risk Assessment Field Activities | 10 days | Mon 10/30/17 | Fri 11/10/17 | Roux | |
| 69 | | Validation of South Pond Data | 25 days | Mon 11/13/17 | Fri 12/15/17 | Data Validator | 68 |
| 70 | | Completion of South Pond Risk Assessment Tech Memo | 80 days | Mon 12/18/17 | Fri 4/6/18 | Roux/EHS Support | 69 |
| 71 | | **Phase II Remedial Investigation** | **131 days** | **Wed 4/25/18** | **Tue 10/23/18** | | |
| 72 | | Site Reconnaisance | 3 days | Wed 4/25/18 | Fri 4/27/18 | Roux | |
| 73 | | Soil Borings with Geoprobe | 15 days | Mon 4/30/18 | Fri 5/18/18 | Roux | 72 |
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| 75 | | Soil borings with Hand Tools | 8 days | Sat 6/23/18 | Tue 7/3/18 | Roux | |
| 76 | | Surface Water Sampling - Round 1 | 15 days | Mon 6/4/18 | Fri 6/22/18 | Roux/Hydrometrics | |
| 77 | | Groundwater Sampling - Round 1 | 14 days | Mon 6/4/18 | Thu 6/21/18 | Roux/Hydrometrics | 76SS |
| 78 | | Surface Water Sampling - Round 2 | 12 days | Mon 10/8/18 | Tue 10/23/18 | Roux/Hydrometrics | |
| 79 | | Groundwater Sampling - Round 2 | 12 days | Mon 10/8/18 | Tue 10/23/18 | Roux/Hydrometrics | 78SS |
| 80 | | **Phase II Remedial Investigation Data Summary Report** | **143 days** | **Wed 10/24/18** | **Fri 5/10/19** | | |
| 81 | | Validation of Round 2 sampling data | 15 days | Wed 10/24/18 | Tue 11/13/18 | Data Validator | 79 |
| 82 | X | Draft Phase II Remedial Investigation Data Summary Report to EPA/MDEQ | 78 days | Wed 11/14/18 | Fri 3/1/19 | Roux | 81 |
| 83 | | EPA review of draft Phase II Data Summary Report | 30 days | Mon 3/4/19 | Fri 4/12/19 | EPA | 82 |
| 84 | X | Final Phase II RI Data Summary Report | 20 days | Mon 4/15/19 | Fri 5/10/19 | Roux | 83 |
| 85 | | **Baseline Ecological Risk Assessment** | **295 days** | **Tue 5/1/18** | **Fri 6/14/19** | | |
| 86 | X | Draft Ecological Risk Assessment Interim Deliverables | 60 days | Tue 5/1/18 | Fri 7/20/18 | Roux/EHS Support | |
| 87 | | EPA Review of Ecological Risk Assessment Intermin Deliverables | 30 days | Mon 7/23/18 | Fri 8/31/18 | EPA | 86 |
| 88 | X | Final Ecological Risk Assessment Interim Deliverables | 15 days | Mon 9/3/18 | Fri 9/21/18 | Roux/EHS Support | 87 |
| 89 | X | Draft Baseline Ecological Risk Assessment Summary Report | 78 days | Wed 11/14/18 | Fri 3/1/19 | Roux/EHS Support | 81 |
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| 91 | X | Final Baseline Ecological Risk Assessment Summary Report | 30 days | Mon 5/6/19 | Fri 6/14/19 | Roux/EHS Support | 90 |
| 92 | | **Baseline Human Health Risk Assessment** | **295 days** | **Tue 5/1/18** | **Fri 6/14/19** | | |
| 93 | X | Draft Human Health Risk Assessment Interim Deliverables | 60 days | Tue 5/1/18 | Fri 7/20/18 | Roux/EHS Support | |
| 94 | | EPA Review of Human Health Risk Assessment Intermin Deliverables | 30 days | Mon 7/23/18 | Fri 8/31/18 | EPA | 93 |
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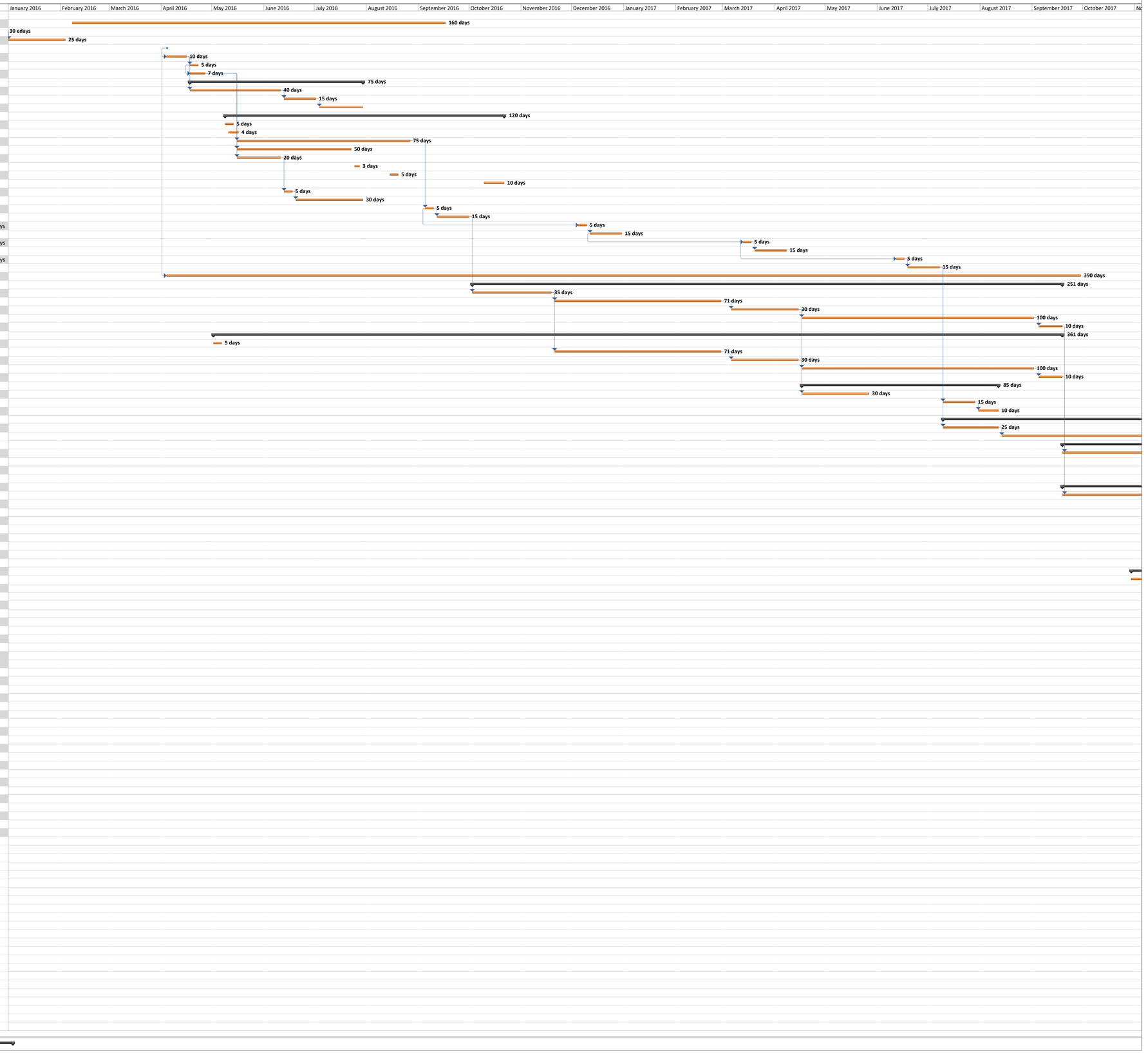
| 97 | | EPA Review of Draft Baseline Human Health Risk Assessement Summary Report | 45 days | Mon 3/4/19 | Fri 5/3/19 | EPA | 96 |
| 98 | X | Final Baseline Human Health Risk Assessment Summary Report | 30 days | Mon 5/6/19 | Fri 6/14/19 | Roux/EHS Support | 97 |



CFAC RI/FS Schedule Updated April 30, 2018

| ID | Deliverable | Task Name | Duration | Start | Finish | Company | Predecessors |
|---|---|---|---|---|---|---|---|
| 1 | | AOC is executed by all parties | 1 day | Mon 11/30/15 | Mon 11/30/15 | EPA/CFAC | |
| 2 | | Historical Records Review | 160 days | Mon 2/8/16 | Fri 9/16/16 | Roux | |
| 3 | X | Draft Health and Safety Plan (HASP) | 30 edays | Mon 11/30/15 | Wed 12/30/15 | Roux | 1 |
| 4 | X | Final Health and Safety Plan (HASP) | 25 days | Thu 12/31/15 | Wed 2/3/16 | Roux | 3 |
| 5 | | Site is clear of Snow / Field Work Begins | 1 day | Mon 4/4/16 | Mon 4/4/16 | | |
| 6 | | Pre-Intrusive Task 1 - Site Reconnaisance | 10 days | Mon 4/4/16 | Fri 4/15/16 | Roux | 5SS |
| 7 | | Pre-Intrusive Task 2 - Geophysical Survey | 5 days | Mon 4/18/16 | Fri 4/22/16 | Roux | 6 |
| 8 | | Pre-Intrusive Task 3 - Soil Gas Survey | 7 days | Mon 4/18/16 | Tue 4/26/16 | Roux | 7SS |
| 9 | | **SAP Addendum** | **75 days** | **Mon 4/18/16** | **Fri 7/29/16** | **Roux** | |
| 10 | X | Draft SAP Addendum | 40 days | Mon 4/18/16 | Fri 6/10/16 | Roux | 6 |
| 11 | | EPA Review of Draft SAP Addendum | 15 days | Mon 6/13/16 | Fri 7/1/16 | EPA | 10 |
| 12 | X | Final SAP Addendum | 20 days | Mon 7/4/16 | Fri 7/29/16 | Roux | 11 |
| 13 | | **Source Area Investigation - Phase I Site Characterization Field Activities** | **120 days** | **Mon 5/9/16** | **Fri 10/21/16** | **Roux/Hydrometrics** | |
| 14 | | GPR Utility Mark-Outs | 5 days | Mon 5/9/16 | Fri 5/13/16 | Roux | |
| 15 | | Clearing / Grading for Drill Rig Access | 4 days | Wed 5/11/16 | Mon 5/16/16 | Roux | |
| 16 | | Sonic Rig 1 | 75 days | Mon 5/16/16 | Fri 8/26/16 | Roux | 8FS+10 days |
| 17 | | Sonic Rig 2 | 50 days | Mon 5/16/16 | Fri 7/22/16 | Roux | 8FS+10 days |
| 18 | | Geoprobe | 20 days | Mon 5/16/16 | Fri 6/10/16 | Hydrometrics | 8FS+10 days |
| 19 | | Landfill GPR Survey Field Work | 3 days | Mon 7/25/16 | Wed 7/27/16 | Roux | |
| 20 | | Test Pitting | 5 days | Mon 8/15/16 | Fri 8/19/16 | Roux | |
| 21 | | Additional Monitoring Well redevelopment activities | 10 days | Mon 10/10/16 | Fri 10/21/16 | Hydrometrics | |
| 22 | | Background Area Investigation | 5 days | Mon 6/13/16 | Fri 6/17/16 | Hydrometrics | 18 |
| 23 | | Operational Grid Area Investigation | 30 days | Mon 6/20/16 | Fri 7/29/16 | Hydrometrics | 22 |
| 24 | | Site-Wide Surface Water Sampling - Event 1 | 5 days | Mon 9/5/16 | Fri 9/9/16 | Roux/Hydrometrics | 16FS+5 days |
| 25 | | Site-Wide Groundwater Sampling - Event 1 | 15 days | Mon 9/12/16 | Fri 9/30/16 | Roux/Hydrometrics | 24 |
| 26 | | Site-Wide Surface Water Sampling - Event 2 | 5 days | Mon 12/5/16 | Fri 12/9/16 | Roux/Hydrometrics | 24SS+90 edays |
| 27 | | Site-Wide Groundwater Sampling - Event 2 | 15 days | Mon 12/12/16 | Fri 12/30/16 | Roux/Hydrometrics | 26 |
| 28 | | Site-Wide Surface Water Sampling - Event 3 | 5 days | Mon 3/13/17 | Fri 3/17/17 | Roux/Hydrometrics | 27SS+90 edays |
| 29 | | Site-Wide Groundwater Sampling - Event 3 | 15 days | Mon 3/20/17 | Fri 4/7/17 | Roux/Hydrometrics | 28 |
| 30 | | Site-Wide Surface Water Sampling - Event 4 | 5 days | Mon 6/12/17 | Fri 6/16/17 | Roux/Hydrometrics | 28SS+90 edays |
| 31 | | Site-Wide Groundwater Sampling - Event 4 | 15 days | Mon 6/19/17 | Fri 7/7/17 | Roux/Hydrometrics | 30 |
| 32 | | Investigation Derived Waste Management/Disposal | 390 days | Mon 4/4/16 | Fri 9/29/17 | Roux | 5SS |
| 33 | | **Phase 1 Site Characterization Data Summary Report** | **251 days** | **Mon 10/3/16** | **Mon 9/18/17** | **Roux** | |
| 34 | | Data Validation Completion | 35 days | Mon 10/3/16 | Fri 11/18/16 | Data Validator | 25 |
| 35 | X | Draft Phase I Site Characterization Summary Report to EPA/MDEQ | 71 days | Mon 11/21/16 | Mon 2/27/17 | Roux | 34 |
| 36 | | EPA review of Draft Phase I Data Summary Report | 30 days | Mon 3/6/17 | Fri 4/14/17 | EPA | 35 |
| 37 | X | Response to EPA/MDEQ Comments on Draft Phase I Data Summary Report | 100 days | Mon 4/17/17 | Fri 9/1/17 | Roux/EPA | 36 |
| 38 | X | Final Submission of Phase I Summary Report to EPA/MDEQ | 10 days | Tue 9/5/17 | Mon 9/18/17 | Roux | 37 |
| 39 | | **Screening Level Ecological Risk Assessment (SLERA)** | **361 days** | **Mon 5/2/16** | **Mon 9/18/17** | **Roux** | |
| 40 | | Completion of SLERA Field Work | 5 days | Mon 5/2/16 | Fri 5/6/16 | Roux | |
| 41 | X | Draft SLERA Summary Report | 71 days | Mon 11/21/16 | Mon 2/27/17 | Roux | 34 |
| 42 | | EPA review of Draft SLERA Report | 30 days | Mon 3/6/17 | Fri 4/14/17 | EPA | 41 |
| 43 | X | Response to EPA/MDEQ Comments on Draft SLERA Summary Report | 100 days | Mon 4/17/17 | Fri 9/1/17 | Roux/EPA | 42 |
| 44 | X | Final Submission of SLERA Report to EPA/MDEQ | 10 days | Tue 9/5/17 | Mon 9/18/17 | Roux | 43 |
| 45 | | **2017 Additional Field Activities** | **85 days** | **Mon 4/17/17** | **Fri 8/11/17** | **Roux** | |
| 46 | | Preparation of 2017 field activities plan/SAP Mods | 30 days | Mon 4/17/17 | Fri 5/26/17 | Roux | 36 |
| 47 | | Pnuematic Slug Testing | 15 days | Mon 7/10/17 | Fri 7/28/17 | Roux | 31 |
| 48 | | Asbestos Landfill Soil Sampling | 10 days | Mon 7/31/17 | Fri 8/11/17 | Roux/Hydrometrics | 47 |
| 49 | | **Groundwater and Surface Water Sampling Data Summary Report** | **101 days** | **Mon 7/10/17** | **Mon 11/27/17** | **Roux** | |
| 50 | | Validation of Round 4 sampling data | 25 days | Mon 7/10/17 | Fri 8/11/17 | Data Validator | 31 |
| 51 | X | GW/SW Summary Report to EPA/MDEQ | 76 days | Mon 8/14/17 | Mon 11/27/17 | Roux | 50 |
| 52 | | **Baseline Human Health Risk Assessment Work Plan** | **184 days** | **Mon 9/18/17** | **Fri 6/1/18** | Roux | |
| 53 | X | Draft BHHRA Work Plan to EPA/MDEQ | 60 edays | Mon 9/18/17 | Fri 11/17/17 | Roux/EHS Support | 38 |
| 54 | | EPA review of Draft BHHRA Work plan | 35 days | Mon 11/20/17 | Fri 1/5/18 | EPA | 58 |
| 55 | X | Response to EPA/MDEQ Comments on BHHRA Work Plan | 70 days | Mon 1/8/18 | Fri 4/13/18 | Roux | 54 |
| 56 | X | Final Submission of BHHRA WP to EPA/MDEQ | 35 days | Mon 4/16/18 | Fri 6/1/18 | Roux | 55 |
| 57 | | **Baseline Ecological Risk Assessment Work Plan** | **184 days** | **Mon 9/18/17** | **Fri 6/1/18** | **Roux** | |
| 58 | X | Draft BERA Work Plan to EPA/MDEQ | 60 edays | Mon 9/18/17 | Fri 11/17/17 | Roux/EHS Support | 44 |
| 59 | | EPA reivew of Draft BERA Work Plan | 35 days | Mon 11/20/17 | Fri 1/5/18 | EPA | 58 |
| 60 | X | Response to EPA/MDEQ Comments on BERA Work Plan | 70 days | Mon 1/8/18 | Fri 4/13/18 | Roux | 59 |
| 61 | X | Final Submission BERA Work Plan to EPA/MDEQ | 35 days | Mon 4/16/18 | Fri 6/1/18 | Roux | 60 |
| 62 | | **Phase II Remedial Investigation Sampling and Analysis Plan** | **117 days** | **Tue 11/28/17** | **Wed 5/9/18** | **Roux** | |
| 63 | X | Draft Phase II Sampling and Analysis Plan to EPA/MDEQ | 67 days | Tue 11/28/17 | Wed 2/28/18 | Roux | 51 |
| 64 | | EPA reivew of draft Phase II Sampling and Analysis Plan | 25 days | Thu 3/1/18 | Wed 4/4/18 | EPA | 63 |
| 65 | X | Response to EPA/MDEQ Comments on Phase II Sampling and Analysis Plan | 15 days | Thu 4/5/18 | Wed 4/25/18 | Roux | 64 |
| 66 | X | Final Phase II Sampling and Analysis Plan | 10 days | Thu 4/26/18 | Wed 5/9/18 | Roux | 65 |
| 67 | | **South Percolation Pond Expedited Risk Assessment** | **115 days** | **Mon 10/30/17** | **Fri 4/6/18** | | |
| 68 | | South Percolation Pond Risk Expedited Risk Assessment Field Activities | 10 days | Mon 10/30/17 | Fri 11/10/17 | Roux | |
| 69 | | Validation of South Pond Data | 25 days | Mon 11/13/17 | Fri 12/15/17 | Data Validator | 68 |
| 70 | | Completion of South Pond Risk Assessment Tech Memo | 80 days | Mon 12/18/17 | Fri 4/6/18 | Roux/EHS Support | 69 |
| 71 | | **Phase II Remedial Investigation** | **131 days** | **Wed 4/25/18** | **Tue 10/23/18** | | |
| 72 | | Site Reconnaisance | 3 days | Wed 4/25/18 | Fri 4/27/18 | Roux | |
| 73 | | Soil Borings with Geoprobe | 15 days | Mon 4/30/18 | Fri 5/18/18 | Roux | 72 |
| 74 | | Soil Borings and Monitoring Well Installation with Sonic Rig | 19 days | Mon 4/30/18 | Thu 5/24/18 | Roux | 72 |
| 75 | | Soil borings with Hand Tools | 8 days | Sat 6/23/18 | Tue 7/3/18 | Roux | |
| 76 | | Surface Water Sampling - Round 1 | 15 days | Mon 6/4/18 | Fri 6/22/18 | Roux/Hydrometrics | |
| 77 | | Groundwater Sampling - Round 1 | 14 days | Mon 6/4/18 | Thu 6/21/18 | Roux/Hydrometrics | 76SS |
| 78 | | Surface Water Sampling - Round 2 | 12 days | Mon 10/8/18 | Tue 10/23/18 | Roux/Hydrometrics | |
| 79 | | Groundwater Sampling - Round 2 | 12 days | Mon 10/8/18 | Tue 10/23/18 | Roux/Hydrometrics | 78SS |
| 80 | | **Phase II Remedial Investigation Data Summary Report** | **143 days** | **Wed 10/24/18** | **Fri 5/10/19** | | |
| 81 | | Validation of Round 2 sampling data | 15 days | Wed 10/24/18 | Tue 11/13/18 | Data Validator | 79 |
| 82 | X | Draft Phase II Remedial Investigation Data Summary Report to EPA/MDEQ | 78 days | Wed 11/14/18 | Fri 3/1/19 | Roux | 81 |
| 83 | | EPA review of draft Phase II Data Summary Report | 30 days | Mon 3/4/19 | Fri 4/12/19 | EPA | 82 |
| 84 | X | Final Phase II RI Data Summary Report | 20 days | Mon 4/15/19 | Fri 5/10/19 | Roux | 83 |
| 85 | | **Baseline Ecological Risk Assessment** | **295 days** | **Tue 5/1/18** | **Fri 6/14/19** | | |
| 86 | X | Draft Ecological Risk Assessment Interim Deliverables | 60 days | Tue 5/1/18 | Fri 7/20/18 | Roux/EHS Support | |
| 87 | | EPA Review of Ecological Risk Assessment Intermin Deliverables | 30 days | Mon 7/23/18 | Fri 8/31/18 | EPA | 86 |
| 88 | X | Final Ecological Risk Assessment Interim Deliverables | 15 days | Mon 9/3/18 | Fri 9/21/18 | Roux/EHS Support | 87 |
| 89 | X | Draft Baseline Ecological Risk Assessment Summary Report | 78 days | Wed 11/14/18 | Fri 3/1/19 | Roux/EHS Support | 81 |
| 90 | | EPA Review of Draft Baseline Ecological Risk Assesement Summary Report | 45 days | Mon 3/4/19 | Fri 5/3/19 | EPA | 89 |
| 91 | X | Final Baseline Ecological Risk Assessment Summary Report | 30 days | Mon 5/6/19 | Fri 6/14/19 | Roux/EHS Support | 90 |
| 92 | | **Baseline Human Health Risk Assessment** | **295 days** | **Tue 5/1/18** | **Fri 6/14/19** | | |
| 93 | X | Draft Human Health Risk Assessment Interim Deliverables | 60 days | Tue 5/1/18 | Fri 7/20/18 | Roux/EHS Support | |
| 94 | | EPA Review of Human Health Risk Assessment Intermin Deliverables | 30 days | Mon 7/23/18 | Fri 8/31/18 | EPA | 93 |
| 95 | X | Final Human Health Risk Assessment Interim Deliverables | 15 days | Mon 9/3/18 | Fri 9/21/18 | Roux/EHS Support | 94 |
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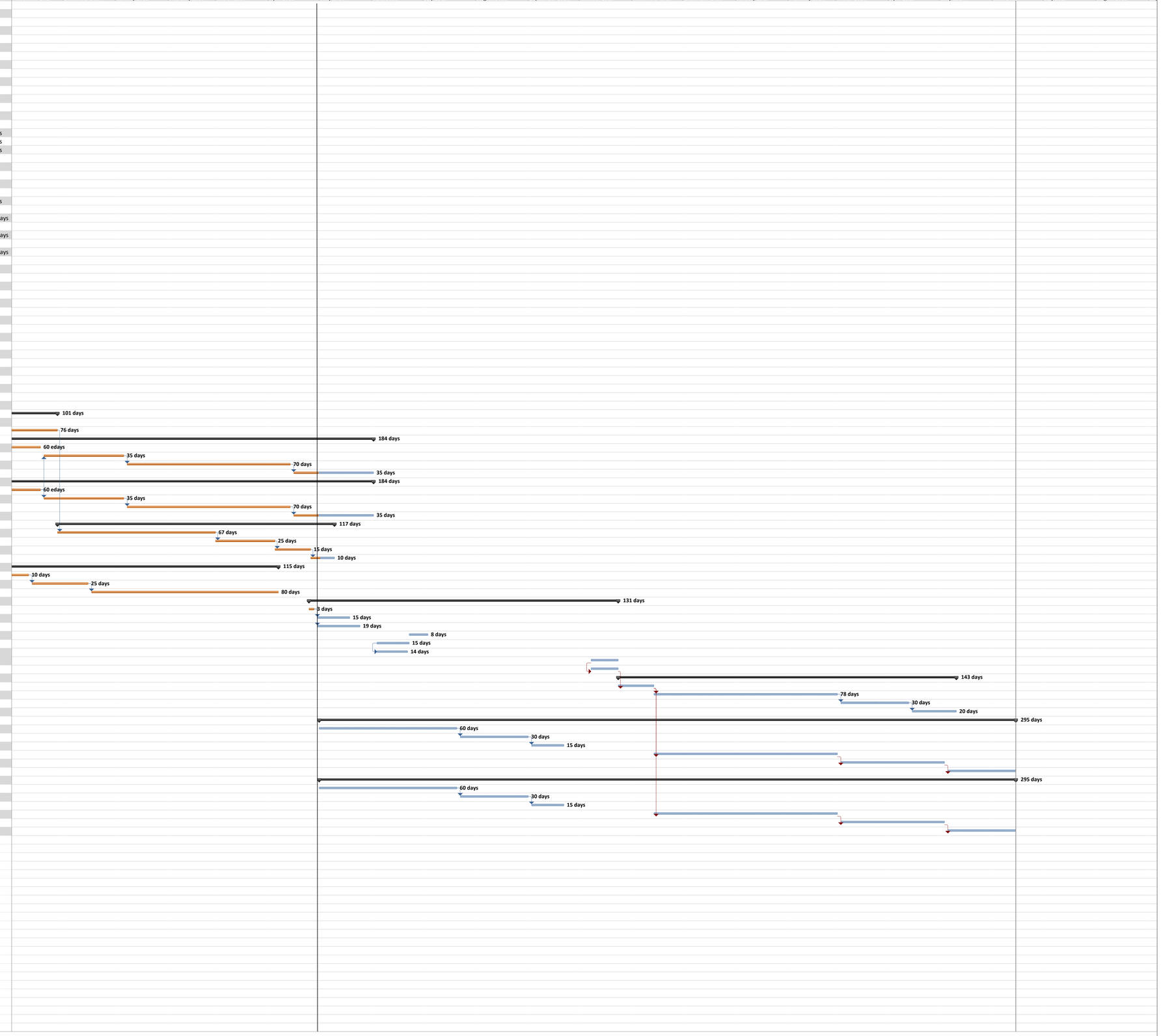


Scheduled Task | Task Progress Complete | Summary

# APPENDIX D

## Evaluation of Data Quality
## Objective-Based Minimum Sample Sizes

EHS Support
consider it done

# Columbia Falls Aluminum Company

# Evaluation of Data Quality Objective-Based Minimum Sample Sizes

# Columbia Falls, Montana

**Prepared for:**
**Columbia Falls Aluminum Company, LLC**
**2000 Aluminum Drive**
**Columbia Falls, MT**

**May 2018**

*consider it done*

**Prepared by:**
**EHS Support LLC**



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Figure 3g HMW PAHs Outliers in Soil
Figure 3h Benzo(a)pyrene Outliers in Soil

**ACRONYMS**

| | |
|---|---|
| Δ | (delta) allowable error margin |
| α | (alpha) false rejection rate (Type I decision error) |
| BERA | Baseline Ecological Risk Assessment |
| BHHRA | Baseline Human Health Risk Assessment |
| CC | confidence coefficient |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFAC | Columbia Falls Aluminum Company, LLC |
| COPC | constituent of potential concern |
| COPEC | constituent of potential ecological concern |
| DCGL | Derived Concentration Guidance Level |
| DQO | data quality objective |
| EHS Support | EHS Support, LLC |
| EPC | exposure point concentration |
| ESV | ecological screening value |
| HMW | high molecular weight |
| ISS | incremental soil sampling |
| LMW | low molecular weight |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MDEQ | Montana Department of Environmental Quality |
| PAH | polycyclic aromatic hydrocarbon |
| ProUCL | ProUCL Version 5.1 (USEPA statistical software) |
| RBSL | Risk-Based Screening Level |
| RI/FS | Remedial Investigation/Feasibility Study |
| Roux | Roux Associates, Inc. |
| RSL | Regional Screening Level |
| *s* | sample standard deviation |
| SAP | Sampling and Analysis Plan |
| SLERA | screening-level ecological risk assessment |
| $UCL_{mean}$ | upper confidence limit of the mean |
| USEPA | United States Environmental Protection Agency |

## 1.0 INTRODUCTION

On behalf of Roux Associates, Inc. (Roux) and the Columbia Falls Aluminum Company, LLC (CFAC), EHS Support, LLC (EHS Support) prepared a data quality objective (DQO)-based minimum sample size evaluation to support the ongoing Remedial Investigation/Feasibility Study (RI/FS) of the former CFAC aluminum reduction facility (commonly referred to as an aluminum smelter) located in Flathead County, Montana (Site). The RI/FS is being conducted pursuant to the Administrative Settlement Agreement and Order on Consent dated November 30, 2015, between CFAC and the United States Environmental Protection Agency (USEPA) (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 08-2016-0002).

The RI of the CFAC Site is being conducted in a phased approach:

- Phase I Site Characterization: The initial characterization conducted in 2016 consisted of a detailed Site survey and analytical sampling program to characterize known and potential source areas and to broadly characterize site hydrogeology, soil, groundwater, surface water, and sediment (Roux, 2017a).
- Phase II Site Characterization: Based on the findings of the Phase I Site Characterization, a Phase II Sampling and Analysis Plan (SAP) is being developed to address potential data needs. Baseline Ecological Risk Assessment (BERA) and Baseline Human Health Risk Assessment (BHHRA) Work Plans have been prepared based on the findings of the Phase I Site Characterization (EHS Support, 2017a; EHS Support, 2017b). Data to support the BERA and BHHRA will be collected as part of the Phase II Site Characterization and any additional phases of investigation deemed necessary.

The DQO-based sample size evaluation presented in this appendix was conducted to approximate minimum sample sizes needed to estimate unknown population parameters (e.g., mean, upper confidence limits) of constituents of potential ecological concern (COPECs) and constituents of potential concern (COPCs) in soil to support the BERA and BHHRA, respectively. The upper confidence limit of the mean ($UCL_{mean}$) concentrations for relevant soil intervals will be used to estimate exposure point concentrations (EPCs) for relevant ecological and human health receptors. The DQO-based sample size evaluation was conducted to approximate minimum sample sizes needed to support the calculation of EPCs for the BERA and BHHRA within specified performance criteria. This statistical evaluation was performed solely as an exercise for the Phase II dataset and sample size adequacy, and the refined ESVs used in this Appendix D have not yet been reviewed and approved by USEPA for use in the risk assessment. Refinement of ESVs for use in the risk assessment will need to be conducted as part of the risk assessment, and will be subject to USEPA review and approval.

The approach for approximating minimum sample sizes was developed consistent with *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006), with supplemental guidance provided in USEPA *ProUCL Version 5.1. Technical Guide* (USEPA, 2015). This appendix documents the statistical approach and presents approximate minimum sample sizes to support the calculation of EPCs in the BERA and BHHRA.

## 2.0 STATISTICAL APPROACH

The DQO-based sample size evaluation was conducted to assess whether existing Phase I Site Characterization data and proposed Phase II Site Characterization data provide sufficient data to calculate $UCL_{mean}$ EPCs for each exposure area within specified performance criteria. USEPA guidance for the calculation of $UCL_{mean}$ EPCs recommends a minimum of 8 to 10 observations as a general guideline for sample size estimation (USEPA, 2015). This general recommendation has been used to guide the development of representative sample sizes and represents a minimum sample size for most exposure areas. This section presents the approach for a more robust site-specific statistical evaluation of minimum sample sizes for each exposure area based on the variance observed in Phase I Site Characterization data.

The statistical approach for approximating minimum sample sizes is based on a DQO-based parametric minimum sample size formula incorporated into ProUCL Version 5.1 (ProUCL; USEPA, 2015). Soil data from the Phase I Site Characterization were used to estimate the representative sample standard deviation within each exposure area for input into the minimum sample size formula. The DQO-based minimum sample size formula is based on two primary assumptions: 1) the sample mean follows a normal distribution; and 2) soil samples are randomly collected from the same statistical population (e.g., area of concern). Soil sampling conducted during the Phase I Site Characterization was based primarily on a judgmental sampling scheme, particularly in Site operation areas (e.g., Main Plant Area, Central Landfills Area, Northern Percolation Ponds); therefore, soil datasets for these exposure areas may not satisfy the assumption of randomly collected samples. In undeveloped areas of the Site where there was no history of Site operations (e.g., Western Undeveloped Area, Eastern Undeveloped Area, North-Central Undeveloped Area), sample collection was not specifically biased to particular locations; therefore, soil datasets from these areas are likely more consistent with the assumption of random sample collection.

Given that Phase I Site Characterization soil datasets may not satisfy the assumptions of the DQO-based minimum sample size formula in all exposure areas, minimum sample sizes approximated using this approach are not intended to be prescriptive for each indicator constituent in the Phase II SAP sampling design. Rather, the minimum sample size estimates are intended to provide a basis for using professional judgment to evaluate the adequacy of the overall sampling design. Specific inputs into the DQO-based minimum sample size formula, specifically sample standard deviation and allowable error margin, may also result in sampling designs with extremely large estimates of samples sizes that are not practical or reasonable to implement from a level of effort and cost standpoint. In the cases of extreme sample size estimates, professional judgement and cost/benefit evaluation is needed to adjust tolerances to determine a sample size that is scientifically robust and feasible to implement (PNNL, 2014).

It is also important to note that the statistical evaluation of minimum sample sizes is one of several components considered in the development of the sampling design for the Phase II SAP. Other considerations include the spatial representativeness of RI data to characterize the nature and extent of soil constituents and an understanding of conceptual migration pathways from Site sources. The findings of the evaluation of minimum sample sizes are incorporated with these other considerations to inform the development of the Phase II sampling design.

Data analysis procedures for approximating minimum sample sizes based on existing Phase I Site Characterization data are illustrated in **Figure 1**. Data analysis procedures consist of two primary components discussed in the following sections: data pre-processing and minimum sample size estimation.

## 2.1 Data Pre-Processing

Data pre-processing included compilation and statistical characterization of Phase I Site Characterization soil data to support the approximation of minimum sample sizes. A subset of constituents identified during preliminary screening in the BERA and BHHRA Work Plans were selected as indicator constituents to assess minimum sample sizes for each exposure area. Indicator constituents used in the sample size estimation approach included cyanide, fluoride, copper, lead, nickel, zinc, benzo(a)pyrene, low molecular weight (LMW) polycyclic aromatic hydrocarbons (PAHs), and high molecular weight (HMW) PAHs. Indicator constituents were selected based on frequent exceedances of ecological screening values (ESVs) for soil in the Screening-Level Ecological Risk Assessment (SLERA) and COPEC refinement in the BERA Work Plan (Roux, 2017b; EHS Support, 2017a).

Available Phase I Site Characterization soil data from discrete samples were compiled for each indicator constituent within the ecological exposure areas identified in the BERA Work Plan. Soil data from the incremental soil sampling (ISS) program within the operational area were not included in the analysis because these data will be evaluated separately from data collected from discrete soil borings in the estimation of $UCL_{mean}$ EPCs in BERA and BHHRA (EHS Support, 2017a; EHS Support 2017b).

The boundaries of human health exposure areas varied slightly from ecological exposure areas, particularly the boundary between the Main Plant Area and Western Undeveloped Area. However, the differences in exposure area boundaries only affected the classification of approximately five soil boring stations; it was assumed that the difference in classification of these five samples would not materially affect minimum sample size approximation between BERA and BHHRA exposure areas. Minimum sample sizes were not approximated for the Northern Surface Water Feature due to the limited number of samples ($n = 2$) collected during the Phase I investigation.

Depth-weighted average concentrations of indicator constituents were calculated for sampling intervals within the 0-2 feet below ground surface (ft bgs) (0-0.5 ft and 0.5-2.0 ft) to provide a representative concentration for each soil boring station. Depth-weighted average concentrations for the 0-2 ft bgs sampling interval were calculated as follows:

$$C_{0-2ft} = C_{0-0.5ft} \times \frac{0.5ft}{2ft} + C_{0.5-2ft} \times \frac{1.5ft}{2ft}$$

where:

$C_{x\text{-}y\ ft}$ = Concentration of indicator constituent in sampling interval starting from *x* to *y* ft bgs.

Prior to approximating minimum sample sizes, summary statistics were estimated (e.g., mean, standard deviation) and goodness-of-fit tests were conducted in USEPA ProUCL to approximate the distribution of the soil datasets in each exposure area (i.e., normal distribution, lognormal distribution, gamma distribution, distribution free).

In addition to distribution testing, outlier testing was conducted to identify extreme values in the dataset (**Figure 1**). As stated above, a key assumption in the approximation of minimum sample size is that samples were randomly collected from the same statistical population (USEPA, 2015; USEPA, 2006). Given that Phase I Site Characterization soil data were collected based on a judgmental sampling design, outlier testing was conducted for data within each exposure area prior to minimum sample size approximation to evaluate extreme values that may influence minimum sample size estimates. Outlier testing was conducted in ProUCL using Rosner's ($n \geq 25$) or Dixon's test ($n < 25$), depending on the sample size of the Phase I dataset within each exposure area, specifying an alpha of 0.05 ($\alpha$=0.05). If outliers were identified, they

were removed from the dataset and goodness-of-fit tests were repeated on the modified dataset to approximate the data distribution (**Figure 1**). Outlier testing was not conducted in the following exposure areas due to insufficient sample size: Cedar Creek Reservoir Overflow Ditch, Eastern Undeveloped Area, Flathead River Riparian Area, and North-Central Undeveloped Area. Minimum sample sizes were approximated for complete and modified datasets, as described in **Section 2.2**.

## 2.2 Minimum Sample Size Estimation

Minimum sample sizes were approximated based on the formula presented in USEPA (2006) and used in ProUCL v. 5.1 software (USEPA, 2015) to compute minimum sample sizes (*n*) needed to estimate the mean for a specified confidence coefficient (CC, 1-α) and allowable error margin (Δ):

$$n = s^2 z^2_{1-(\alpha/2)} \,/\, \Delta^2 + z^2_{1-(\alpha/2)} \,/\, 2$$

where:

| | | |
|---|---|---|
| $s$ | = | Sample standard deviation. |
| α | = | False rejection rate (Type I decision error). |
| $z_{(1-\alpha)}$ | = | A value from a standard normal distribution for which the proportion of the distribution to the left of this value is 1 – α. |
| Δ | = | Allowable error margin in the estimate of the mean (allowable absolute difference between the estimate and the parameter). |

Minimum sample sizes were approximated for complete and modified datasets (outliers removed) based on the equation above using the R statistical software environment (CRAN R v. 3.4.2). Calculations were verified in ProUCL[1] for a subset of the calculations conducted in R. Sample standard deviations were estimated in ProUCL based on Phase I Site Characterization data for each exposure area. A false rejection rate (α) of 0.05 was used in calculations to establish a CC of 0.95.

The DQO-based minimum sample size formula in ProUCL assumes that soil data are normally distributed (USEPA 2015; USEPA, 2006). However, ProUCL does not provide an alternative non-parametric model for the approximation of minimum sample sizes of non-normal datasets. In the absence of an equivalent non-parametric model, minimum sample sizes were approximated for lognormal, gamma, or distribution free datasets using the minimum sample size formula in ProUCL. Minimum sample size estimates for non-normal datasets are qualified and should be used with caution due to greater uncertainty in the estimates because the distributional assumption is not satisfied. Further discussion of this uncertainty in the evaluation of minimum sample sizes for non-normal datasets is provided in **Section 3.3**.

Values for Δ were estimated based on ecological and human health risk-based benchmark concentrations (**Table 1**). Guidance on the estimation of Δ is limited in documents describing the approximation of minimum sample sizes (USEPA, 2015; USEPA, 2006). However, the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) recommends that an initial Δ value be selected and adjusted to develop a survey design that is appropriate for a specific Site (MARSSIM, 2000). As an arbitrary value, MARSSIM establishes one-half the value of a risk based criterion, the Derived Concentration Guidance Level (DCGL), as an initial estimate of Δ. Consistent with MARSSIM guidance, Δ values for the approximation of minimum sample sizes were estimated based on ecological and human health risk-based benchmark concentrations. Δ values were selected as the lower value of the ecological and human health benchmarks selected for each indicator constituent. Selecting the lower benchmark value indicates that

[1] Sample size estimates were conducted in ProUCL v. 5.1 using the function: Stats/Sample Sizes > DQO Based Sample Sizes > Estimate Mean, assuming a CC of 0.95.

approximate sample sizes would be adequate to estimate exposure terms (e.g., EPCs) for the BERA and BHHRA. A range of Δ values were established to evaluate the sensitivity of the selected Δ on the approximation of minimum sample sizes. For the analysis, Δ values were established as one-half Δ (Δ × 0.5), Δ, Δ × 2, and Δ × 3.

Ecological benchmark concentrations used to estimate Δ were based on ESVs established for soil during the COPEC refinement in the BERA Work Plan (EHS Support, 2017a; **Table 1**). BERA ESVs established in the COPEC refinement process were selected to be protective of chronic exposure to ecological receptor groups, but represent a broader range of no effect concentrations than the minimum ESVs used in the conservative SLERA screening process. BERA ESVs are considered conservative ecological benchmarks to support risk-based decision making in the BERA process.

Human health benchmark concentrations used to estimate Δ were based on risk-based screening criteria used in the preliminary selection of COPCs for the direct contact soil exposure pathway in the BHHRA Work Plan (EHS Support, 2017b), including the USEPA Regional Screening Levels (RSLs) for Residential Soil and Montana Department of Environmental Quality (MDEQ) Risk-Based Screening Level (RBSL) for Residential Surface Soil (**Table 1**).

Ecological benchmarks were lower than human health benchmarks for each indicator constituent, except benzo(a)pyrene. Therefore, human health benchmarks were used to estimate Δ for benzo(a)pyrene and ecological benchmarks were used to estimate Δ for all other indicator constituents (**Table 1**). Two direct contact human health benchmarks were used to estimate Δ for benzo(a)pyrene: MDEQ RBSL for Residential Surface Soil (0.018 mg/kg) and the USEPA RSL for Residential Soil (0.11 mg/kg), which was updated in June 2017. Both values were used to estimate Δ to evaluate the sensitivity of these benchmarks in approximating minimum sample sizes.

## 3.0 RESULTS AND DISCUSSION

The results of the minimum sample size evaluation are summarized by exposure area in **Table 1**. Approximate minimum sample sizes are presented for complete and modified (outliers removed) soil datasets. The proposed number of samples in the combined Phase I and Phase II investigation datasets are presented for comparison to approximate minimum sample sizes to evaluate the overall adequacy of the proposed sampling plan to support the calculation of exposure terms (e.g., EPCs) in the BERA and BHHRA. The distributions of indicator constituents are presented visually by exposure area in **Figures 2a – 2e**. The spatial distribution of identified outlying data points are illustrated in **Figures 3a – 3h**. The following sections present the results of the minimum sample size evaluation and discuss the uncertainty and limitations of the statistical approach.

### 3.1 Identification of Potential Outliers

Statistical outlier testing was conducted in ProUCL to identify potential outlying data points in the Phase I Site Characterization (see **Section 2.1**). The presence of outlying data points likely increases the sample standard deviation, which may result in extremely large estimates of minimum sample sizes for indicator constituents. Removal of outlier points reduces variability and may provide a more representative dataset for the exposure area in the approximation of minimum sample sizes.

As presented in **Table 1**, the results of outlier testing indicate that statistical outliers are primarily associated with exposure areas located in the operational areas of the Site, specifically the Main Plant Area, Central Landfills Area, and North Percolation Pond. As illustrated in **Figures 3a – 3h**, samples with results identified as statistical outliers within each exposure area were consistently located in the northern portion of the Main Plant, the southern portion of the Central Landfills Area, and the North Percolation Pond Area. The predominance of statistical outlier data points in this area of the Site may be attributed to the judgmental sampling design employed in the Phase I Site Characterization that biased sample collection to areas of known or suspected soil impacts associated with Site operations. The removal of outliers generally reduced estimates of sample standard deviation as extreme values were removed from the datasets; lower sample standard deviations resulted in lower minimum sample size approximations (**Table 1**).

### 3.2 Approximation of Minimum Sample Sizes

**Table 1** summarizes approximate minimum sample sizes for complete and modified datasets in each exposure area. Shaded cells in **Table 1** indicate the $\Delta$ values where the aggregate Phase I Site Characterization and proposed Phase II Site Characterization sample sizes exceed the approximated minimum sample sizes. Bold values in **Table 1** indicate the benchmark used as the basis for $\Delta$, which was selected as the lower of the ecological and human health benchmark values. The range of approximate minimum sample sizes based on the range of $\Delta$ values ($\Delta \times 0.5$ to $\Delta \times 3$) is presented to evaluate the sensitivity of the selected $\Delta$ value on the approximation of minimum sample sizes (**Table 1**). Minimum sample sizes associated with the range of $\Delta$ values provide an indication of potential uncertainty in estimating exposure terms for each constituent.

In general, the sensitivity of the minimum sample size approximation was related to the sample standard deviation and $\Delta$. As sample standard deviation increases or the value of $\Delta$ decreases, the approximate minimum sample size increases. Therefore, indicator constituents with the greatest minimum sample size approximations were constituents with low $\Delta$ values (e.g., cyanide, benzo(a)pyrene, LMW PAHs) relative to the sample standard deviation. The approximate minimum sample size for benzo(a)pyrene was highly sensitive to the human health benchmark selected as the $\Delta$ value (USEPA RSL for Residential Soil or

MDEQ RBSL for Residential Surface Soil), with estimated minimum sample sizes differing by one to two orders of magnitude, depending on the selected benchmark (**Table 1)**.

Brief summaries of the minimum sample size evaluations for each exposure area are presented below, with supporting detail presented in **Table 1**.

### *3.2.1 Main Plant Area*

Soil concentrations were not normally distributed for any indicator constituents in complete datasets from the Main Plant Area. Non-normal distributions and relatively high standard deviations for most constituents may be attributed to judgmental sampling in the Main Plain Area, resulting in right-skewed distributions (**Figures 2a – 2e**). Outliers were identified for each constituent in the Main Plant Area (**Table 1**). Removal of outliers resulted in normally distributed modified datasets for copper, lead, nickel, and zinc.

Aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates based on complete datasets for cyanide, copper, lead, nickel, zinc, and LMW PAHs at $\Delta \times 0.5$. Aggregate sample sizes satisfied the minimum sample size estimate for fluoride at $\Delta$ (**Table 1**). Minimum sample size estimates for benzo(a)pyrene and HMW PAHs exceeded aggregate sample sizes across the range of $\Delta$ values (**Table 1**). Sample size estimates for benzo(a)pyrene and HMW PAHs were extremely large due to high standard deviations relative to $\Delta$ values likely associated with lognormal, right-skewed datasets (**Figures 2e** and **2d**, respectively).

Based on modified Phase I datasets (outliers removed), aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates at $\Delta \times 0.5$ for each indicator constituent except benzo(a)pyrene and HMW PAHs (**Table 1**); minimum sample sizes estimated for HMW PAHs and benzo(a)pyrene based on the USEPA RSL for Residential Soil were satisfied by aggregate sample sizes at $\Delta \times 2$. The minimum sample size estimate for benzo(a)pyrene based on the MDEQ RBSL for Residential Surface Soil was two orders of magnitude greater than the estimate for the USEPA RSL for Residential Soil at the $\Delta \times 2$ value. Elevated sample size estimates for benzo(a)pyrene based on the MDEQ RBSL for Residential Surface Soil are attributed to its elevated standard deviation relative to $\Delta$ value.

### *3.2.2 Central Landfills Area*

Similar to the Main Plant Area, soil concentrations were not normally distributed for any indicator constituents in complete datasets from the Central Landfills Area. With the exception of fluoride, outliers were identified for each constituent in the Central Landfills Area (**Table 1**). Removal of outliers resulted in normally distributed modified datasets for copper, lead, and nickel.

Aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates based on complete Phase I datasets for cyanide, fluoride, lead, nickel, and zinc at $\Delta \times 0.5$. Aggregate sample sizes satisfied the minimum sample size estimate for total LMW PAHs at $\Delta \times 2$ (**Table 1**). Minimum sample size estimates for copper, benzo(a)pyrene, and HMW PAHs exceeded aggregate sample sizes across the range of $\Delta$ values (**Table 1**). Sample size estimates for copper (**Figure 2b**), benzo(a)pyrene (**Figure 2e**), and HMW PAHs (**Figure 2d**) were extremely large due to high standard deviations relative to $\Delta$ values likely associated with lognormal, right-skewed datasets.

Based on modified Phase I datasets (outliers removed), aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates at $\Delta \times 0.5$ for each indicator constituent except benzo(a)pyrene (**Table 1**). Low sample size estimates for copper

based on the modified dataset relative to the complete dataset indicate the importance of outlier points in elevating the standard deviation and associated sample size estimates (**Figure 2b**). Minimum sample sizes estimated for benzo(a)pyrene based on the USEPA RSL for Residential Soil were satisfied by aggregate sample sizes at Δ. The minimum sample size estimate for benzo(a)pyrene based on the MDEQ RBSL for Residential Surface Soil was an order of magnitude greater than the estimate for the USEPA RSL for Residential Soil at the Δ value. Elevated sample size estimates for benzo(a)pyrene based on the MDEQ RBSL for Residential Surface Soil are attributed to its elevated standard deviation relative to Δ value.

### *3.2.3 North Percolation Pond Area*

Soil concentrations were not normally distributed for cyanide, lead, nickel, zinc, or LMW PAHs in complete datasets from the North Percolation Pond. Removal of outliers resulted in normally distributed modified datasets for cyanide, nickel, zinc, and LMW PAHs; no outliers were identified for lead.

Aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates at Δ × 0.5 for copper based on complete Phase I datasets. Aggregate sample sizes satisfied the minimum sample size estimate for fluoride, lead, and zinc at Δ × 2 (**Table 1**). Minimum sample size estimates for cyanide, nickel, benzo(a)pyrene, LMW PAHs, and HMW PAHs exceeded aggregate sample sizes across the range of Δ values (**Table 1**). Sample size estimates for cyanide (**Figure 2a**), benzo(a)pyrene (**Figure 2e**), and HMW PAHs (**Figure 2d**) were extremely large due to high standard deviations relative to Δ values likely associated with lognormal, right-skewed datasets.

Based on modified Phase I datasets (outliers removed), aggregate sample sizes satisfied minimum sample size estimates for copper at Δ × 0.5, nickel and zinc at Δ, and cyanide and LMW PAHs at Δ × 3 (**Table 1**). Lower sample size estimates for cyanide based on the modified dataset relative to the complete dataset indicate the importance of outlier points in elevating the standard deviation and associated sample size estimates (**Figure 2a**). Minimum sample sizes estimated for HMW PAHs were extremely large due to high standard deviations relative to Δ in modified datasets following the removal outliers. Given the limitations in sample size estimates for benzo(a)pyrene and HMW PAHs, there is limited practical use for minimum sample size estimates for these constituents in the North Percolation Pond.

### *3.2.4 Cedar Creek Reservoir Overflow Ditch*

Except fluoride, each indicator constituent had a normal distribution in the complete dataset in the Cedar Creek Reservoir Overflow Ditch. Aggregate sample sizes from the Phase I Site Characterization and proposed Phase II Site Characterization satisfied minimum sample size estimates at Δ × 0.5 for fluoride, copper, lead, nickel, zinc, and LMW PAHs based on complete Phase I datasets; the estimated minimum sample sizes for cyanide and HMW PAHs were satisfied at Δ × 3 (**Table 1**). Minimum sample size estimates for benzo(a)pyrene and HMW PAHs were relatively large due to high sample standard deviations relative to Δ.

### *3.2.5 South Percolation Pond Area*

Based on complete datasets, all indicator constituents evaluated in the South Percolation Pond Area fit a gamma distribution; after the removal of a single outlier for cyanide, the modified dataset for cyanide was normally distributed.

Based on aggregate Phase I and Phase II sample sizes, minimum sample size estimates were satisfied at the Δ × 0.5 value for fluoride, lead, nickel, zinc, benzo(a)pyrene (USEPA RSL), HMW PAHs, and LMW

PAHs. Minimum sample size estimates for cyanide and copper were satisfied at the Δ value; the minimum sample size estimate for benzo(a)pyrene (MDEQ RBSL) was satisfied at Δ × 3 (**Table 1**).

### *3.2.6 Flathead River Riparian Area*

Soil datasets were normally distributed for all indicator constituents in the Flathead River Riparian Area based on complete datasets. Aggregate sample sizes for existing Phase I and proposed Phase II datasets satisfy minimum sample size estimates for all indicator constituents except benzo(a)pyrene (MDEQ RBSL) at the Δ × 0.5 value. The estimated minimum sample size for benzo(a)pyrene (MDEQ RBSL) was satisfied at Δ × 2 (**Table 1**).

### *3.2.7 Eastern Undeveloped Area*

With the exception of cyanide, copper, and fluoride, complete datasets for indicator constituents were normally distributed in the Eastern Undeveloped Area. Aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates for the Eastern Undeveloped Area at the Δ × 0.5 value for all indicator constituents, except benzo(a)pyrene and HMW PAHs in complete datasets (**Table 1**). Aggregate sample sizes for HMW PAHs and benzo(a)pyrene (USEPA RSL) were satisfied at Δ × 2 values. However, the minimum sample size estimate for benzo(a)pyrene (MDEQ RBSL) was an order of magnitude greater than the estimate for benzo(a)pyrene (USEPA RSL) at the Δ × 2 value.

### *3.2.8 North-Central Undeveloped Area*

With the exception of cyanide and nickel, complete datasets for indicator constituents were normally distributed in the North-Central Undeveloped Area. Based on sample estimates from complete datasets, aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates for all indicator constituents except benzo(a)pyrene (MDEQ RBSL) at the Δ × 0.5 value. The minimum sample size estimate for benzo(a)pyrene (MDEQ RBSL) was satisfied at the Δ value (**Table 1**).

### *3.2.9 Western Undeveloped Area*

Soil concentrations were not normally distributed for any indicator constituents in complete datasets from the Western Undeveloped Area. The removal of outliers for resulted in normally distributed modified datasets for cyanide and zinc; other constituents were lognormal or did not follow a distribution (none) in modified datasets (**Table 1**). Based on sample estimates from complete datasets, aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates for all indicator constituents at Δ × 0.5 in the Western Undeveloped Area (**Table 1**).

## 3.3 Uncertainty and Limitations

The minimum sample size estimates presented in the preceding sections were based on model parameter/statistical assumptions and study design assumptions. These assumptions may introduce uncertainty and limit the utility of some results in the practical planning and implementation of the Phase II SAP. Uncertainties and limitations associated with model parameter/statistical assumptions are summarized below:

- Non-normal distributions: An assumption of the DQO-based minimum sample size formula in ProUCL is that the sample mean follows a normal distribution; ProUCL does not provide a formula for the estimation of sample sizes for datasets that do not follow a normal distribution. In the absence of an equivalent non-parametric approach, sample sizes were estimated for all distributions using the parametric formula and the interpretation of minimum sample size estimates was qualified

for distributions not fitting a normal distribution. The result of this assumption is likely an overestimation of minimum sample sizes in non-normal datasets with right-skewed distributions, particularly datasets from the Site operation areas (e.g., Main Plant Area, Central Landfill Area, Northern Percolation Ponds) where Phase I Site Characterization sampling was biased to areas of known or suspected impacts from Site operations.

- Allowable error margin (Δ value): The approximation of minimum sample sizes was highly sensitive to the selection of the Δ value to establish the allowable error margin for the estimation of the mean. As previously stated, guidance on the estimation of Δ is limited in documents describing the approximation of minimum sample sizes (USEPA, 2015; USEPA, 2006). For this analysis, an initial Δ value was established based on the lower value of human health and ecological risk-based benchmarks. A range of Δ values was established (Δ × 0.5, Δ, Δ × 2, and Δ × 3) to evaluate the sensitivity of the selected Δ on the approximation of minimum sample sizes. Minimum sample sizes estimated based on the range of Δ values also enabled an evaluation of the uncertainty in estimating $UCL_{mean}$ EPCs based on aggregate Phase I and Phase II sample sizes.
- Suitability of *s* value: The minimum sample size evaluation assumes that the sample standard deviation adequately reflects the population standard deviation. The representativeness of the sample standard deviation in relation to the population standard deviation is largely associated with the uncertainty in study design assumptions, as discussed below.

Uncertainties and limitations associated with study design assumptions are summarized below:

- Phase I Site Characterization sampling design: Another assumption of the DQO-based parametric minimum sample size formula in ProUCL is that soil samples are randomly collected from the same statistical population. As previously stated, soil sampling conducted during the Phase I Site Characterization was based primarily on a judgmental sampling scheme. The uncertainty associated with this assumption is likely greatest in Site operation areas (e.g., Main Plant Area, Central Landfill Area, Northern Percolation Ponds) where sample collection was biased to areas of known or suspected impacts. There is likely less uncertainty associated with this assumption in undeveloped areas of the Site (e.g., Western Undeveloped Area, Eastern Undeveloped Area, North-Central Undeveloped Area) where sample collection was not specifically biased to particular locations because there was no history of Site operations.
- Spatial representativeness: As previously stated, statistical considerations are only one element in designing a sampling program to achieve RI/FS objectives, including the DQO-based performance criteria for estimating $UCL_{mean}$ EPCs. The analyses presented in this appendix consider only the statistical aspects of minimum sample size estimation. Minimum sample size estimates presented in **Table 1** do not take into account the size of exposure areas and the number of samples necessary to characterize the nature and extent of soil constituents based on conceptual migration pathways from potential source areas. Minimum sample size estimates presented in this appendix are intended to inform the overall development of a Phase II sampling design that also considers the spatial characterization of constituents in soil within each exposure area.
- General minimum sample size guideline: As previously stated, a minimum of 8 to 10 observations is recommended as a general guideline for sample size estimation to calculate $UCL_{mean}$ EPCs (USEPA, 2015). Based on the exposure area-specific evaluation of minimum sample sizes, the general guideline provides sufficient sample sizes to estimate $UCL_{mean}$ EPCs for many constituents in exposure areas where sample standard deviations are low relative to Δ. However, for constituents with high sample standard deviations relative to Δ, the general guideline may be inadequate and, as presented in this appendix, an exposure area-specific evaluation is warranted to estimate minimum sample sizes to satisfy performance criteria for estimating $UCL_{mean}$ EPCs.

## 4.0 SUMMARY

This appendix presents the findings of a DQO-based sample size evaluation to assess whether existing Phase I Site Characterization data and proposed Phase II Site Characterization data provide sufficient data to calculate $UCL_{mean}$ EPCs to support the BERA and BHHRA for the Site. A summary of key findings of the minimum sample size evaluation is presented below:

- The sensitivity of the minimum sample size approximation was related to the sample standard deviation and Δ. As sample standard deviation increases or the value of Δ decreases, the approximate minimum sample size increases. Therefore, the greatest minimum sample size approximations were for constituents with low Δ values (e.g., cyanide, benzo(a)pyrene, LMW PAHs) relative to the sample standard deviation.
- The approximate minimum sample size for benzo(a)pyrene was highly sensitive to the human health benchmark selected as the Δ value (USEPA RSL for Residential Soil or MDEQ RBSL for Residential Surface Soil), with estimated minimum sample sizes differing by one to two orders of magnitude, depending on the selected benchmark used as the basis for Δ.
- Greatest minimum sample sizes were estimated for benzo(a)pyrene and HMW PAHs in the North Percolation Pond. Extremely large approximated minimum sample sizes for these constituents are attributed to low Δ values relative to elevated sample standard deviations. The greater variability observed in these datasets may have resulted from non-random, judgmental sampling that was biased towards areas of known or suspected impacts in these areas. Given these limitations, there is limited practical use for minimum sample size estimates for benzo(a)pyrene and HMW PAHs in the North Percolation Pond.
- Extremely large minimum sample sizes were also estimated for benzo(a)pyrene and HMW PAHs in the Central Landfills Area and Main Plant Area based on complete datasets. However, removal of outlying data points reduced sample standard deviations such that aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates based on modified datasets at $\Delta \times 0.5$ for most constituents and at $\Delta \times 2$ for all constituents evaluated within these exposure areas.
- For exposure areas outside of site operational areas, aggregate Phase I and Phase II sample sizes satisfied minimum sample size requirements based on $\Delta \times 0.5$ in most cases, except for benzo(a)pyrene. Minimum sample size estimates for the Cedar Creek Overflow Ditch, South Percolation Pond Area, Flathead River Riparian Area, and undeveloped site areas (Eastern, Western, and North-Central) were low relative to site operational areas due to lower sample standard deviations for most constituents. In large, undeveloped areas of the Site, sample size selection may be driven more by the need to ensure adequate spatial representativeness and characterize conceptual migration pathways than statistical considerations based on sample standard deviation.
- Minimum sample size estimates for metals (copper, lead, nickel, and zinc) were relatively low throughout the Site exposure areas; aggregate Phase I and Phase II sample sizes satisfied minimum sample size estimates for these metals at $\boldsymbol{\Delta} \times 0.5$ in most cases.
- Several sources of uncertainty and limitations associated with estimated minimum sample sizes were identified, including: the use of a parametric sample size formula on non-parametric datasets, the sensitivity of the Δ value in estimating minimum sample sizes, the use of non-random data in estimating sample standard deviation, and considerations of spatial representativeness of data in addition to statistical considerations.

The results of the minimum sample size evaluation presented in this appendix indicate that data from existing Phase I samples and proposed Phase II samples will provide sufficient data to calculate $UCL_{mean}$ EPCs within allowable error margins for most cases. From a statistical standpoint, there is low uncertainty in the estimation of $UCL_{mean}$ EPCs in exposure areas outside of site operational areas (e.g., undeveloped areas) where overall variability in constituent concentrations are low. Greater uncertainty was identified for

the estimation of $UCL_{mean}$ EPCs for constituents in exposure areas near site operations (e.g., North Percolation Pond, Central Landfills Area, Main Plant Area) where overall variability in constituent concentrations was greater. However, with the exception of HMW PAHs and benzo(a)pyrene in the North Percolation Pond, aggregate Phase I and Phase II samples satisfied minimum sample sizes estimates based on $\boldsymbol{\Delta} \times 0.5$ for most constituents and $\boldsymbol{\Delta} \times 3$ for other constituents.

Minimum sample sizes approximated using the statistical approach presented in this appendix are not intended to be prescriptive for each indicator constituent in the Phase II SAP sampling design. Rather, the minimum sample size estimates are intended to provide a basis for using professional judgment to evaluate the adequacy of the overall sampling design. The statistical aspects of the minimum sample size estimation should be considered in conjunction with an evaluation of the spatial representativeness of data and an understanding of the conceptual site model to support the development of a soil sampling design for the Phase II SAP.

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# TABLES

**Table 1**
**Estimates of Minimum Sample Sizes to Calculate Upper Confidence Limit of the Mean Exposure Point Concentrations**
**Appendix D - Phase 2 Sampling Analysis Plan**
**Columbia Falls Aluminum Company**
**Columbia Falls, Montana**

| Exposure Area | Phase 1 Site Characterization Dataset[1] | | Allowable Error Margin (Δ)[3] | | Complete Dataset - No Outliers Removed[5] | | | | | | | Modified Dataset - Outliers Removed[5,7] | | | | | | | Phase 2 Investigation Sample Size Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | |
| Chemical Name | Number of Stations | Number of Potential Statistical Outliers[2] | Ecological Benchmark (mg/kg) | Human Health Benchmark (mg/kg) | Data Distribution[4] | Raw Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Data Distribution[6] | Untransformed Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Proposed Phase 2 Sample Size[8] | Aggregate Phase 1/ Phase 2 Sample Size[9] |
| ***MAIN PLANT AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 65 | 7 | **0.183** | 2.3 | Lognormal | 0.31 | 1.08 | 47 | 14 | 5 | 4 | Gamma | 0.04 | 0.76 | 3 | 3 | 2 | 2 | 15 | 80 |
| Fluoride | 65 | 7 | **30** | 310 | Lognormal | 75.7 | 1.02 | 100 | 27 | 9 | 5 | Gamma | 23.99 | 0.84 | 12 | 5 | 3 | 3 | 15 | 80 |
| Copper | 65 | 2 | **28** | 310 | None | 5.39 | 0.31 | 3 | 3 | 2 | 2 | Normal | 3.47 | 0.26 | 3 | 2 | 2 | 2 | 15 | 80 |
| Lead | 65 | 9 | **15.3** | NA | None | 8.83 | 0.5 | 8 | 4 | 3 | 3 | Normal | 3.04 | 0.32 | 3 | 3 | 2 | 2 | 15 | 80 |
| Nickel | 65 | 7 | **38** | 150 | None | 14.34 | 0.5 | 5 | 3 | 3 | 2 | Normal | 3.29 | 0.27 | 3 | 2 | 2 | 2 | 15 | 80 |
| Zinc | 65 | 2 | **60.5** | 2300 | Lognormal | 26.75 | 0.38 | 5 | 3 | 3 | 3 | Normal | 13.15 | 0.29 | 3 | 3 | 2 | 2 | 15 | 80 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 65 | 10 | 1.52 | **0.018** | Lognormal | 7.83 | 1.98 | >10,000 | >10,000 | >10,000 | >10,000 | Lognormal | 0.75 | 1.53 | >10,000 | 6658 | 1666 | 742 | 15 | 80 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 65 | 10 | 1.52 | **0.11** | Lognormal | 7.83 | 1.98 | >10,000 | >10,000 | 4866 | 2164 | Lognormal | 0.75 | 1.53 | 715 | 181 | 47 | 22 | 15 | 80 |
| Total HMW PAHs | 65 | 10 | **1.1** | NA | Lognormal | 65.85 | 1.92 | >10,000 | >10,000 | 3445 | 1532 | Lognormal | 6.69 | 1.47 | 571 | 145 | 38 | 18 | 15 | 80 |
| Total LMW PAHs | 65 | 10 | **29** | NA | Lognormal | 24.36 | 1.89 | 13 | 5 | 3 | 3 | Lognormal | 2.25 | 1.4 | 3 | 2 | 2 | 2 | 15 | 80 |
| ***CENTRAL LANDFILLS AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 27 | 5 | **0.183** | 2.3 | Lognormal | 0.21 | 1.2 | 22 | 7 | 4 | 3 | Lognormal | 0.03 | 0.73 | 3 | 3 | 2 | 2 | 8 | 35 |
| Fluoride | 27 | 0 | **30** | 310 | Lognormal | 42.28 | 0.86 | 33 | 10 | 4 | 3 | | | | | | | | 8 | 35 |
| Copper | 27 | 4 | **28** | 310 | None | 351.33 | 0.99 | 2422 | 607 | 154 | 70 | Normal | 3.11 | 0.23 | 3 | 2 | 2 | 2 | 8 | 35 |
| Lead | 27 | 2 | **15.3** | NA | None | 3.81 | 0.29 | 3 | 3 | 2 | 2 | Normal | 2.58 | 0.23 | 3 | 3 | 2 | 2 | 8 | 35 |
| Nickel | 27 | 7 | **38** | 150 | None | 7.38 | 0.39 | 3 | 3 | 2 | 2 | Normal | 1.93 | 0.17 | 2 | 2 | 2 | 2 | 8 | 35 |
| Zinc | 27 | 4 | **60.5** | 2300 | Lognormal | 20.08 | 0.33 | 4 | 3 | 3 | 2 | Lognormal | 8.3 | 0.19 | 3 | 2 | 2 | 2 | 8 | 35 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 27 | 3 | 1.52 | **0.018** | Lognormal | 15.56 | 1.77 | >10,000 | >10,000 | >10,000 | >10,000 | Lognormal | 0.3 | 1.12 | 4389 | 1099 | 277 | 124 | 8 | 35 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 27 | 3 | 1.52 | **0.11** | Lognormal | 15.56 | 1.77 | >10,000 | >10,000 | >10,000 | 8548 | Lognormal | 0.3 | 1.12 | 120 | 32 | 10 | 6 | 8 | 35 |
| Total HMW PAHs | 27 | 10 | **1.1** | NA | Lognormal | 133.2 | 1.73 | >10,000 | >10,000 | >10,000 | 6261 | Lognormal | 1.01 | 0.74 | 15 | 6 | 3 | 3 | 8 | 35 |
| Total LMW PAHs | 27 | 4 | **29** | NA | Lognormal | 110.48 | 1.85 | 225 | 58 | 16 | 9 | Lognormal | 0.73 | 0.97 | 2 | 2 | 2 | 2 | 8 | 35 |
| ***NORTH PERCOLATION POND AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 11 | 3 | **0.183** | 2.3 | Log-Normal | 38.13 | 2.02 | >10,000 | >10,000 | >10,000 | >10,000 | Normal | 0.99 | 1.15 | 454 | 115 | 31 | 15 | 7 | 18 |
| Fluoride | 11 | 0 | **30** | 310 | Normal | 71.70 | 0.81 | 90 | 24 | 8 | 5 | | | | | | | | 7 | 18 |
| Copper | 11 | 1 | **28** | 310 | Normal | 21.90 | 0.70 | 12 | 5 | 3 | 3 | Normal | 14.61 | 0.62 | 7 | 3 | 3 | 3 | 7 | 18 |
| Lead | 11 | 0 | **15.3** | NA | Log-Normal | 55.90 | 1.02 | 208 | 54 | 15 | 8 | | | | | | | | 7 | 18 |
| Nickel | 11 | 2 | **38** | 150 | Log-Normal | 242.36 | 1.09 | 627 | 159 | 41 | 20 | Normal | 77.23 | 0.79 | 66 | 18 | 6 | 4 | 7 | 18 |
| Zinc | 11 | 1 | **60.5** | 2300 | Log-Normal | 227.82 | 0.74 | 220 | 57 | 16 | 8 | Normal | 88.40 | 0.54 | 35 | 11 | 4 | 3 | 7 | 18 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 11 | 0 | 1.52 | **0.018** | Normal | 54.99 | 1.63 | >10,000 | >10,000 | >10,000 | >10,000 | | | | | | | | 7 | 18 |
| Benzo(A)Pyrene$_{EPA\ RSL}$ | 11 | 0 | 1.52 | **0.11** | Normal | 54.99 | 1.63 | >10,000 | >10,000 | >10,000 | >10,000 | | | | | | | | 7 | 18 |
| Total HMW PAHs | 11 | 1 | **1.1** | NA | Normal | 744.15 | 1.64 | >10,000 | >10,000 | >10,000 | >10,000 | Normal | 433.28 | 1.53 | >10,000 | >10,000 | >10,000 | >10,000 | 7 | 18 |
| Total LMW PAHs | 11 | 1 | **29** | NA | Log-Normal | 464.56 | 1.93 | 3946 | 988 | 249 | 112 | Normal | 136.79 | 1.69 | 344 | 88 | 24 | 12 | 7 | 18 |

**Table 1**
**Estimates of Minimum Sample Sizes to Calculate Upper Confidence Limit of the Mean Exposure Point Concentrations**
**Appendix D - Phase 2 Sampling Analysis Plan**
**Columbia Falls Aluminum Company**
**Columbia Falls, Montana**

| Exposure Area | Phase 1 Site Characterization Dataset[1] | | Allowable Error Margin (Δ)[3] | | Complete Dataset - No Outliers Removed[5] | | | | | | | Modified Dataset - Outliers Removed[5,7] | | | | | | | Phase 2 Investigation Sample Size Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | |
| Chemical Name | Number of Stations | Number of Potential Statistical Outliers[2] | Ecological Benchmark (mg/kg) | Human Health Benchmark (mg/kg) | Data Distribution[4] | Raw Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Data Distribution[6] | Untransformed Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Proposed Phase 2 Sample Size[8] | Aggregate Phase 1/ Phase 2 Sample Size[9] |
| ***CEDAR CREEK RESERVOIR OVERFLOW DITCH*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 5 | NC | **0.183** | 2.3 | Normal | 0.49 | 0.66 | 114 | 30 | 9 | 6 | | | | | | | | 3 | 8 |
| Fluoride | 5 | NC | **30** | 310 | Log-Normal | 1.21 | 0.46 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 8 |
| Copper | 5 | NC | **28** | 310 | Normal | 3.34 | 0.14 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 8 |
| Lead | 5 | NC | **15.3** | NA | Normal | 2.79 | 0.18 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 8 |
| Nickel | 5 | NC | **38** | 150 | Normal | 11.10 | 0.40 | 4 | 3 | 3 | 2 | | | | | | | | 3 | 8 |
| Zinc | 5 | NC | **60.5** | 2300 | Normal | 30.55 | 0.33 | 6 | 3 | 3 | 3 | | | | | | | | 3 | 8 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 5 | NC | 1.52 | **0.018** | Normal | 0.47 | 1.16 | >10,000 | 2632 | 660 | 295 | | | | | | | | 3 | 8 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 5 | NC | 1.52 | **0.11** | Normal | 0.47 | 1.16 | 284 | 73 | 20 | 10 | | | | | | | | 3 | 8 |
| Total HMW PAHs | 5 | NC | **1.1** | NA | Normal | 4.02 | 1.14 | 207 | 54 | 15 | 8 | | | | | | | | 3 | 8 |
| Total LMW PAHs | 5 | NC | **29** | NA | Normal | 0.90 | 1.10 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 8 |
| ***SOUTH PERCOLATION POND AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 12 | 1 | **0.183** | 2.3 | Gamma | 0.33 | 0.97 | 53 | 15 | 6 | 4 | Normal | 0.15 | 0.86 | 13 | 5 | 3 | 3 | 5 | 17 |
| Fluoride | 12 | 0 | **30** | 310 | Gamma | 8.72 | 1.05 | 4 | 3 | 3 | 2 | | | | | | | | 5 | 17 |
| Copper | 12 | 0 | **28** | 310 | Gamma | 36.33 | 1.00 | 28 | 9 | 4 | 3 | | | | | | | | 5 | 17 |
| Lead | 12 | 0 | **15.3** | NA | Gamma | 3.84 | 0.51 | 3 | 3 | 2 | 2 | | | | | | | | 5 | 17 |
| Nickel | 12 | 0 | **38** | 150 | Gamma | 3.18 | 0.37 | 3 | 2 | 2 | 2 | | | | | | | | 5 | 17 |
| Zinc | 12 | 0 | **60.5** | 2300 | Gamma | 23.15 | 0.52 | 5 | 3 | 3 | 2 | | | | | | | | 5 | 17 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 12 | 0 | 1.52 | **0.018** | Gamma | 0.10 | 1.15 | 435 | 111 | 29 | 14 | | | | | | | | 5 | 17 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 12 | 0 | 1.52 | **0.11** | Gamma | 0.10 | 1.15 | 14 | 5 | 3 | 3 | | | | | | | | 5 | 17 |
| Total HMW PAHs | 12 | 0 | **1.1** | NA | Gamma | 1.03 | 1.00 | 16 | 6 | 3 | 3 | | | | | | | | 5 | 17 |
| Total LMW PAHs | 12 | 0 | **29** | NA | Gamma | 0.18 | 0.69 | 2 | 2 | 2 | 2 | | | | | | | | 5 | 17 |
| ***FLATHEAD RIVER RIPARIAN AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 4 | NC | **0.183** | 2.3 | Normal | 0.03 | 0.80 | 3 | 3 | 2 | 2 | | | | | | | | 14 | 18 |
| Fluoride | 4 | NC | **30** | 310 | Normal | 4.65 | 0.54 | 3 | 3 | 2 | 2 | | | | | | | | 14 | 18 |
| Copper | 4 | NC | **28** | 310 | Normal | 2.92 | 0.20 | 3 | 2 | 2 | 2 | | | | | | | | 14 | 18 |
| Lead | 4 | NC | **15.3** | NA | Normal | 1.35 | 0.15 | 3 | 2 | 2 | 2 | | | | | | | | 14 | 18 |
| Nickel | 4 | NC | **38** | 150 | Normal | 1.42 | 0.11 | 2 | 2 | 2 | 2 | | | | | | | | 14 | 18 |
| Zinc | 4 | NC | **60.5** | 2300 | Normal | 4.56 | 0.12 | 3 | 2 | 2 | 2 | | | | | | | | 14 | 18 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 4 | NC | 1.52 | **0.018** | Normal | 0.04 | 0.72 | 79 | 22 | 7 | 5 | | | | | | | | 14 | 18 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 4 | NC | 1.52 | **0.11** | Normal | 0.04 | 0.72 | 4 | 3 | 3 | 2 | | | | | | | | 14 | 18 |
| Total HMW PAHs | 4 | NC | **1.1** | NA | Normal | 0.39 | 0.71 | 4 | 3 | 3 | 2 | | | | | | | | 14 | 18 |
| Total LMW PAHs | 4 | NC | **29** | NA | Normal | 0.07 | 0.50 | 2 | 2 | 2 | 2 | | | | | | | | 14 | 18 |

**Table 1**
**Estimates of Minimum Sample Sizes to Calculate Upper Confidence Limit of the Mean Exposure Point Concentrations**
**Appendix D - Phase 2 Sampling Analysis Plan**
**Columbia Falls Aluminum Company**
**Columbia Falls, Montana**

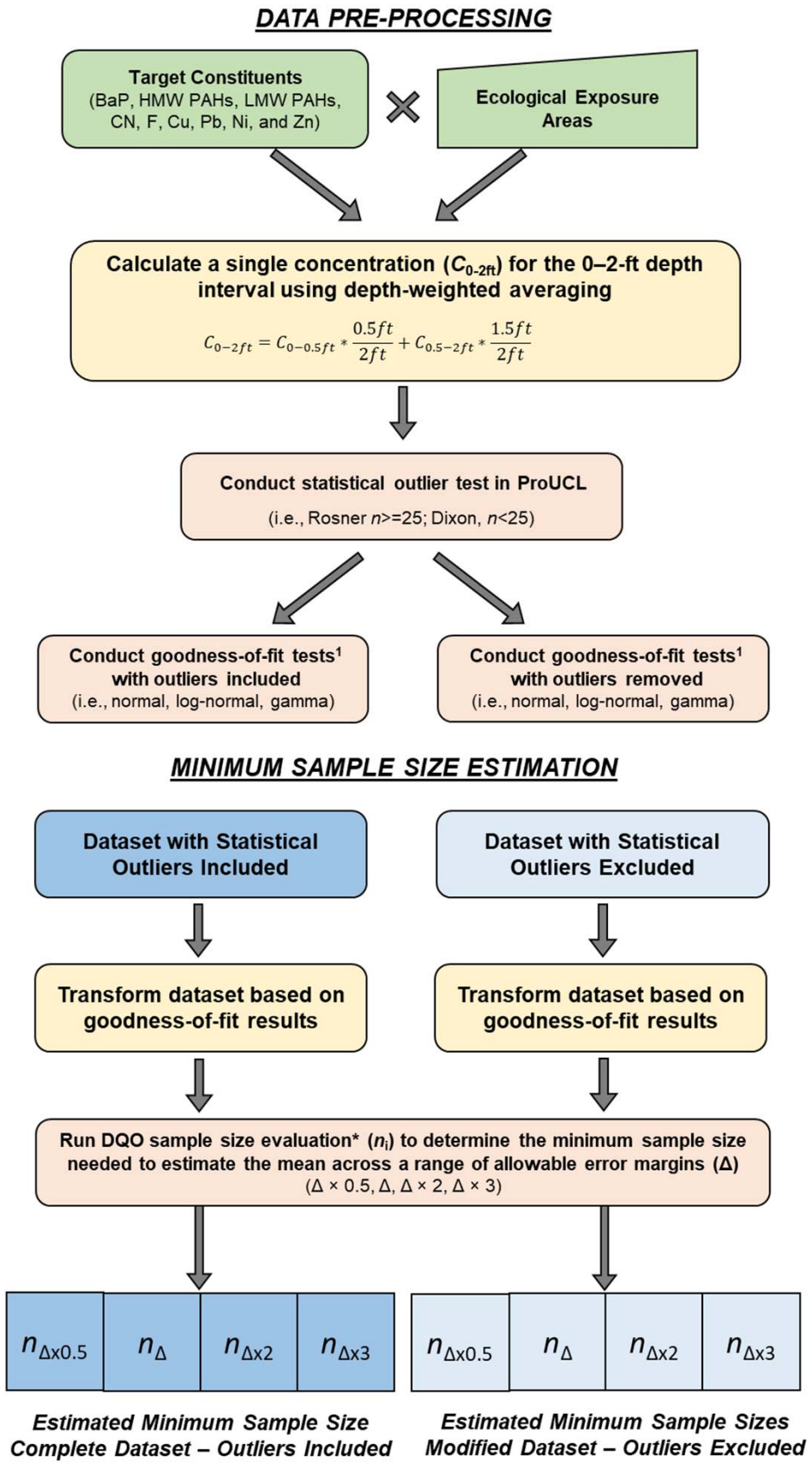
| Exposure Area | Phase 1 Site Characterization Dataset[1] | | Allowable Error Margin (Δ)[3] | | Complete Dataset - No Outliers Removed[5] | | | | | | | Modified Dataset - Outliers Removed[5,7] | | | | | | | Phase 2 Investigation Sample Size Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | Sample Standard Deviation | | Minimum Estimated Sample Size (*n*) | | | | | |
| Chemical Name | Number of Stations | Number of Potential Statistical Outliers[2] | Ecological Benchmark (mg/kg) | Human Health Benchmark (mg/kg) | Data Distribution[4] | Raw Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Data Distribution[6] | Untransformed Data (mg/kg) | Ln-Transformed Data (mg/kg) | Δ x 0.5 | Δ | Δ x 2 | Δ x 3 | Proposed Phase 2 Sample Size[8] | Aggregate Phase 1/ Phase 2 Sample Size[9] |
| ***EASTERN UNDEVELOPED AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 7 | NC | **0.183** | 2.3 | Gamma | 0.15 | 0.95 | 12 | 5 | 3 | 3 | | | | | | | | 12 | 19 |
| Fluoride | 7 | NC | **30** | 310 | Log-Normal | 15.68 | 0.44 | 7 | 3 | 3 | 3 | | | | | | | | 12 | 19 |
| Copper | 7 | NC | **28** | 310 | None | 6.94 | 0.49 | 3 | 3 | 2 | 2 | | | | | | | | 12 | 19 |
| Lead | 7 | NC | **15.3** | NA | Normal | 2.31 | 0.22 | 3 | 3 | 2 | 2 | | | | | | | | 12 | 19 |
| Nickel | 7 | NC | **38** | 150 | Normal | 2.89 | 0.22 | 3 | 2 | 2 | 2 | | | | | | | | 12 | 19 |
| Zinc | 7 | NC | **60.5** | 2300 | Normal | 6.44 | 0.11 | 3 | 2 | 2 | 2 | | | | | | | | 12 | 19 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 7 | NC | 1.52 | **0.018** | Normal | 0.32 | 1.44 | 4902 | 1227 | 309 | 139 | | | | | | | | 12 | 19 |
| Benzo(A)Pyrene$_{EPA\ RSL}$ | 7 | NC | 1.52 | **0.11** | Normal | 0.32 | 1.44 | 134 | 35 | 11 | 6 | | | | | | | | 12 | 19 |
| Total HMW PAHs | 7 | NC | **1.1** | NA | Normal | 3.73 | 1.42 | 179 | 47 | 13 | 7 | | | | | | | | 12 | 19 |
| Total LMW PAHs | 7 | NC | **29** | NA | Normal | 0.64 | 1.25 | 2 | 2 | 2 | 2 | | | | | | | | 12 | 19 |
| ***NORTH-CENTRAL UNDEVELOPED AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 4 | NC | **0.183** | 2.3 | Log-Normal | 0.06 | 0.61 | 4 | 3 | 3 | 2 | | | | | | | | 7 | 11 |
| Fluoride | 4 | NC | **30** | 310 | Normal | 9.05 | 0.50 | 4 | 3 | 3 | 2 | | | | | | | | 7 | 11 |
| Copper | 4 | NC | **28** | 310 | Normal | 3.01 | 0.20 | 3 | 2 | 2 | 2 | | | | | | | | 7 | 11 |
| Lead | 4 | NC | **15.3** | NA | Normal | 1.51 | 0.15 | 3 | 2 | 2 | 2 | | | | | | | | 7 | 11 |
| Nickel | 4 | NC | **38** | 150 | None | 1.02 | 0.10 | 2 | 2 | 2 | 2 | | | | | | | | 7 | 11 |
| Zinc | 4 | NC | **60.5** | 2300 | Normal | 12.11 | 0.27 | 3 | 3 | 2 | 2 | | | | | | | | 7 | 11 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 4 | NC | 1.52 | **0.018** | Normal | 0.03 | 0.81 | 34 | 10 | 4 | 3 | | | | | | | | 7 | 11 |
| Benzo(A)Pyrene$_{EPA\ RSL}$ | 4 | NC | 1.52 | **0.11** | Normal | 0.03 | 0.81 | 3 | 3 | 2 | 2 | | | | | | | | 7 | 11 |
| Total HMW PAHs | 4 | NC | **1.1** | NA | Normal | 0.31 | 0.86 | 4 | 3 | 2 | 2 | | | | | | | | 7 | 11 |
| Total LMW PAHs | 4 | NC | **29** | NA | Normal | 0.05 | 0.49 | 2 | 2 | 2 | 2 | | | | | | | | 7 | 11 |
| ***WESTERN UNDEVELOPED AREA*** | | | | | | | | | | | | | | | | | | | | |
| Cyanide | 15 | 1 | **0.183** | 2.3 | Gamma | 0.07 | 0.73 | 4 | 3 | 3 | 2 | Normal | 0.04 | 0.64 | 3 | 3 | 2 | 2 | 13 | 28 |
| Fluoride | 15 | 0 | **30** | 310 | Gamma | 3.27 | 0.80 | 3 | 2 | 2 | 2 | | | | | | | | 13 | 28 |
| Copper | 15 | 0 | **28** | 310 | Gamma | 4.04 | 0.26 | 3 | 3 | 2 | 2 | | | | | | | | 13 | 28 |
| Lead | 15 | 0 | **15.3** | NA | Gamma | 3.87 | 0.33 | 3 | 3 | 2 | 2 | | | | | | | | 13 | 28 |
| Nickel | 15 | 0 | **38** | 150 | Gamma | 2.08 | 0.22 | 2 | 2 | 2 | 2 | | | | | | | | 13 | 28 |
| Zinc | 15 | 1 | **60.5** | 2300 | None | 32.86 | 0.52 | 7 | 4 | 3 | 3 | Normal | 13.32 | 0.41 | 3 | 3 | 2 | 2 | 13 | 28 |
| Benzo(A)Pyrene$_{MDEQ\ RBSL}$ | 15 | 1 | 1.52 | **0.018** | Gamma | 0.02 | 0.82 | 16 | 6 | 3 | 3 | Log-Normal | 0.01 | 0.71 | 9 | 4 | 3 | 3 | 13 | 28 |
| Benzo(A)Pyrene$_{USEPA\ RSL}$ | 15 | 1 | 1.52 | **0.11** | Gamma | 0.02 | 0.82 | 3 | 3 | 2 | 2 | Log-Normal | 0.01 | 0.71 | 3 | 2 | 2 | 2 | 13 | 28 |
| Total HMW PAHs | 15 | 1 | **1.1** | NA | None | 0.17 | 0.67 | 3 | 3 | 2 | 2 | None | 0.10 | 0.54 | 3 | 2 | 2 | 2 | 13 | 28 |
| Total LMW PAHs | 15 | 1 | **29** | NA | Gamma | 0.04 | 0.38 | 2 | 2 | 2 | 2 | Log-Normal | 0.02 | 0.30 | 2 | 2 | 2 | 2 | 13 | 28 |

**Table 1**
**Estimates of Minimum Sample Sizes to Calculate Upper Confidence Limit of the Mean Exposure Point Concentrations**
**Appendix D - Phase 2 Sampling Analysis Plan**
**Columbia Falls Aluminum Company**
**Columbia Falls, Montana**

**Notes:**
1. Analysis based on depth-weighted average concentrations for 0-2-feet below ground surface collected during Phase 1 Site Characterization Sampling.
2. Outliers identified in ProUCL based on Rosner's Test ($n \geq 25$) or Dixon's Test ($n < 25$) at $\alpha = 0.05$.
3. Allowable error margin specified as the lower of the ecological and human health benchmark concentrations (bold values).
4. Goodness-of-fit testing conducted in ProUCL v. 5.1 based on complete Phase 1 Site Characterization without removing outliers.
5. Shaded cells indicate aggregate Phase 1 Site Characterization and Proposed Phase 2 Site Characterization sample size exceeds estimated minimum sample size.
6. Goodness-of-fit testing conducted in ProUCL v. 5.1 based on complete Phase 1 Site Characterization after removing outliers.
7. Blank cells indicate no additional analysis on modified datasets because no outliers were identified in complete datasets.
8. Estimated Phase 2 sample size includes supplemental sampling conducted in the South Percolation Pond Area in Fall 2017 after the Phase 1 Site Characterization sampling.

USEPA = US Environmental Protection Agency
HMW = high molecular weight
LMW = low molecular weight
MDEQ = Montana Department of Environmental Quality
mg/kg = milligram per kilogram
NC = not calculated due to insufficient sample size
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
RBSL = risk-based screening level
RSL = regional screening level

# FIGURES




Notes:
1, Goodness-of-fit testing conducted in USEPA ProUCL v. 5.1; alpha = 0.05.
Δ, Allowable error margin selected as the lower value of ecological and human health benchmark concentrations. .

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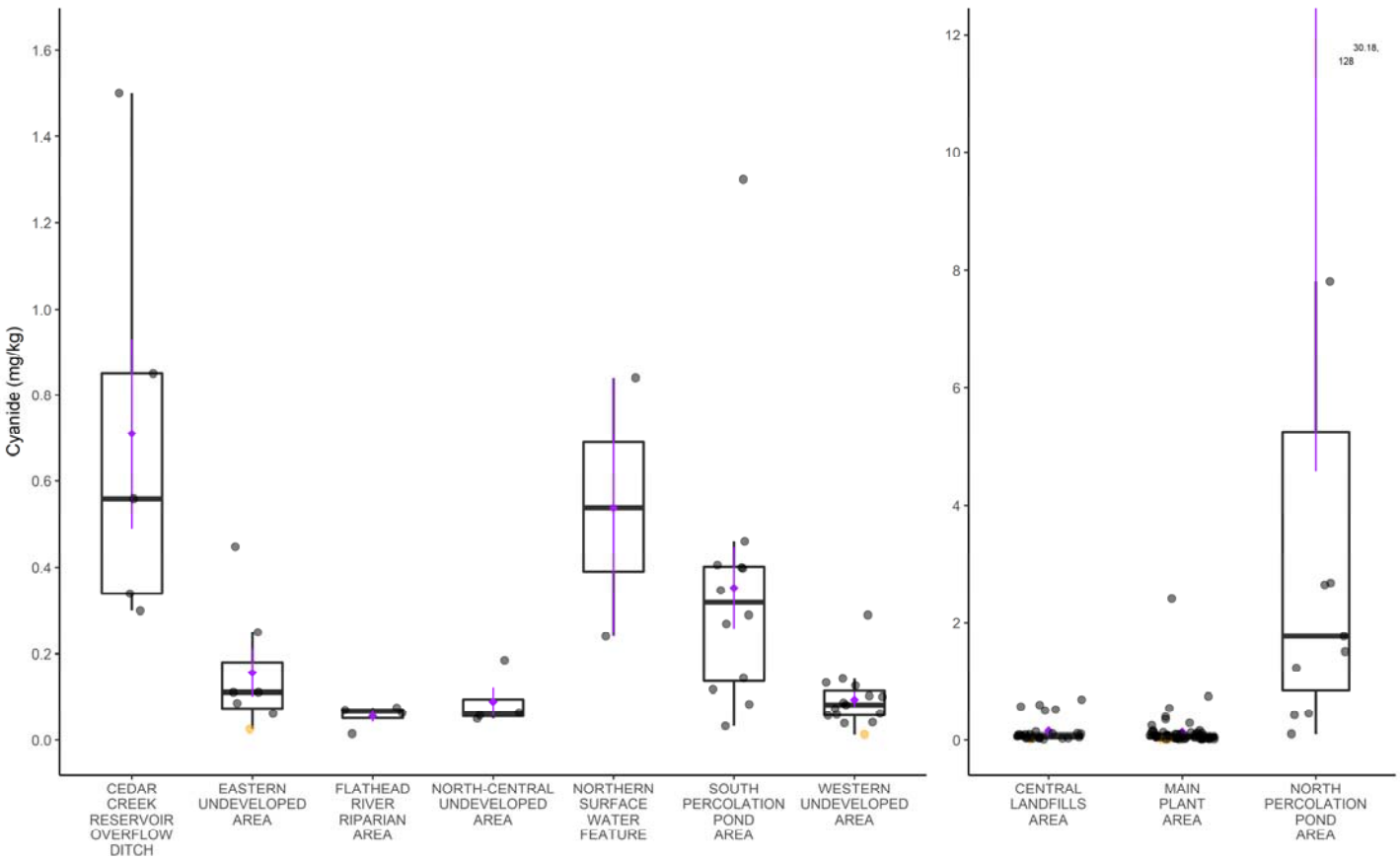
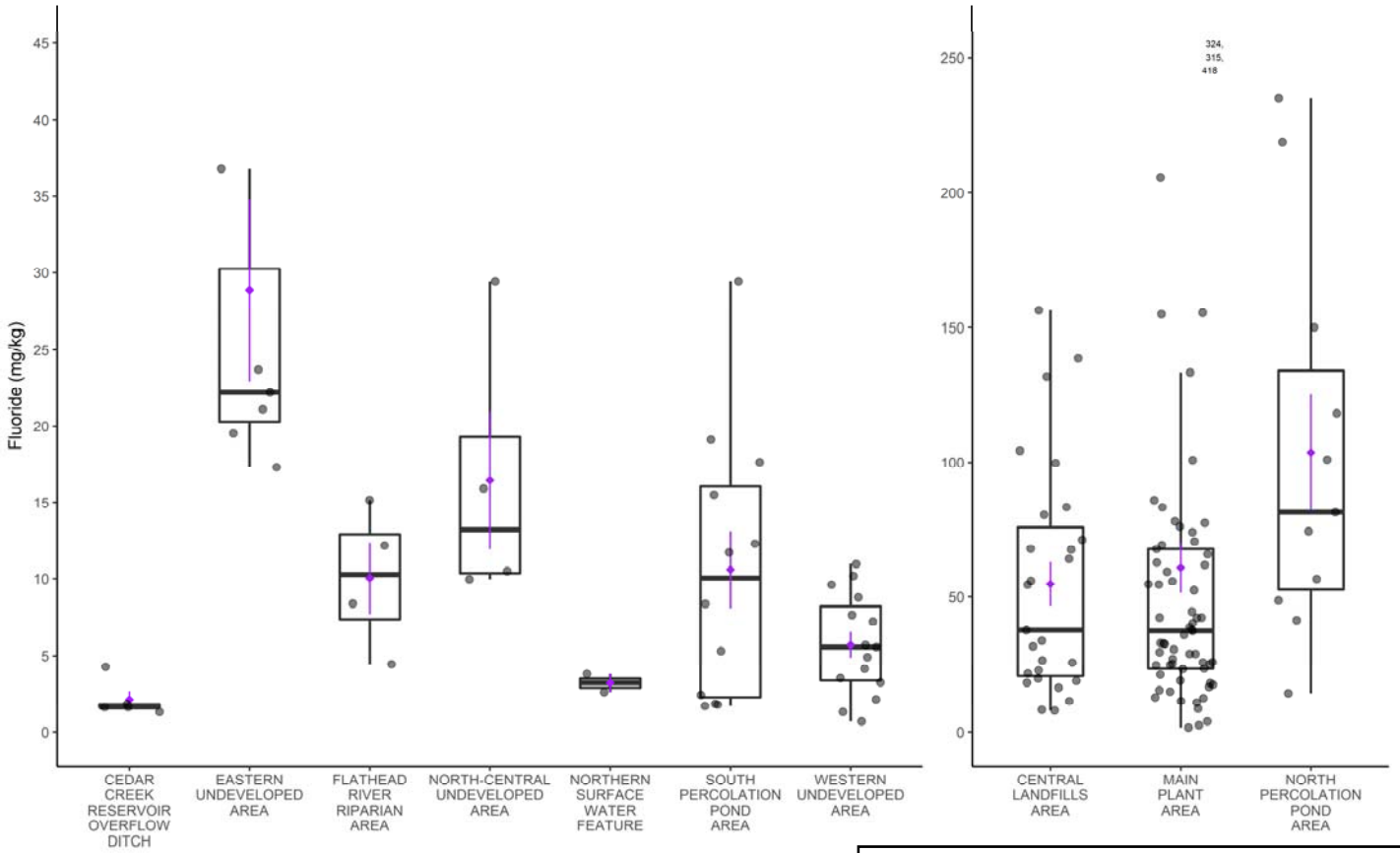
**Figure 1**
STATISTICAL ANALYSIS WORKFLOW DIAGRAM FOR APPROXIMATING MINIMUM SAMPLE SIZES

| | |
|---|---|
| Prepared by: S. Parker | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




Legend:
●, Result above detection limit
●, Result below detection limit
100, Result exceeding scale of plot

Notes:
1. Concentrations represent depth-weight average concentration from 0-2-feet below ground surface (bgs)

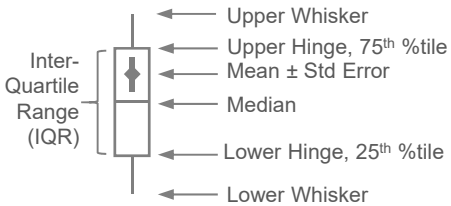



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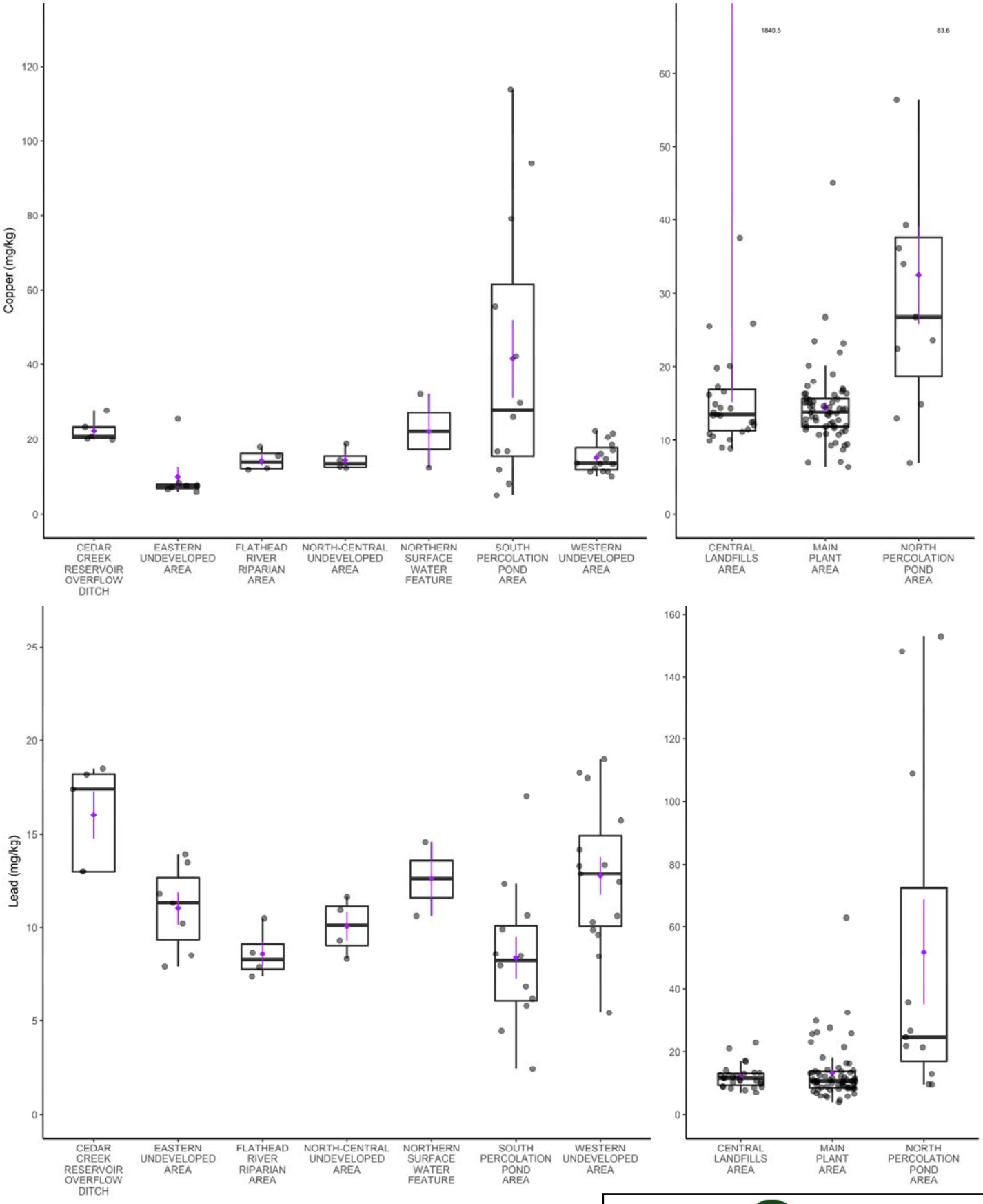
**Figure 2a**

DISTRIBUTION OF INDICATOR CONSTITUENTS IN SURFACE SOIL BY EXPOSURE AREA – FLUORIDE AND CYANIDE

| | |
|---|---|
| Prepared by: R. Sleeper | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




Legend:
●, Result above detection limit
●, Result below detection limit
100, Result exceeding scale of plot

Notes:
1. Concentrations represent depth-weight average concentration from 0-2-feet below ground surface (bgs)

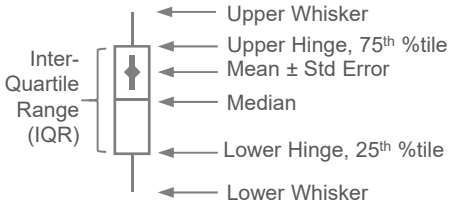



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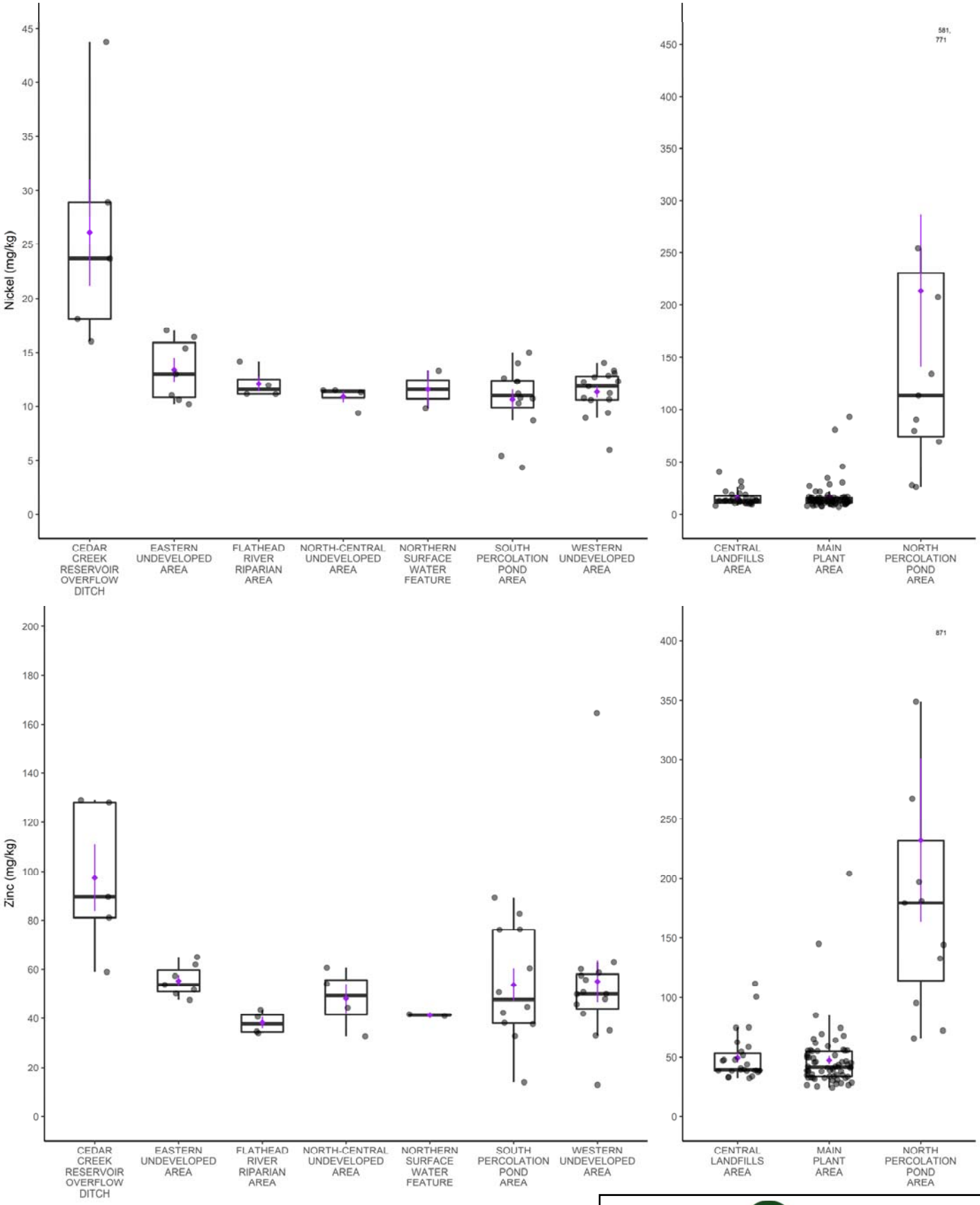
**Figure 2b**

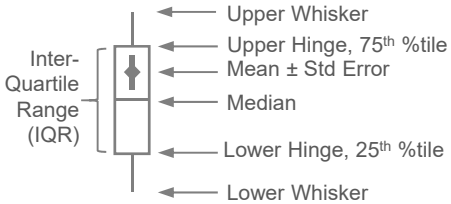
DISTRIBUTION OF INDICATOR CONSTITUENTS IN SURFACE SOIL BY EXPOSURE AREA – COPPER AND LEAD

| | |
|---|---|
| Prepared by: R. Sleeper | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




Legend:
●, Result above detection limit
●, Result below detection limit
100, Result exceeding scale of plot

Notes:
1. Concentrations represent depth-weight average concentration from 0-2-feet below ground surface (bgs)

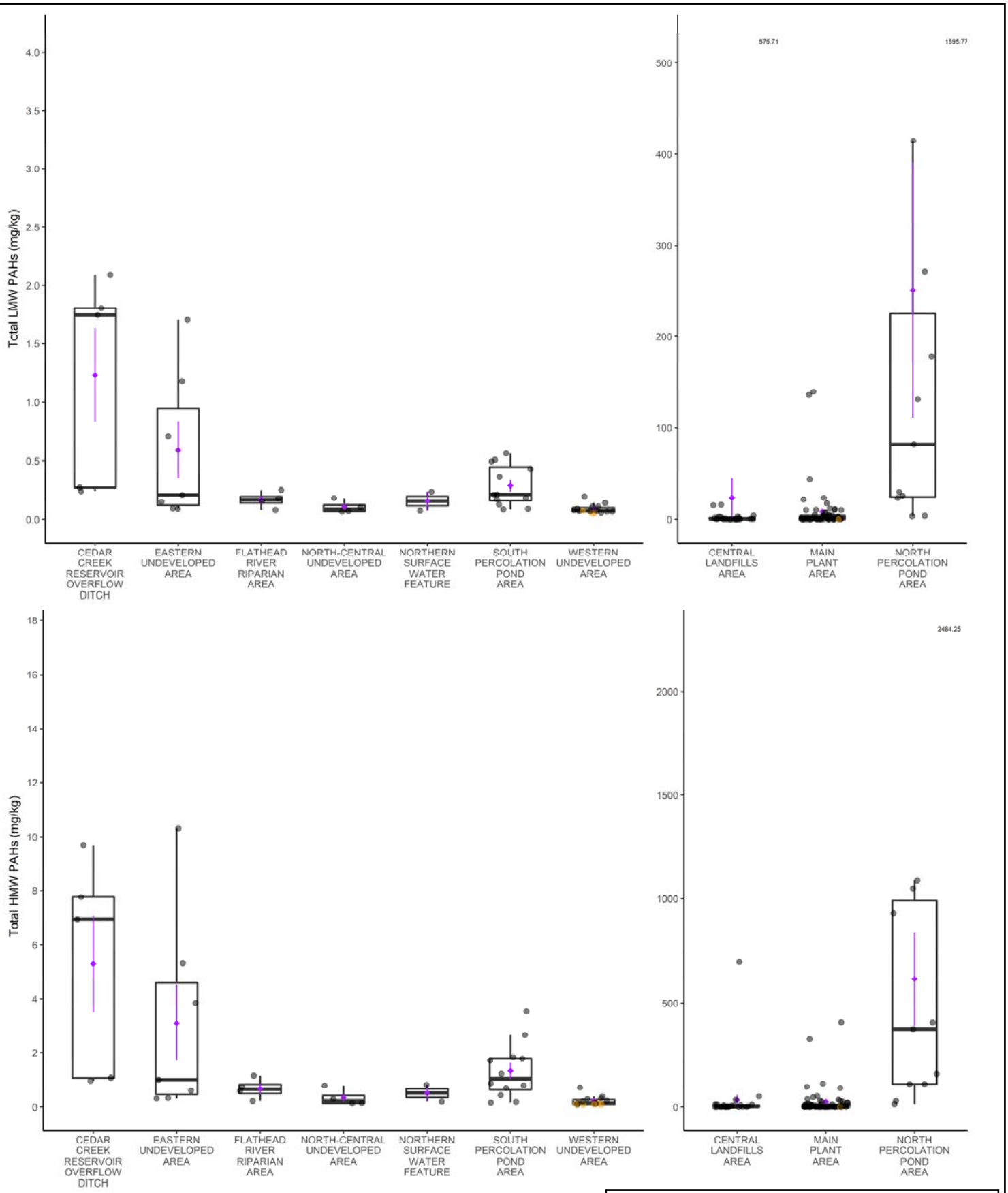



EHS Support *consider it done*

**Figure 2c**

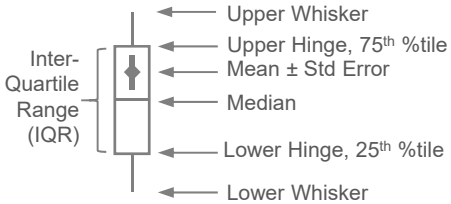
DISTRIBUTION OF INDICATOR CONSTITUENTS IN SURFACE SOIL BY EXPOSURE AREA – NICKEL AND ZINC

| | |
|---|---|
| Prepared by: R. Sleeper | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




Legend:
●, Result above detection limit
●, Result below detection limit
100, Result exceeding scale of plot

Notes:
1. Concentrations represent depth-weight average concentration from 0-2-feet below ground surface (bgs)

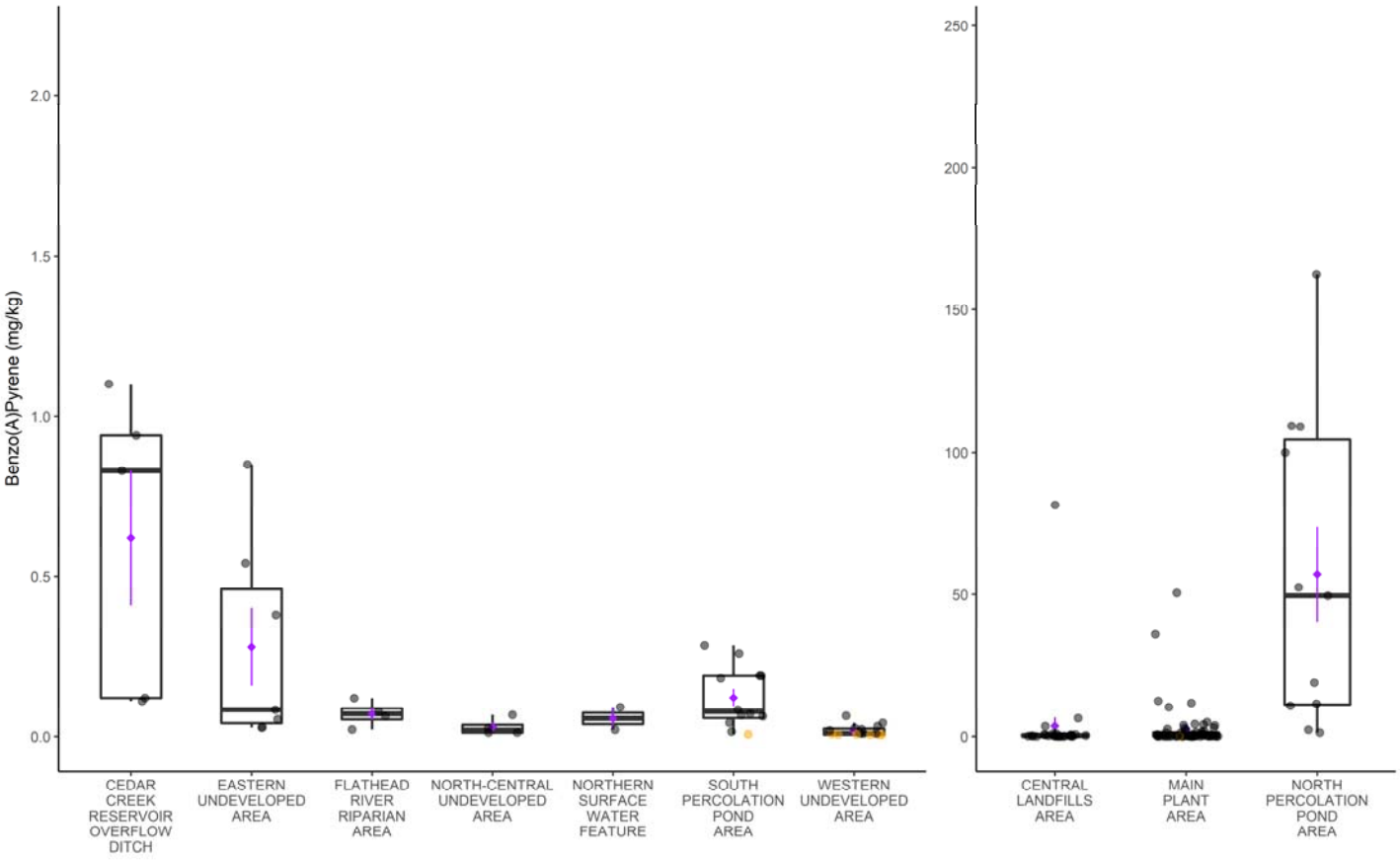



EHS Support *consider it done*

**Figure 2d**

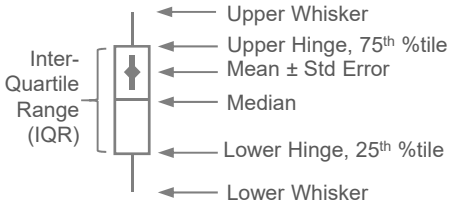
DISTRIBUTION OF INDICATOR CONSTITUENTS IN SURFACE SOIL BY EXPOSURE AREA – LMW PAHs and HMW PAHs

| | |
|---|---|
| Prepared by: R. Sleeper | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




Legend:
●, Result above detection limit
●, Result below detection limit
100, Result exceeding scale of plot

Notes:
1. Concentrations represent depth-weight average concentration from 0-2-feet below ground surface (bgs)

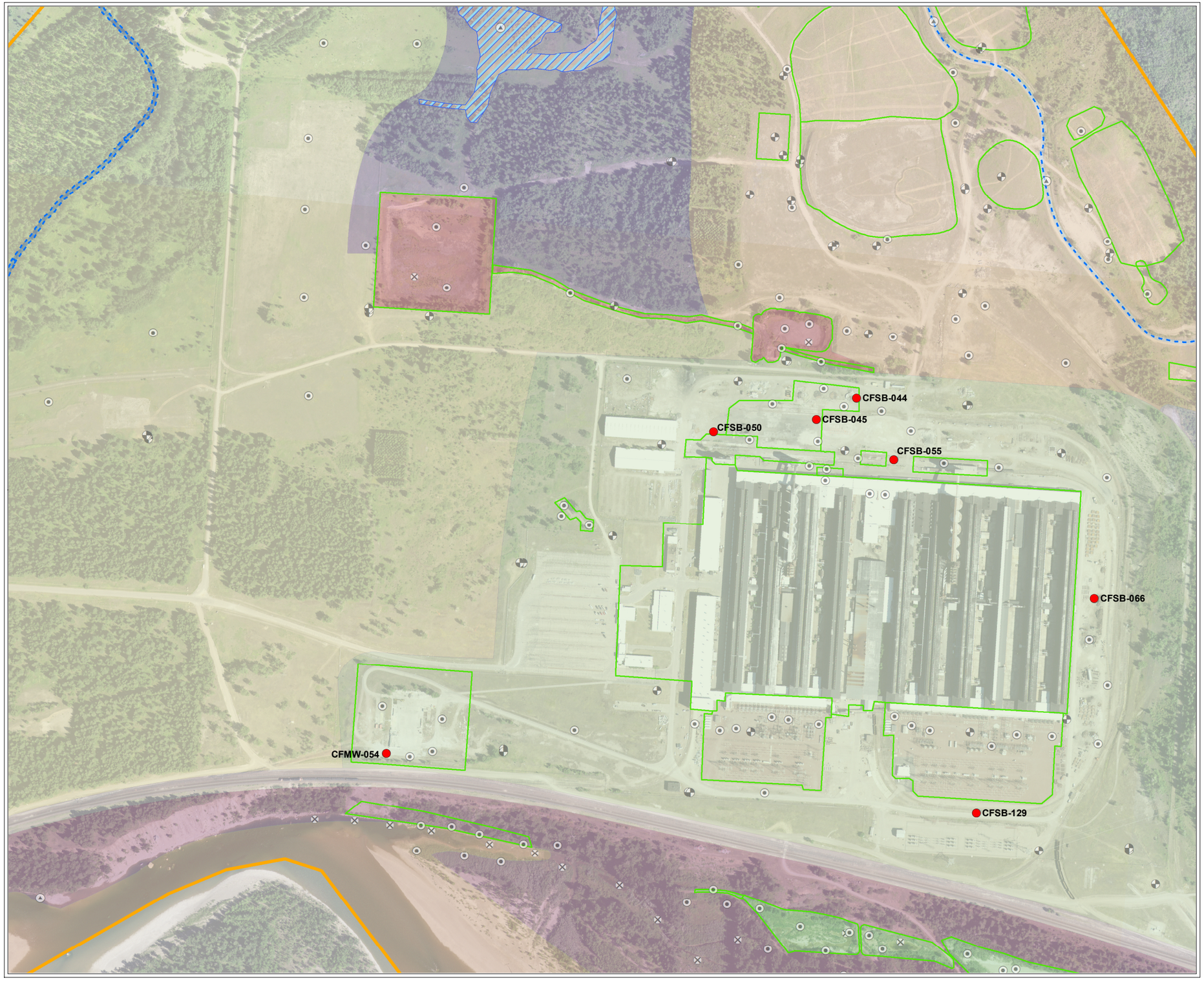



EHS Support consider it done

**Figure 2e**

DISTRIBUTION OF INDICATOR CONSTITUENTS IN SURFACE SOIL BY EXPOSURE AREA – BENZO(A)PYRENE

| | |
|---|---|
| Prepared by: R. Sleeper | Checked by: G. Long |
| Job: Columbia Falls Aluminum Company | Date: 02/25/2018 |




N

LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**FLUORIDE OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 28FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.12.mxd | |

APPENDIX **D3a**

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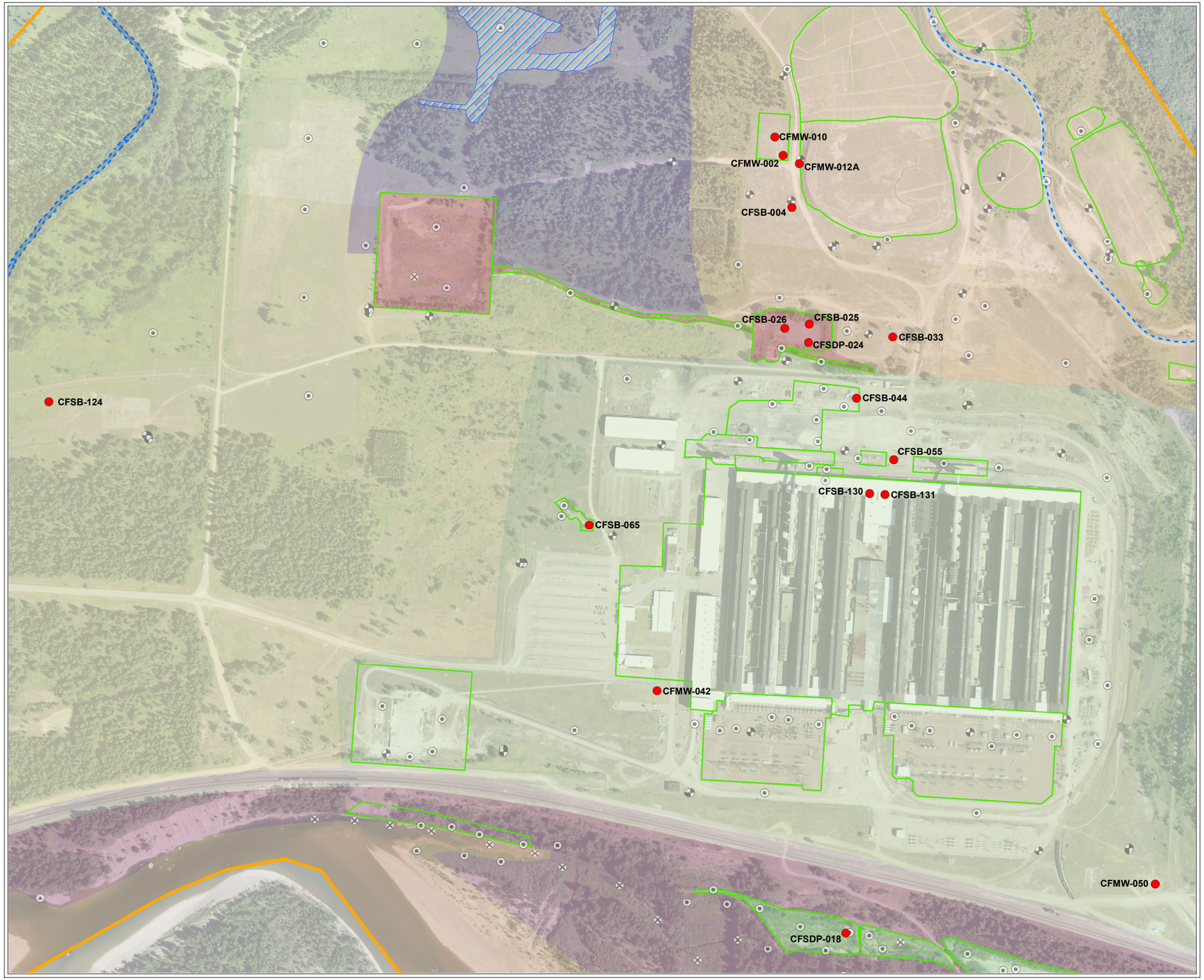


LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**CYANIDE OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 28FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.11.mxd | |

APPENDIX **D3b**

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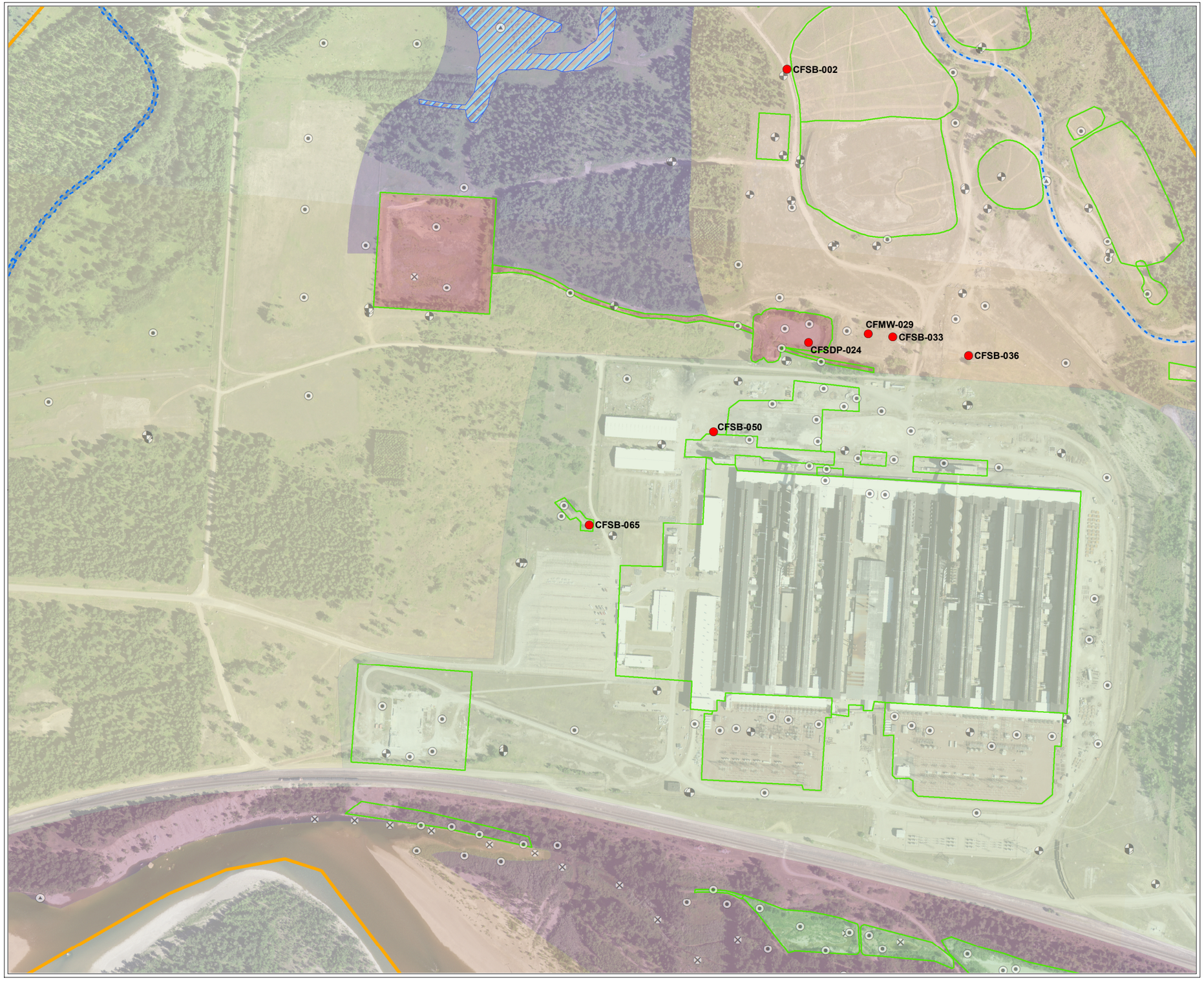


LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**COPPER OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

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| Compiled by: L.J. | Date: 28FEB18 | APPENDIX |
| Prepared by: M.S.R. | Scale: AS SHOWN | **D3c** |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.10.mxd | | |

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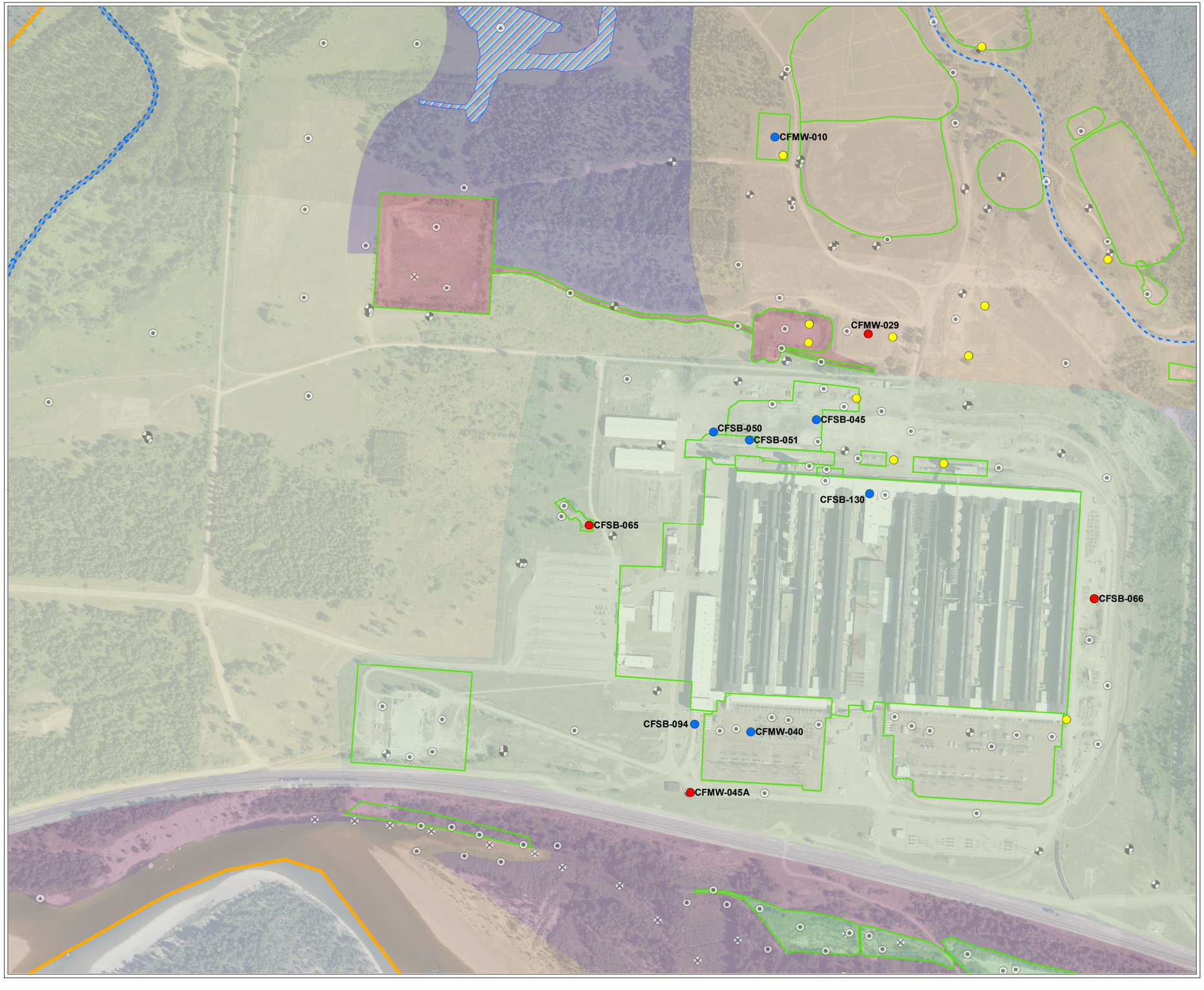


N

LEGEND

- OUTLIER – NICKEL AND LEAD
- OUTLIER – NICKEL
- OUTLIER – LEAD
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**LEAD AND NICKEL OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

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| Prepared by: M.S.R. | Scale: AS SHOWN | D3d |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
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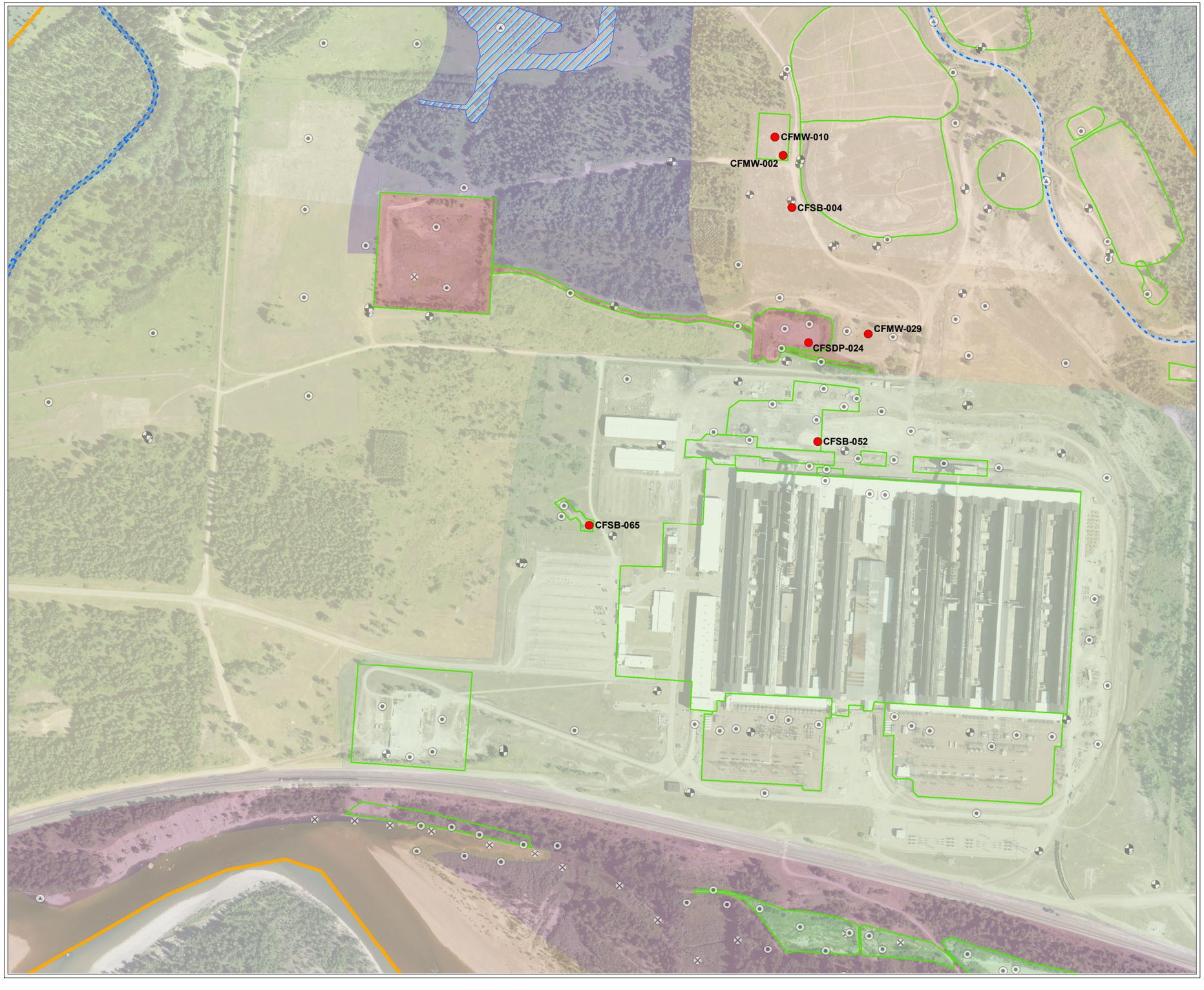


N

LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**ZINC OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

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|---|---|---|
| Compiled by: L.J. | Date: 28FEB18 | APPENDIX |
| Prepared by: M.S.R. | Scale: AS SHOWN | **D3e** |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.16.mxd | | |

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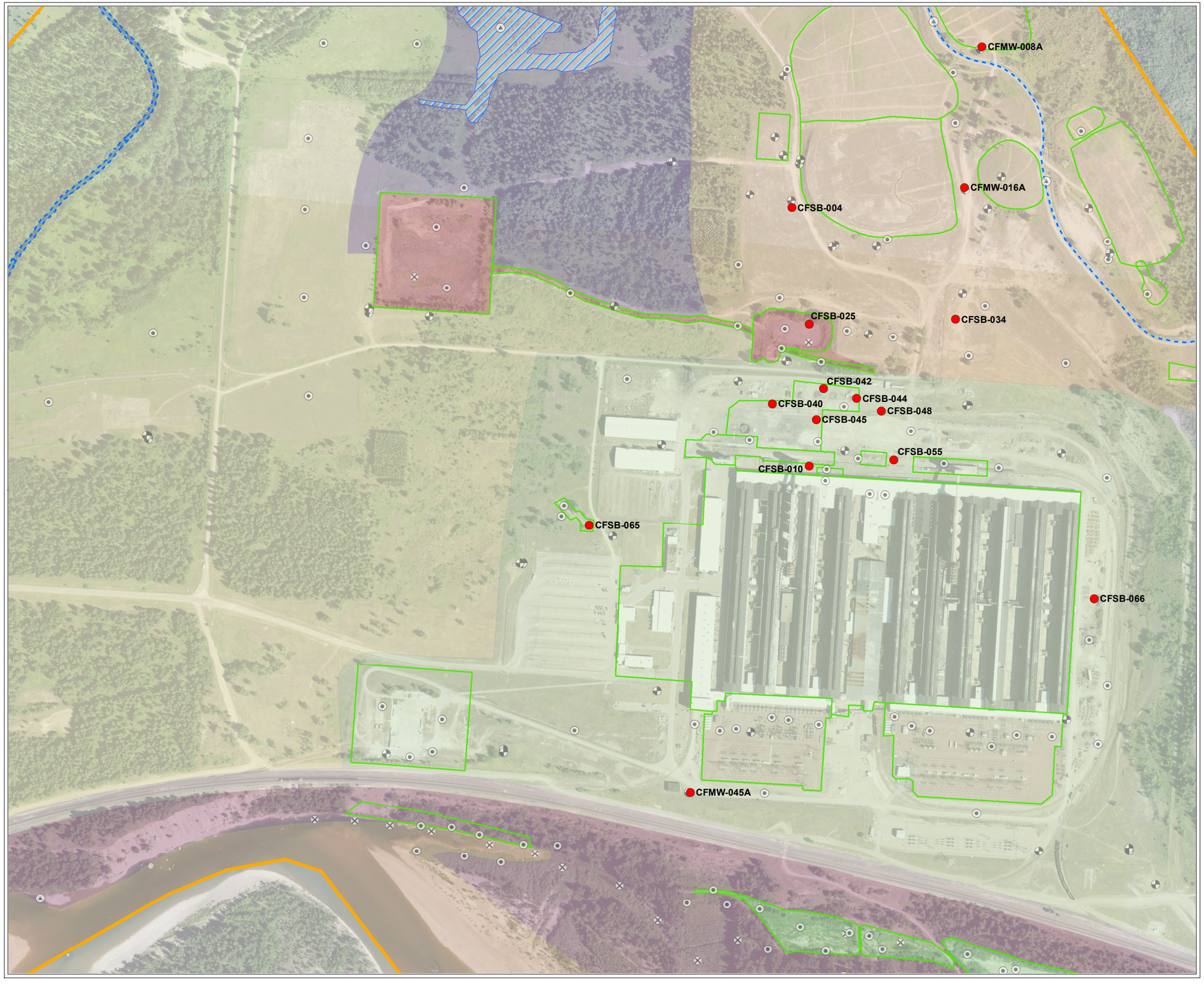


N

LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**LOW MOLECULAR WEIGHT PAHs OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
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| Compiled by: L.J. | Date: 28FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.15.mxd | |

APPENDIX **D3f**

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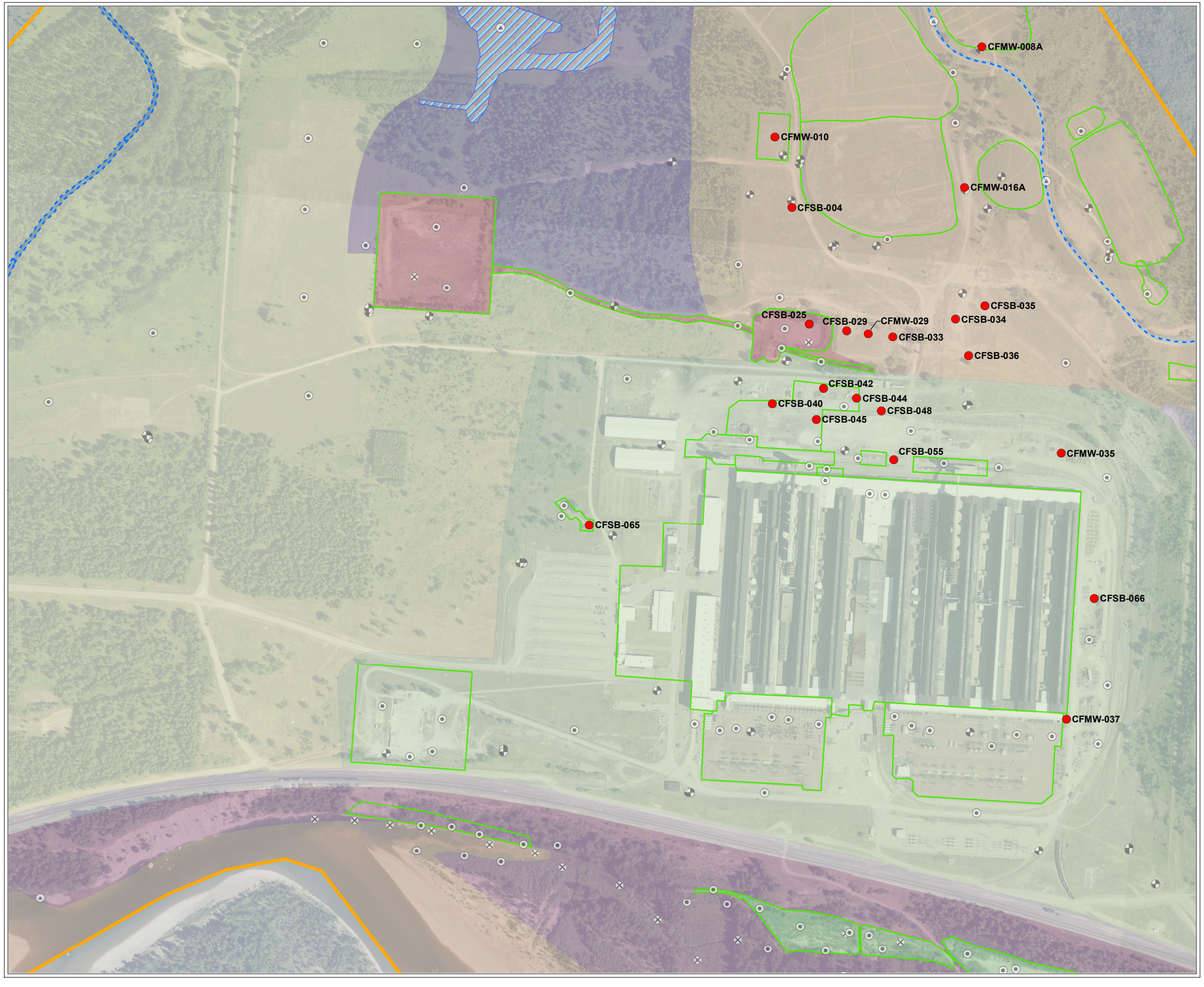


N

LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500 Feet

Title:

**HIGH MOLECULAR WEIGHT PAHs OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

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| Compiled by: L.J. | Date: 28FEB18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.14.mxd | |

APPENDIX **D3g**

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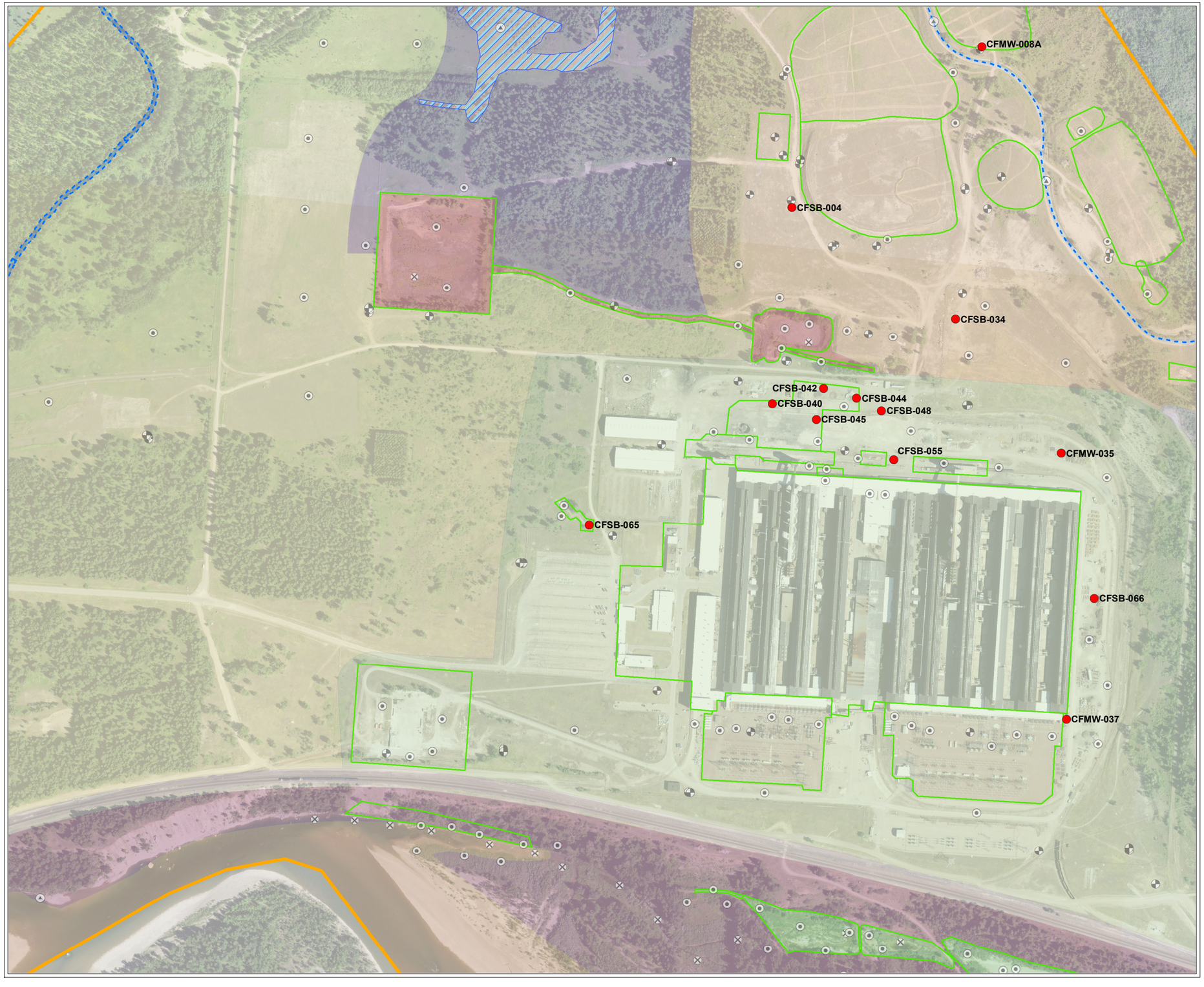


N

LEGEND

- OUTLIER
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SOIL COLLECTED AT PROPOSED SEDIMENT SAMPLE LOCATION
- PHASE 1 SEDIMENT SAMPLE LOCATION
- SITE FEATURES
- SITE BOUNDARY
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT

500 0 500
Feet

Title:

**BENZO(A)PYRENE OUTLIERS IN SOIL**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:
COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

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| Compiled by: L.J. | Date: 28FEB18 | APPENDIX D3h |
| Prepared by: M.S.R. | Scale: AS SHOWN | |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.9.mxd | | |

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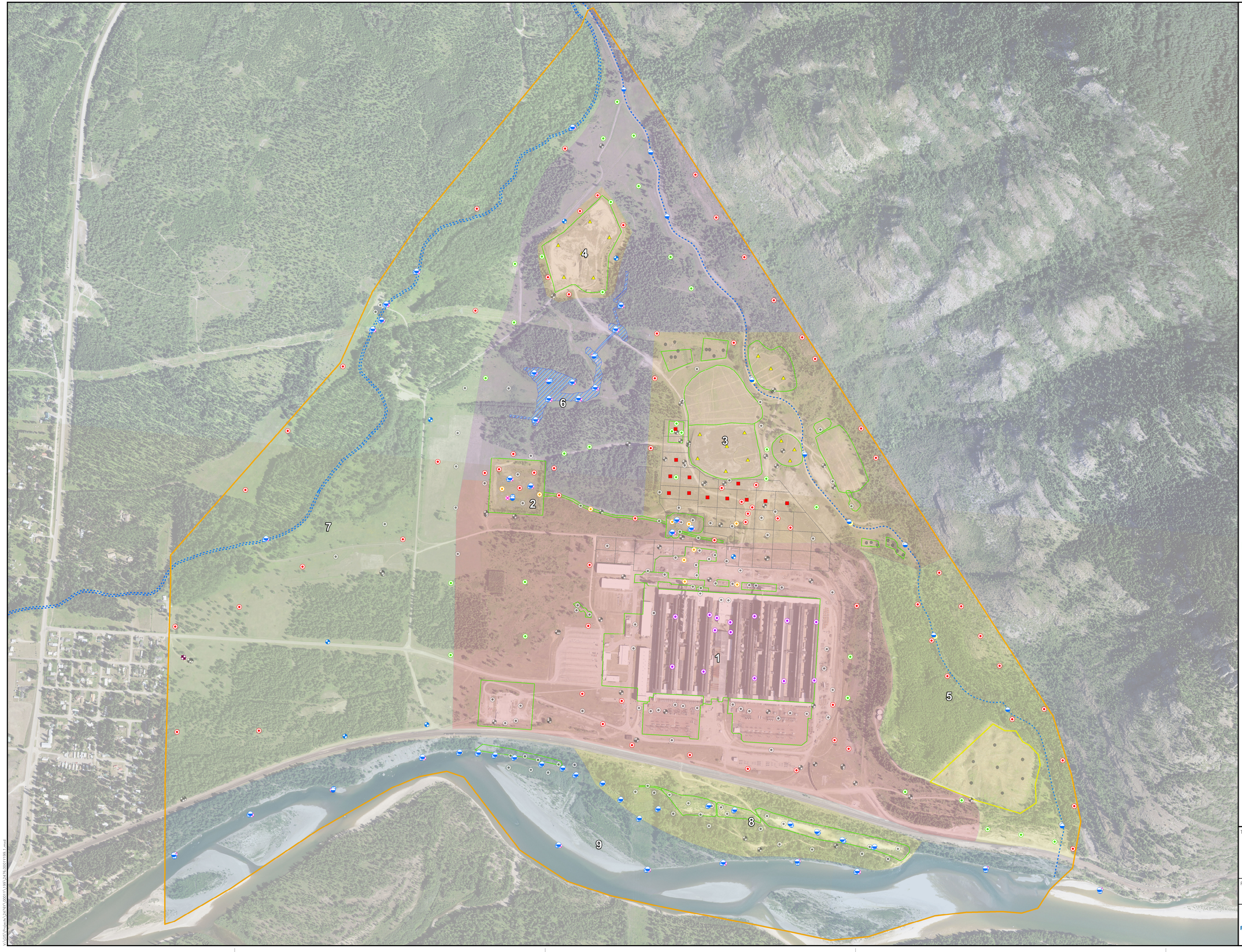
# PLATES

1. Proposed Phase II Sample Locations and Human Health Exposure Areas
2. Proposed Phase II Sample Locations and Ecological Exposure Areas
3. Proposed Phase II Soil Borings and Soil Sampling Locations
4. Proposed Phase II Surface Water, Sediment, and Porewater Sampling Locations
5. Proposed Phase II Monitoring Well Locations and Groundwater Samples




N

LEGEND

- PHASE 2 MONITORING WELL – NO SOIL
- PHASE 2 MONITORING WELL – SOIL COLLECTED TO 12 FT
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 12 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 2 SOIL BORING – SOIL COLLECTED BENEATH MAIN PLANT WITH SONIC RIG
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 22 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 0.5 FT WITH HAND TOOLS
- PHASE 2 OPERATIONAL GRID INCREMENTAL SOIL SAMPLE (32 RANDOMLY GENERATED POINTS)
- PHASE 2 SURFACE WATER SAMPLE
- PHASE 2 POREWATER SAMPLE
- PHASE 2 SEDIMENT SAMPLE
- PHASE 2 LANDFILL CAP SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 1 TEST PIT
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SURFACE WATER SAMPLE
- PHASE 1 SOIL SAMPLE COLLECTED AT PROPOSED SEDIMENT LOCATION
- PHASE 1 SEDIMENT SAMPLE
- SITE FEATURES
- BORROW PIT AREA
- NORTHERN SURFACE WATER FEATURE
- SITE BOUNDARY
- CREEK FEATURES
- OPERATIONAL GRIDS

NOTE

EACH INCREMENTAL SOIL SAMPLE CONSISTS OF 32 RANDOMLY GENERATED SOIL INCREMENTS COLLECTED WITHIN ONE OPERATIONAL GRID, IN ACCORDANCE WITH THE ITRC INCREMENTAL SOIL SAMPLING GUIDANCE.

225 0 225 450
Feet

Title:

# PROPOSED PHASE II SAMPLE LOCATIONS AND HUMAN HEALTH EXPOSURE AREAS

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX
ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | | |
|---|---|---|
| Compiled by: L.J. | Date: 01MAY18 | PLATE 1 |
| Prepared by: M.S.R. | Scale: AS SHOWN | |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.1.mxd | | |

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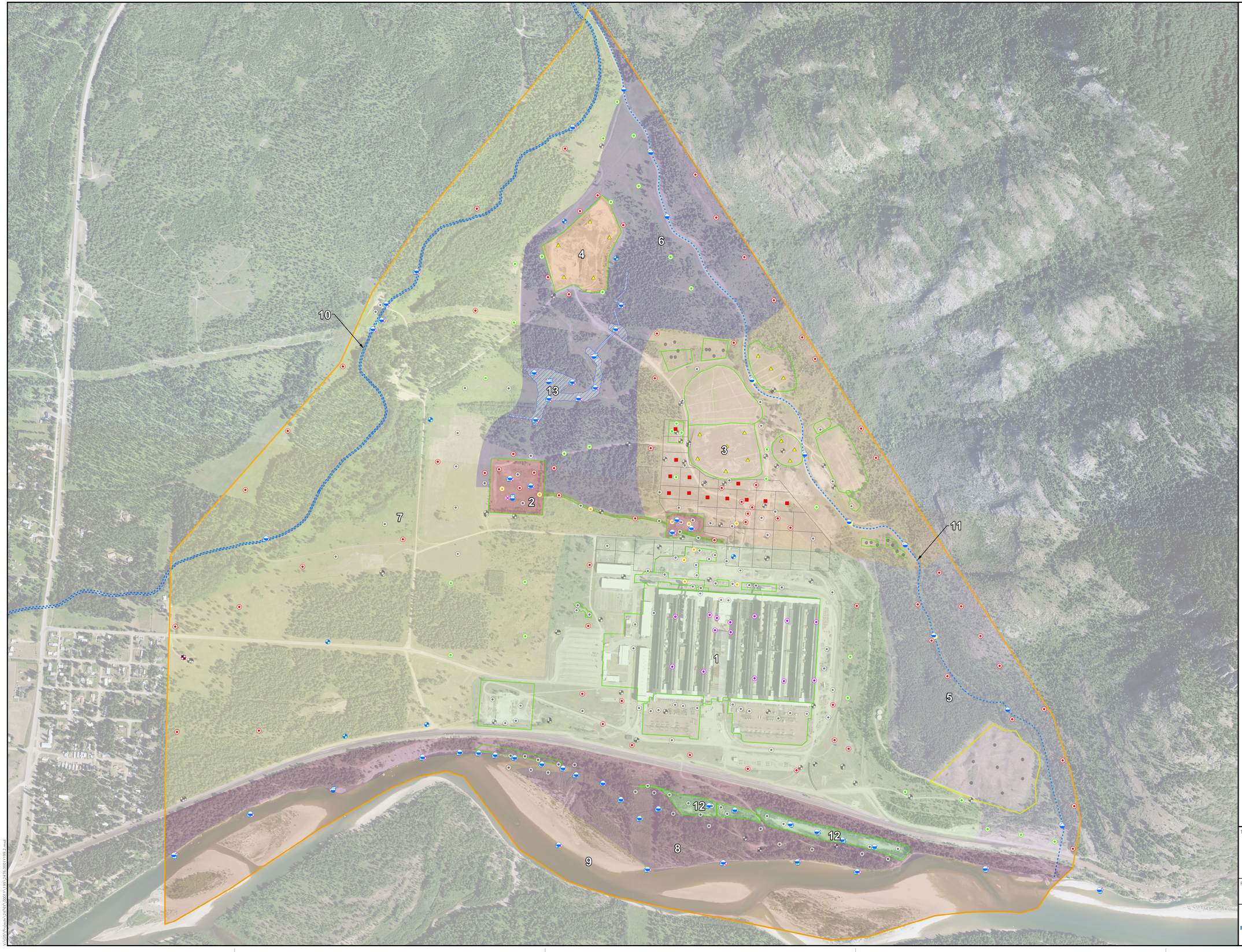


LEGEND

- PHASE 2 MONITORING WELL – NO SOIL
- PHASE 2 MONITORING WELL – SOIL COLLECTED TO 12 FT
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 12 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 2 SOIL BORING – SOIL COLLECTED BENEATH MAIN PLANT WITH SONIC RIG
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 22 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 0.5 FT WITH HAND TOOLS
- PHASE 2 OPERATIONAL GRID INCREMENTAL SOIL SAMPLE (32 RANDOMLY GENERATED POINTS)
- PHASE 2 SURFACE WATER SAMPLE
- PHASE 2 POREWATER SAMPLE
- PHASE 2 SEDIMENT SAMPLE
- PHASE 2 LANDFILL CAP SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 1 TEST PIT
- EXISTING MONITORING WELL
- PHASE 1 SOIL BORING
- PHASE 1 SURFACE WATER SAMPLE
- PHASE 1 SOIL SAMPLE COLLECTED AT PROPOSED SEDIMENT LOCATION
- PHASE 1 SEDIMENT SAMPLE
- SITE FEATURES
- BORROW PIT AREA
- NORTHERN SURFACE WATER FEATURE
- SITE BOUNDARY
- CREEK FEATURES
- OPERATIONAL GRIDS

NOTE

EACH INCREMENTAL SOIL SAMPLE CONSISTS OF 32 RANDOMLY GENERATED SOIL INCREMENTS COLLECTED WITHIN ONE OPERATIONAL GRID, IN ACCORDANCE WITH THE ITRC INCREMENTAL SOIL SAMPLING GUIDANCE.

225 0 225 450
Feet

Title:

# PROPOSED PHASE II SAMPLE LOCATIONS AND ECOLOGICAL EXPOSURE AREAS

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX
ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 01MAY18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199.2.mxd | |

PLATE **2**

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N

LEGEND

- PHASE 2 MONITORING WELL – SOIL COLLECTED TO 12 FT
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 12 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 2 SOIL BORING – SOIL COLLECTED BENEATH MAIN PLANT WITH SONIC RIG
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 22 FT WITH GEOPROBE
- PHASE 2 SOIL BORING – SOIL COLLECTED TO 0.5 FT WITH HAND TOOLS
- PHASE 2 OPERATIONAL GRID INCREMENTAL SOIL SAMPLE (32 RANDOMLY GENERATED POINTS)
- PHASE 2 LANDFILL CAP SOIL BORING – SOIL COLLECTED TO 2 FT WITH HAND TOOLS
- PHASE 1 SOIL BORING
- PHASE 1 TEST PIT SAMPLE LOCATIONS
- PHASE 1 MONITORING WELL AND SOIL BORING
- SITE FEATURES
- BORROW PIT AREA
- NORTHERN SURFACE WATER FEATURE
- SITE BOUNDARY
- CREEK FEATURES
- OPERATIONAL GRIDS

NOTE

EACH INCREMENTAL SOIL SAMPLE CONSISTS OF 32 RANDOMLY GENERATED SOIL INCREMENTS COLLECTED WITHIN ONE OPERATIONAL GRID, IN ACCORDANCE WITH THE ITRC INCREMENTAL SOIL SAMPLING GUIDANCE.

225 0 225 450
Feet

Title:

**PROPOSED PHASE II SOIL BORINGS AND SOIL SAMPLING LOCATIONS**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX
ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | |
|---|---|
| Compiled by: L.J. | Date: 01MAY18 |
| Prepared by: M.S.R. | Scale: AS SHOWN |
| Project Mgr: M.R. | Project: 2476.0001Y004 |
| File: 2476.0001Y199_3.mxd | |

PLATE 3

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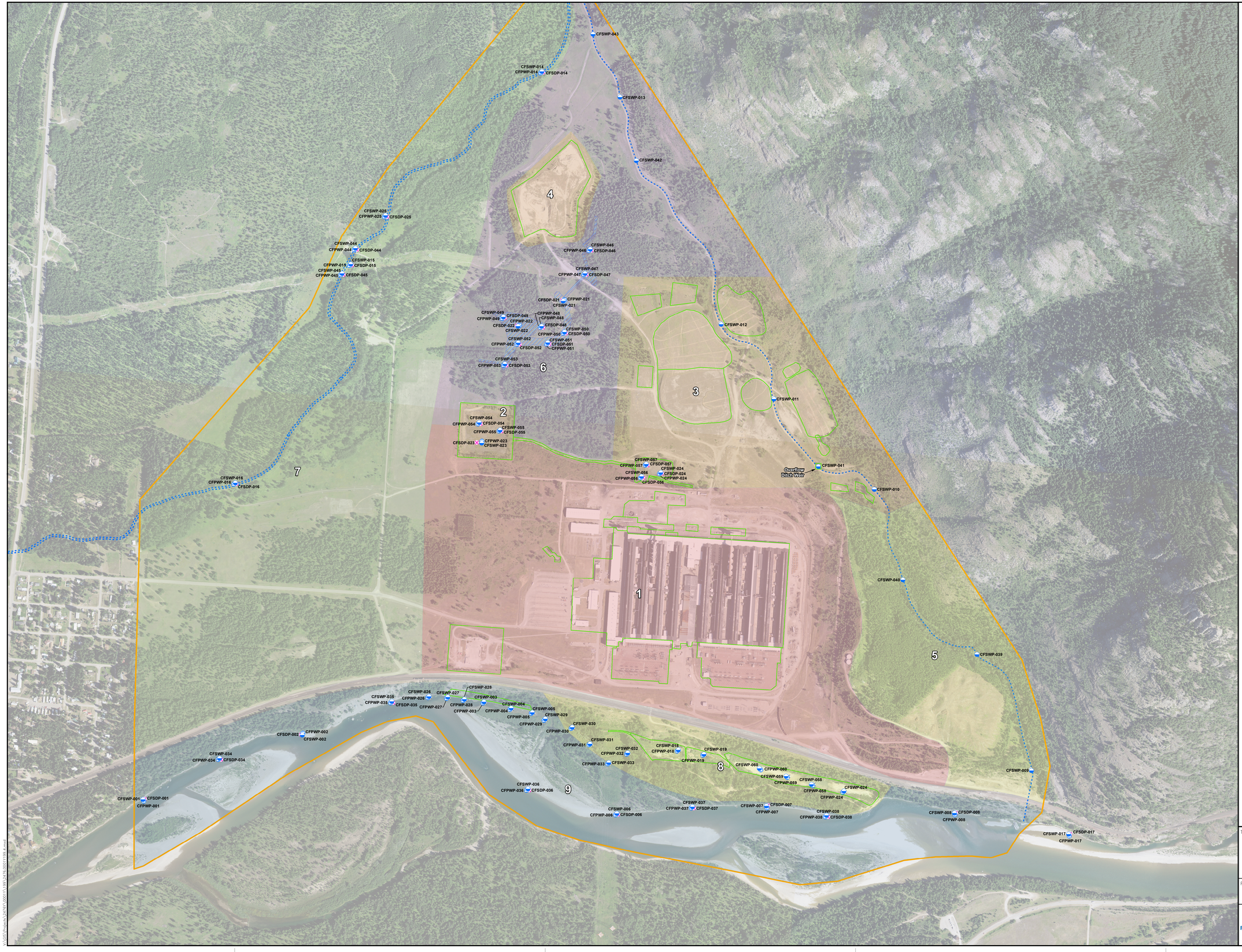


Title:

# PROPOSED PHASE II SURFACE WATER, SEDIMENT, AND POREWATER SAMPLING LOCATIONS

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | | |
|---|---|---|
| Compiled by: L.J. | Date: 06MAR18 | PLATE |
| Prepared by: M.S.R. | Scale: AS SHOWN | 4 |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.4.mxd | | |

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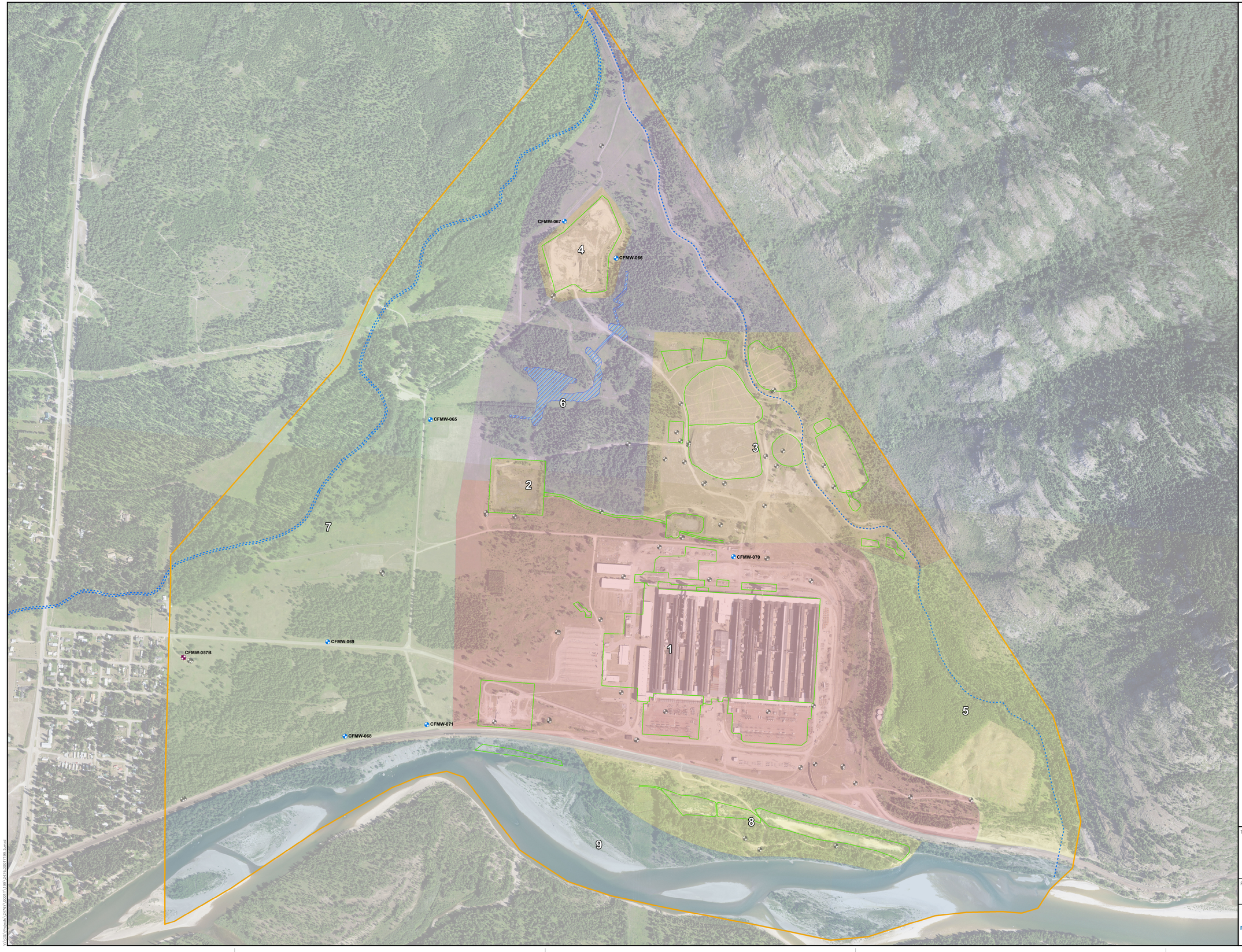


N

LEGEND

- PHASE 2 MONITORING WELL – NO SOIL
- PHASE 2 MONITORING WELL – SOIL COLLECTED TO 12 FT
- EXISTING MONITORING WELL
- SITE FEATURES
- NORTHERN SURFACE WATER FEATURE
- SITE BOUNDARY
- CREEK FEATURES

225 0 225 450
Feet

Title:

**PROPOSED PHASE II MONITORING WELL LOCATIONS AND GROUNDWATER SAMPLES**

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared For:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX
ROUX ASSOCIATES, INC.
*Environmental Consulting & Management*

| | | |
|---|---|---|
| Compiled by: L.J. | Date: 01MAY18 | PLATE |
| Prepared by: M.S.R. | Scale: AS SHOWN | 5 |
| Project Mgr: M.R. | Project: 2476.0001Y004 | |
| File: 2476.0001Y199.5.mxd | | |