APPLIED INTELLECT

Umpqua Mine

Engineering Evaluation/Cost Analysis

Douglas County, Oregon

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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared for the Bureau of Land Management (BLM) Roseburg District Office for work at the Umpqua Mercury Mine (the site) in Douglas County, Oregon (Figure 1). Applied Intellect, LLC (AI) was awarded Contract No. L16PX01354 to complete the EE/CA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The site is located in Douglas County, Oregon, approximately 30 miles southeast of Roseburg, Oregon. The Umpqua Mine focused on the mining, milling, and processing of cinnabar ore to produce mercury. A thermal vaporization/distillation process was used to extract and condense mercury from the ore. During previous investigations in the early 2000s, a significant amount of mining and milling equipment was observed on-site in its original position in varying degrees of disrepair. This appeared to include a rotary furnace, powerhouse area, trestle, ore bins, grizzly, condenser, fuel oil tank and related equipment.

Development of the Umpqua Mine began in 1918. Approximately 1,100 feet of underground workings were eventually developed, mostly during the 1920s and 1930s. Cinnabar ore was mined, milled, and processed by distillation to produce flasks of liquid mercury. The general site layout includes a powerhouse area, upper processing area, and main processing plant. The historic features of each of these areas are described below:

Powerhouse Area
The powerhouse area is located at the southern (uphill) portion of the site adjacent to private property. The area reportedly included the main working adit and a previous brick powerhouse structure.

Upper Processing Area
The upper processing area is characterized by a large road turnout and earthen working platform. It previously included a wooden trestle, main ore bin, crusher/grizzly and conveyor system to the main processing plant (located further downslope). The original fuel oil storage tank that supplied fuel for a diesel motor for the crusher was reportedly adjacent to the main ore bin.

Main Processing Plant
The main processing plant area included the main ore processing features of the Umpqua Mine. Former mill features reportedly included a fine ore bin that contained crushed ore, rotary furnace for heating the ore (which volatilized the mercury), condenser (for collecting and cooling the mercury vapor back to liquid) and spent ore disposal area. An adit (now caved) was also reported to be present on the eastern edge of the processing area.

As part of the EE/CA, a supplemental sampling program was implemented to address data gaps and further evaluate the presence, concentrations, and volumes of potential contaminants. This site investigation, conducted from April 18 through 21, 2017, involved a site reconnaissance, field

screening with an X-ray fluorescence analyzer (XRF), and sampling and laboratory analysis. Visual observations during the April 2017 site reconnaissance indicated the site had been heavily disturbed at some point following the previous investigations. All the mining equipment (except for a fuel oil tank and a portable retort) had been consolidated into non-engineered, partially constructed repositories in the central and southeastern portions of the site.

A total of 60 XRF readings were collected to characterize metals concentrations at the site. Screening results indicated mercury and arsenic were the primary contaminants of concern. Both mercury and arsenic concentrations exceeded BLM Screening Levels (SLs) for protection of recreational visitors. Results of soil and sediment sample laboratory analyses indicated that mercury exceeded the BLM SL in only one sample. Arsenic exceeded the BLM SL in four samples. Petroleum hydrocarbon results from samples collected beneath the former fuel oil tank location indicated diesel range organic concentrations exceeded the Oregon Risk-Based Concentration. Analytical results of surface water samples indicate water samples did not exceed any criteria. However, it should be noted that in some instances, criteria values were lower than analytical reporting limits. Total metal results for samples of mine process residuals displayed elevated levels of mercury and arsenic. Toxicity characteristic leaching procedure (TCLP) results for the samples of the mine process residuals and soil were well below the Resource Conservation and Recovery Act (RCRA) toxicity thresholds and indicate mine wastes or metals impacted soils are very unlikely to be classified as a RCRA hazardous waste.

Based on results of previous site investigations and data collected as part of this EE/CA, the following contaminants of concern (COCs) are of primary concern at the site:

- Mercury and arsenic in the fine-grained process residuals within the equipment located in the non-engineered repository (Figure 4);
- Arsenic in a soil stockpile of debris and the eastern waste rock pile from the powerhouse area (Figure 6);
- Mercury and arsenic in surficial soils within the main ore processing area (Figure 4); and
- Petroleum contaminated soil at the former location of the fuel oil tank (Figure 5).

Potential general removal technologies and processes were identified from a review of technical literature and previous experience at similar sites. The general removal action categories include:

- **No Action** involves leaving the site as is. The No Action alternative is used as a baseline to compare with the various alternatives;
- **Institutional Controls** that minimize or prevent public exposure by limiting access;
- **Engineering Controls (including disposal options)** that minimize uncontrolled migration and exposure to the environment or human contact; and
- **Treatment** that separates contaminants from the soil and waste material.

Five potential removal action alternatives to manage mine wastes and petroleum contaminated soil were developed from the general removal technologies retained from the preliminary screening process. These alternatives are described as follows:

- **Alternative 1 – No Action**: No removal actions would be performed and the site would remain as is. This alternative provides a basis for cost comparisons with other alternatives.
- **Alternative 2 – Institutional Controls:** Signs will be posted around the mine waste (waste rock and processed ore) and metal contaminated soil to notify the public of risks associated with dermal contact and ingestion, and informational placards will be installed at selected areas to inform the public of site risks. The existing debris repository, and all areas that exceed any criteria will be fenced.
- **Alternative 3 – Remove Waste Materials to an On-Site Repository, Cap and Revegetate:** Waste rock, processed ore and soil that exceeds applicable criteria, and all debris would be excavated and consolidated in a newly constructed repository near the existing debris stockpile. Material that exceeds the criteria will be placed separately in a part of the repository for later covering by liner. The entire repository will be capped with a 2- to 3-foot thick soil cover. The repository will be revegetated with fertilizer and a BLM-approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to a metal recycling facility. Petroleum sludge and contaminated soil will be properly disposed of at an approved off-site facility.
- **Alternative 4 and 4a – Offsite Disposal:** All waste material and debris will be excavated and transported to the nearest RCRA Subpart D or Subpart C landfill for disposal. The fuel oil tank will be addressed as described in Alternative 3.
- **Alternative 5 – Combination of On-Site and Off-Site Disposal:** As much metal debris as possible will be tested for contamination in detail by XRF. That which is not contaminated may be transported to metal recycling facility. All remaining material and the fuel oil tank will be addressed as described in Alternative 3. The material volume and therefore repository size will be reduced from Alternative 3. Recycling, an acknowledged preference, is also incorporated.

Each removal action alternative was evaluated based on the following criteria:

- Effectiveness;
- Compliance with ARARs;
- Ease of implementation; and
- Relative cost.

Alternatives 2 through 5 are compliant with ARARs. Alternatives 4, 4a, and 5 comply with all ARARs but at a significantly increased cost over Alternative 3. The advantage of complete removal of all criteria soil and debris provided in Alternatives 4 and 4a is offset by their higher costs relative to Alternative 3. Alternative 5 satisfies agency desires to recycle whenever possible. However, the added cost of recycling is a disadvantage.

The preferred removal action alternative is **Alternative 3 – Remove Waste Materials to an On-Site Repository, Cap and Revegetate**. The total estimated cost for the preferred alternatives is **$151,910**.

1. INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared for the Bureau of Land Management (BLM) Roseburg District Office for work at the Umpqua Mine (the site) in Douglas County, Oregon (Figure 1). Applied Intellect, LLC (AI) was awarded Contract No. L16PX01354 to complete the EE/CA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

This EE/CA identifies and evaluates potential removal action technologies and alternatives for the cleanup of mine wastes remaining at the site. This document fulfills the requirements of CERCLA (42 USC 9601 et seq., 1980), under the Superfund Accelerated Cleanup Model (SACM) and the National Contingency Plan (NCP, 40 CFR 300.415). The EE/CA was prepared in accordance with U.S. Environmental Protection Agency (EPA) guidance for conducting non-time-critical removal actions under CERCLA (EPA, 1993).

The EE/CA satisfies environmental review requirements for removal actions, administrative record requirements for documentation of removal action selection, and provides a framework for evaluating and selecting alternative technologies. The primary objectives of the EE/CA are to:

- Evaluate existing studies and data from previous documents;
- Identify and address potential data gaps necessary to satisfy environmental review requirements;
- Conduct additional sampling, if necessary;
- Identify applicable or relevant and appropriate requirements (ARARs) for the site;
- Conduct a human health risk assessment;
- Identify the removal action objectives (RAO);
- Identify and screen potential removal technologies;
- Develop removal action alternatives;
- Analyze and evaluate alternatives for effectiveness, implementability, and cost;
- Recommend a removal action alternative(s) for the site; and
- Satisfy administrative record requirements for documenting the selected removal action.

2. SITE DESCRIPTION AND HISTORY

This section provides a brief site description and a summary of the site history, site characteristics (topography, meteorology, geology, hydrology), surrounding land use, sensitive environments, and previous investigations.

2.1 Site Location and History

The site is located in Douglas County, Oregon, approximately 30 miles southeast of Roseburg, Oregon (T. 29S, R. 2W, S. 34, Willamette Meridian). The site can be accessed by traveling to Canyonville then heading east on Douglas County Highway 1 to the town of Tiller. From Tiller, continue northeast on County Road 46 for approximately 5 miles then head north on a series of

BLM Roads (13-0, 1.3, and finally 26.0) for approximately 6 miles before arriving at the Umpqua Mine (Figure 2).

The Umpqua Mine focused on the mining, milling, and processing of cinnabar ore to produce mercury. A thermal vaporization/distillation process was used to extract and condense mercury from the ore. During previous investigations in the early 2000s, a significant amount of mining and milling equipment was observed on-site in its original position in varying degrees of disrepair (Dynamac, 2001). This appeared to include a rotary furnace, powerhouse area, trestle, ore bins, grizzly, condenser, fuel oil tank and related equipment.

Information contained in the draft EE/CA by Dynamac (2001) indicates development of the Umpqua Mine began in 1918. Approximately 1,100 feet of underground workings were eventually developed, mostly during the 1920s and 1930s. Cinnabar ore was mined, milled, and processed by distillation to produce flasks of liquid mercury. Reported production of mercury was four flasks in 1929 and five flasks in 1943 (Brooks, 1963). Approximately 100 tons of low-grade ore were mined and treated at the adjacent Maud S. Mine (located on private property). According to Dynamac (2001), some ore from the Maud S. Mine was also reportedly processed at the Umpqua Mine.

The general site layout is illustrated in Figure 3 and includes a powerhouse area, upper processing area, and main processing plant. The historic features of each of these areas are described below.

Powerhouse Area

The powerhouse area is located at the southern (uphill) portion of the site adjacent to private property. The area reportedly included the main working adit and a previous brick powerhouse structure.

Upper Processing Area

The upper processing area is characterized by a large road turnout and earthen working platform. It previously included a wooden trestle, main ore bin, crusher/grizzly and conveyor system to the main processing plant (located further downslope). The original fuel oil storage tank that supplied fuel for a diesel motor for the crusher was reportedly adjacent to the main ore bin.

Main Processing Plant

The main processing plant area included the main ore processing features of the Umpqua Mine. Former mill features reportedly included a fine ore bin that contained crushed ore, rotary furnace for heating the ore (which volatilized the mercury), condenser (for collecting and cooling the mercury vapor back to liquid) and spent ore disposal area. An adit (now caved) was also reported to be present on the eastern edge of the processing area.

2.2 Topography

The site is located at approximately 2,200 feet above mean sea level (amsl) mid-slope on a narrow ridge. The topography of the site slopes downward to the north and the general area is

characterized by rugged forested ridges and valley floors, dominated by the Umpqua River valley. The elevation ranges from approximately 1,000 feet in the valley floor to over 3,000 feet along the ridge tops.

2.3 Meteorology

Average annual precipitation for the area (Roseburg, Oregon) is approximately 34 inches with greater amounts at higher elevations. Average annual maximum temperature is 67 degrees F and average annual minimum of 44 degrees F. The majority of precipitation occurs in the winter months of November through March. Occasional summer thunderstorms cause precipitation during the warmer months (US Climate Data, 2017).

2.4 Geology

The geology of the area is dominated by a thick sequence of non-marine sedimentary rocks. During the Eocene epoch (48 to 34 million years ago) rivers and streams flowing in southwestern Oregon deposited several hundred feet of gravel, sand and silt, known as the Umpqua Formation. The Umpqua Formation is composed of conglomerate, sandstone, and siltstone.

The mine workings explored a fault zone that separated the Umpqua Formation from overlying andesite and tuff. Based on development information on the workings contained in early Oregon Department of Geology and Minerals Industries (DOGAMI) reports, it appears that the overlying units are less than several hundred feet thick. The fault zone strikes N. 65° to 70° E. and dips about 80° N. and is characterized by carbonatized and kaolinized andesite and tuff breccia. Mercury deposits in the area typically formed through alteration and mineralization by hydrothermal fluids migrating along preferential flow paths. At the Umpqua Mine, high-grade ore was generally concentrated along normal faults in the sedimentary rock. These faulted and fractured zones were highly altered and mineralized with cinnabar present as both thin veinlets and as fine disseminations in the adjacent sandstone (Brooks, 1963).

2.5 Hydrology

Figure 2 shows the local drainages in the immediate area. The Umpqua Mine is located adjacent to an unnamed drainage that flows through the site towards the north for approximately 500 feet before discharging into Stanley Creek. Stanley Creek then continues to the northeast for another 500 feet before joining Deadman Creek. Deadman Creek flows towards the east/southeast for approximately 6 miles before joining the South Umpqua River, which is the main drainage in the area.

2.6 Surrounding Land Use and Populations

The site and much of the surrounding area is undeveloped BLM land; although a private patented inholding associated with the Maude S. Mine is located directly south of the site. The nearest town is Tiller (population 235), located approximately 7 air miles southwest of the site. The City

of Medford is located approximately 50 air miles south of the site and is a major population center in the region. Medford has a population of 77,677 with a greater metro area population of 208,545 based on U.S. census data.

No direct evidence of site visitation or recreation use was observed; however, an unmaintained site access road was present in the main area of mine site features and BLM Road 26.0 continues through the site and appears to be traveled periodically by forest users.

2.7 Sensitive Environments

Ecologically, the site is in the Oak Savanna Foothills ecoregion of Southwest Oregon. It is characterized by moderately sloping mountains with intermittent streams and moderate gradients. The area is dominated by Oregon white oak and California black oak woodlands, ponderosa pine, and coast Douglas-fir. Understory species include poison-oak, snowberry, oceanspray, Idaho fescue, California brome, and roughstalk bluegrass (Sleeter and Calzia, 2012).

Ecological resources in the Douglas County region include a variety of birds, plants, and mammals. Government databases were reviewed for endangered species, critical habitats, migratory birds, and wetlands that may be present in the area. Proposed, candidate, threatened and endangered species that may be present in the area include the northern spotted owl (threatened bird) and Kincaid's Lupine (threatened flowering plant). Critical habitat was identified for the northern spotted owl in the area. Migratory birds protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act that may be present in the area include: bald eagle, calliope hummingbird, flammulated owl, fox sparrow, least bittern, Lewis's woodpecker, loggerhead shrike, oak titmouse, olive-sided flycatcher, Oregon vesper sparrow, peregrine falcon, purple finch, rufous hummingbird, short-eared owl, western grebe, white headed woodpecker, and willow flycatcher. All are identified as Birds of Conservation Concern. The site does not appear on the National Wetland Inventory maps (USFWS, 2017). Copies of database search results are included in Appendix 1.

2.8 Previous Investigations

A Preliminary Cultural Assessment was completed by Heritage Research Associates for the BLM in 1999. The assessment documented the extensive presence of mine features and structures that existed at the time of the field investigation in 1999 (Heritage Research Associates, 1999). In 1999-2000, Dynamac Corporation prepared a Site Assessment Report of the site for the BLM. In 2000, BLM conducted additional surface water and soil sampling to expand information contained in the Site Assessment Report. In 2001, a "draft" EE/CA was prepared by Dynamac Corporation but was never finalized. In 2004, Ecology & Environment, Inc. (E&E) performed a supplemental analysis program using a hand auger. An unsigned/undated Action Memorandum was also prepared for the Umpqua Mine by the BLM which identified off-site disposal as the recommended removal action alternative for the site.

During the site assessment conducted in 1999, surface soils, suspected waste materials, surface water, and sediment were sampled. Eight waste material and soil samples were collected along with one background soil sample. Results showed that mercury concentrations exceeded the background soil sample concentration (0.53 milligrams per kilogram [mg/kg]) at all locations. Reported mercury concentrations were between 1.1 to 900 mg/kg and were highest in the material found between the collapsed condenser shed and the depression between the flume, and in the condenser trough. Additionally, two waste samples were tested for mercury leachability by synthetic precipitation leaching procedure (SPLP) method. One of the two samples, the sample collected from the condenser, indicated leaching of mercury was occurring. In addition to the soil mercury analyses, one sample was collected for petroleum hydrocarbons from the visibly stained area directly below the above ground storage tank spigot. Results indicated diesel range petroleum contamination. Dynamac Corporation estimated that less than 42 gallons of material has been released over time, under the reportable quantity for petroleum related spills.

Six surface water and six associated stream sediment samples were collected from locations both on and off-site for mercury analysis to determine any site impacts to surface waters. Mercury was not detected in any of the water samples at the detection limit of 0.0002 milligrams per liter (mg/l) using EPA Method 245.1. Mercury was detected in four of the six sediment samples. The downgradient creek sediment samples had higher mercury concentrations than the upgradient/background samples.

In 2000, the BLM collected additional surface water and soil samples. Using a grid with 40-foot centers over the site, 67 soil measurements were collected using a hand-held X-ray fluorescence (XRF) instrument for nine metals. Mercury was the only elevated metal during the XRF sampling. The highest concentrations of mercury were found in surface soils in the ore chute and condenser areas, as seen in 1999. Surface water was collected at the 6 locations previously sampled in 1999 for testing with a new analytical method which allowed for a much lower mercury detection limit of 0.0000005 mg/l (EPA Method 1631). Sample concentrations ranged from 0.00000612 to 0.0019 mg/l mercury. Stanley Creek downgradient from the site and the unnamed mine drainage samples had the highest concentrations.

To determine the approximate concentration of total mercury which would cause contaminated site material to be classified as a Resource Conservation and Recovery Act (RCRA) hazardous waste, additional sampling was conducted in 2001 by the BLM for toxicity characteristic leaching potential (TCLP). A total of 5 TCLP samples were collected for correlation purposes between TCLP levels and total mercury concentration. The results showed no correlation between total mercury and TCLP concentrations.

The available analytical results from sampling of soil and mining waste during previous investigations indicate that process waste material, primarily present in the main ore bin, fine ore bin, and condenser trough, exhibited elevated concentrations of mercury. These locations were identified as areas of concern. In addition, soil adjacent to these areas also displayed elevated concentrations of mercury (Dynamac, 2001; E&E, 2004). According to the draft EE/CA,

stream sediment sampling results indicate that the finely-ground waste source material is being transported downgradient and beyond the site boundaries in the unnamed drainage into the neighboring stream channels of Stanley and Deadman Creeks and accumulating in the sediments.

3. SITE CHARACTERIZATION

This section presents the results of a site reconnaissance and data gaps investigation conducted in April 2017 as part of this EE/CA.

3.1 Site Reconnaissance and Data Gaps Investigation

The supplemental sampling program was implemented to further evaluate the presence, concentrations, and volumes of potential contaminants. This site investigation, conducted from April 18 through 21, 2017, involved a site reconnaissance, field screening with an XRF, and sampling and laboratory analysis. All site work was conducted in accordance with the approved Sampling and Analysis Plan (SAP) and Health and Safety Plan (HSP) included in the project Work Plan (AI, 2016a).

3.1.1 Site Reconnaissance

A detailed site reconnaissance was conducted that included visual inspection of locations of key mine site features and historic mine and milling equipment locations identified by previous investigators. The reconnaissance focused on visual examination of soil, vegetation, mine waste and mining features. Previous investigations during the late 1990s and early 2000s had identified the presence of relatively intact mine processing equipment in their original position at the site. This included a rotary furnace, powerhouse area, wooden trestle, ore bins, grizzly, condenser, main fuel oil tank and related equipment. Visual observations during the April 2017 site reconnaissance indicated the site had been heavily disturbed at some point following the previous investigations. All the mining equipment (except for a fuel oil tank and a portable retort) had been consolidated into non-engineered, partially constructed repositories in the central and southeastern portions of the site. According to the BLM the work had been conducted by an unknown entity sometime during the last thirteen years (since the 2004 site work by E&E).

Visual observations are described below by area. Site photographs documenting site conditions are presented in Appendix 2.

<u>Main Processing Plant</u>
The main processing plant area previously included the main features of the Umpqua Mine. This area is accessed from an unmaintained road that branches off to the northeast from BLM road 26.0. The area is currently dominated by a large, non-engineered repository. The repository measures approximately 90 feet by 25 feet and includes a soil berm with weathered visqueen liner that is highly degraded and torn. The partially completed feature consisted of two cells. The northern cell included only wood timbers. The southern cell included only metal process equipment. The repository is open and uncovered with exposed equipment and metal/wood

debris. Large metal pieces, including a brick-lined rotary furnace and condenser pipe, are placed in the southern portion of the repository. Visual examination the interior of various pieces of mine processing equipment (e.g., rotary furnace) indicated the presence of small volumes (several cubic feet) of fine-grained process residuals and fibrous thermal insulation material that appeared to be asbestos containing material (ACM).

A spent ore waste pile is present in the north-central portion of the main processing plant area. The spent ore appears to be a finally-ground (coarse sand and fine gravel size) reddish brown material. The land surface is generally devoid of vegetation. A collapsed adit (no water flow) was observed on the eastern portion of the area. Two large (approximately 4 feet by 5 feet) concrete blocks were visible in the central portion of the area and appear to be remnant portions of the ore processing plant foundation. An unnamed drainage flows through the site. Figure 4 presents site features for the main processing plant area.

Upper Processing Area

The upper processing area is characterized by a large flat turnout area along the north side of BLM road 26.0. The turnout includes a small portable retort and steel petroleum storage tank. The retort appears to have been moved to its current location. No evidence of spent ore or other mine waste was observed around the retort. The fuel oil tank also appeared to have been moved to its current location along the side of BLM road 26.0 and was placed in a bermed area with weathered visqueen liner. The bottom of the tank appeared to contain a petroleum water/sludge mixture approximately one foot in depth (approximately 250 gallons). The tank measured approximately 6 feet in diameter and 15 feet in length. Previously, the upper processing area reportedly included a wood trestle, main ore bin, crusher/grizzly and the original fuel oil tank location. Currently these features are not present in their original location and all equipment and wooden structures have been removed and placed in the non-engineered repository located in the main processing plant area.

Visual observations in the area of the former trestle, main ore bin and fuel oil tank indicate the surficial soils were disturbed during removal of the mining equipment. This area had previously displayed elevated mercury concentrations during previous investigations. No visual evidence of stressed vegetation or soil discoloration was observed except for the original location of the fuel oil tank. A concave depression in the ground surface was visible where the fuel oil tank was previously located. A black, viscous, oily substance was present on the ground surface in this area. Site features for the upper processing area are presented in Figure 5.

Powerhouse Area

The upper adit was sealed and discharging groundwater at approximately 10 gallons per minute (visual estimate, piped discharge through an approximately two-foot diameter steel culvert). The reported Powerhouse structure was no longer present. A small (10 foot by 15 foot) non-engineered repository was present near the closed adit. The repository was constructed with an earthen berm and visqueen liner and contained several pieces of steel pipe and debris. The material was exposed to the elements with no cover and the visqueen was highly weathered and torn. A stockpile of soil and brick debris was located directly south of the BLM access road. The

stockpile was covered with torn visqueen and the material was exposed to the elements. An elongated waste rock pile was present directly north and down-slope of the BLM access road. No visual evidence of soil staining or distressed vegetation was observed in the Powerhouse area. The waste rock pile was well vegetated and had several mature trees and small shrubs growing on the surface. The Powerhouse site features are presented in Figure 6.

3.1.2 XRF Field Survey

An XRF field survey was conducted at the site and consisted of a combination of verifying prior measurements and filling in data gaps. Data gaps included evaluating mine features that did not receive sampling previously and conduct more detailed measurements in certain areas to delineate probable "hotspots". In addition, several areas that had been previously characterized were also subsequently highly disturbed by construction equipment and on-site excavation during recent site activities that removed and consolidated mining equipment and debris. These areas were re-evaluated.

A Thermo Fisher Scientific Niton XL3t handheld XRF analyzer was used to perform field analysis of soils and analyze selected metals concentrations within the survey area. The Thermo Fisher Scientific Niton XL3t XRF is equipped with a 50kV x-ray tube, Amptek Silicon Drift detector, and internal GPS and CCD camera. The instrument was set up to analyze and record concentration data in parts per million (ppm) for mercury, arsenic, and lead. In preparation for XRF sample testing, the following procedures were performed:

- Power on analyzer and initiate the Thermo Fisher Scientific Niton XL3t software;
- Run system check;
- Select soil analysis mode;
- Set start/stop for time range/filters (60 seconds); and
- Calibrate instrument using standard reference materials if not satisfied with systems check and/or if specific calibration is desired/required.

XRF analysis of in-situ surface samples were performed to determine the approximate distribution and concentration of metals in mine waste at the site. Field XRF measurements were collected on the ground surface and were marked with flags. XRF field-testing was performed by scraping the upper several inches of the ground surface to remove organic material and expose the soil/mine waste surface. The instrument lens was placed over the sample media and a measurement collected. The instrument was factory calibrated and set to analyze and record sample data over a 60 second period. Following completion of sample analysis, the instrument would display the data for manual recording in field notes and store the results internally for later computer download. The spacing and number of these samples were adjusted in the field depending on the previous XRF readings. The XRF survey locations were located in the field using a handheld GPS. A total of 60 XRF survey locations were analyzed at the site. XRF readings were also collected at depth discrete intervals from five test pits (TP-1 through TP-5) to evaluate vertical extent of metal concentrations. All XRF measurement locations are provided in Figures 4, 5, and 6.

Global Positioning System

All XRF sample locations were recorded by BLM personnel using a resource grade global positioning system (GPS) unit. A Garmin GPS Map 64st handheld GPS was used for data collection in the field. The Garmin GPS Map 64st was WAAS-enabled with a GPS + GLONASS Quad Helix Antenna and built-in waypoint averaging tool. GPS coordinates were recorded for all XRF measurement and physical soil sample collection points. The accuracy of several sample locations was limited due to poor satellite reception in a dense forest canopy.

The field data was downloaded to a laptop computer at the end of the field session. Garmin software was used to post-process the data. Post-processing involves downloading carrier phase and code range measurements from a Continuously Operating Reference Station (CORS) to effectively increase the positional accuracy of the data. All data sets collected by field personnel were post processed before being used in analysis.

XRF Survey Results

A total of 60 XRF readings were collected to characterize metals concentrations at the site. Metals concentrations were analyzed in surface samples at each location. Figures 4 through 6 shows the layout of the actual data collection points for each of the mine feature areas. The results of the XRF survey are summarized in Table 1.

This results summary is based on the suspected contaminants at the site, which include mercury and arsenic. Both metals were present above detection limit by the field instrument at approximately 75% of the measured locations. Both mercury and arsenic exceeded BLM Screening Levels (SLs) for protection of recreational visitors at abandoned mine sites (BLM, 2016). Mercury exceeded the BLM SL, 271 ppm, at only one XRF location. The highest concentration in soil measured was at sample XRF-17 at 401 ppm. Arsenic exceeded the BLM SL, 30.6 ppm, at 8 XRF locations. Detected concentrations ranged across the site from below the level of detection (<LOD) to 98.3 ppm, with the highest arsenic concentration measured at sample XRF-22.

Results of the XRF survey by mine feature area are described below:

Powerhouse Area – Mercury concentrations in ten XRF samples ranged from <LOD to 30.2 ppm. No mercury readings were over the BLM SL. Arsenic concentrations in the ten samples ranged from 9.1 to 58.1 ppm. Arsenic concentrations above the SL were detected in two samples from the soil stockpile (XRF-6 [45.3 ppm] and XRF-7 [47.7 ppm]) and a single sample from the eastern waste rock pile (XRF-59 [58.1 ppm]). XRF sample locations are displayed in Figure 6.

Upper Processing Area – Mercury concentrations in 15 XRF readings (see Figure 5) ranged from <LOD to 57.8 ppm. Arsenic concentrations ranged from 6 to 19.9 ppm. No concentrations for either arsenic or mercury were identified above the BLM recreational SLs.

Main Processing Area – A total of 30 field readings were collected in the main processing area (see Figure 4). Mercury concentrations ranged from <LOD to 401 ppm. The highest mercury concentration, and only XRF sample above BLM SLs, was sample XRF-17 located along the eastern

footprint of the former ore processing plant. Arsenic concentrations ranged from 8.1 ppm to 98.3 ppm. Concentrations above the SLs were detected in samples XRF-17, XRF-19, XRF-21, XRF-22 and XRF-23. The highest arsenic concentrations were generally found in the eastern portion of the area, near the collapsed adit.

3.1.2.1 Statistical Analysis of XRF and Laboratory Data

A statistical analysis was performed to establish a predictive correlation between field XRF and analytical laboratory results that could provide confidence in XRF mercury and arsenic concentrations measured in the field. The resulting data were subjected to linear regression analysis to establish a statistically significant correlation between XRF and laboratory concentrations for the survey area. XRF data was collected by homogenizing (by hand) the soil material in the zip lock bagged sample collected for laboratory analysis. The instrument lens was then placed directly over the bagged sample and the XRF reading was recorded in field notes.

Correlation Results

Linear regression plots were prepared for the 26 sample locations at which both laboratory analysis and XRF data were available for mercury and arsenic. The data was log transformed prior to performing the linear regression. As one cannot log transform a non-detect or zero value, six XRF mercury samples (and thus their corresponding lab samples) were excluded from the linear regression. All 26 arsenic XRF samples were detected and included in the analysis.

The linear regression for the mercury data set indicates that the strength of correlation is strong with a coefficient of determination (R^2) of 0.82. The linear regression for the arsenic data set indicates that the strength of correlation is also strong with a coefficient of determination (R^2) of 0.71. Data tables and correlation plots are presented in Appendix 3.

3.1.3 Sampling and Laboratory Analysis

The purpose of sampling for laboratory analysis was to further evaluate and confirm metals concentrations in various media at the site; and generate definitive laboratory data that could be compared with field XRF data and determine the confidence with which XRF field data could be used to predict metals concentrations. Surface water, stream sediment, soil and mine waste sample locations were selected based on information from prior site investigations, visual reconnaissance and using real time data obtained during the XRF field survey. Samples were collected at the following locations:

Surface water and associated stream sediment samples were collected at five locations as illustrated on Figure 2:

- One upstream sample from Stanley Creek above the influence of the site (UMMSW1/UMMSED1);

- One sample location near the mouth of Stanley Creek downstream from the site (UMMSW3/UMMSED3);
- One sample from Deadman Creek upstream from the influence of the site (UMMSW4/UMMSW4);
- One sample from Deadman Creek downstream from the site (UMMSW5/UMMSW5); and
- One sample of discharge from the onsite adit (UMMSW2/UMMSW2).

Mine waste samples included:

- Two samples from the spent ore pile (UMMSS26 and UMMSS28, Figure 4); and
- Two samples of process waste residuals from the rotary kiln located in the non-engineered repository (UMMPW1 and UMMPW2, Figure 4).

Soil samples included:

- Four samples from beneath the former fuel oil tank location (UMMSSP1 through UMMSSP4, Figure 5);
- Three background samples from areas upslope and adjacent to the Umpqua Mine (UMMBKG1 through UMMBKG3, Figure 2); and
- Eighteen samples of surficial soil from areas likely impacted by historic mine operations as illustrated on Figures 4, 5, and 6.

The approach to site sampling and analysis is summarized below and described in detail in the Sampling and Analysis Plan (AI, 2016b).

Sample Handling and Custody

Soil, stream sediment and mine waste samples were collected using new single-use disposable plastic spoons. A new pair of nitrile sampling gloves was used prior to collection of each sample to prevent cross-contamination of samples. Upon collection, the samples were transferred into plastic zip-lock bags. Samples for methyl mercury followed EPA Method 1669 “clean” sampling and handling techniques. Water samples were collected by partially submerging the laboratory prepared sample bottle into the creek directly. Sample containers were sealed, labeled, and placed in a cooler with ice for shipping. Soil and water samples were delivered to the analytical laboratory within the allowable sample holding times using standard chain-of-custody practices.

Laboratory Analysis

Soil and water samples were submitted to SVL Analytical located in Kellogg, ID for general metals, general water quality parameters and Total Petroleum Hydrocarbon (TPH) analysis. As a screening level survey for the presence of methylmercury, two stream sediment samples were also submitted to Brooks Rand Laboratory in Seattle, WA. Copies of original laboratory reports are presented in Appendix 4.

All soil samples were analyzed for 8 RCRA-regulated metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver) according to EPA Method 6020A. Mercury was analyzed according to EPA Method 7471A and methylmercury was analyzed according to EPA Method 1630. The water samples were also submitted for 8 RCRA metals, total hardness and general water quality parameters (pH, TDS, sulfate). Samples beneath the former fuel oil tank location were analyzed for TPH and diesel range organics by EPA Method 8015 Modified, and benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020. Samples of the mine process waste residuals were also analyzed for metals by toxicity characteristic leaching procedure (TCLP) EPA Method 6010B.

Soil Results

The results of soil and sediment sample analyses are summarized in Table 2. Except for arsenic and mercury, all metals were below the BLM recreational visitor soil SLs. Mercury exceeded the BLM SL, 271 mg/kg, in only one sample, UMM-SS-33 at 287 mg/kg. Arsenic exceeded the BLM SL, 30.6 mg/kg, in four samples. The average mercury concentration in the three background samples was 0.269 mg/kg. The average arsenic concentration was 15.9 mg/kg. Methylmercury was detected in both stream sediment samples at a concentration of 0.000015 mg/kg. This is well below the EPA regional screening level (RSL) of 120 mg/kg. No BLM SL has been established for methylmercury.

Petroleum hydrocarbon results are also summarized in Table 3. BTEX was not detected in any of the four soil samples from the former fuel oil tank location. However, TPH diesel range organic concentrations ranged from non-detect to 140,000 mg/kg. One sample (UMM-SS-P1 [140,000 mg/kg]) exceeded the Oregon Risk-Based Concentration (RBC) of 4,600 mg/kg.

Water Results

Analytical results of the surface water samples are presented in Table 4. Surface water results were compared to EPA maximum contaminant levels (MCLs), EPA RSLs for tap water, and Oregon and EPA human health criteria (for water + organism). Water samples did not exceed any criteria. However, it should be noted that in some instances, criteria values were lower than analytical reporting limits.

Mine Waste Results

Total metal results for samples of mine process residuals are presented in Table 2 and displayed elevated levels of mercury and arsenic. Mercury concentrations ranged from 6,730 to 10,100 mg/kg. Arsenic concentrations ranged from 64.8 to 102 mg/kg.

TCLP results for the samples of the mine process residuals are presented in Table 5. Results were non-detect for arsenic and ranged from 0.00498 to 0.097 mg/l for mercury, which is well below the RCRA toxicity characteristic threshold of 0.2 mg/l. TCLP results for a single soil sample (UMM-SS-17) was similar with non-detect for arsenic and 0.00077 mg/l for mercury. It should be noted that sample UMM-SS-17 displayed the highest mercury concentration by XRF at the site and indicates metals impacted soils are very unlikely to be classified as a RCRA hazardous waste.

3.1.4 Quality Assurance Quality Control

Quality assurance/quality control (QA/QC) procedures employed as part of this project included field and laboratory QA/QC activities as detailed in the SAP (AI, 2016b). A detailed assessment of QA/QC activities are presented in Appendix 5. Soil sample QC included the collection of two blind field duplicates. The duplicates were collected from UMM-SS-26 and UMM-PW-1 and were labeled as samples UMM-SS-66 and UMM-SS-65, respectively. The relative percent difference (RPD) ranged from 0 to 71.9%, with two analytes outside of the 50% limit. High RPDs were attributed to sample heterogeneity typical of soil samples. No site samples were flagged as unacceptable and all laboratory control samples were within QC limits. The analytical data reported for this sampling event are acceptable for use in this investigation.

3.1.5 Soil, Spent Ore, and Waste Rock Volume Estimates

The site reconnaissance identified three distinct areas of mine waste material; an eastern waste rock pile (Figure 6), spent ore pile (Figure 4), and process residuals within equipment placed in a non-engineered repository (Figure 4). In addition, areas of impacted surficial soil and a soil stockpile were also identified. Volume estimates for each of these areas are described below.

Eastern Waste Rock Pile

The eastern waste rock pile is located directly north of BLM Road 26.0 and downslope from the upper adit along the eastern margin of the site. The elongated pile is composed of sand, gravel and cobble size rock with an extensive vegetative surface cover including small trees. The overall pile measured approximately 30 feet long, by 10 feet wide and was estimated to be approximately 10 feet thick (approximately 111 cubic yards). Of three XRF samples, no concentrations of this material exceeded BLM SL criteria for mercury, however, one XRF reading (XRF 59) was slightly above the SL for arsenic. This appears to be an isolated hot-spot within the waste rock pile. Therefore, the volume estimated for removal was established as an excavated area of 10 feet by 10 feet by 1-foot-deep (approximately 4 cubic yards).

Spent Ore Pile

The spent ore pile is located at the northern end of the site, downslope of the former ore processing plant area. The spent ore pile is teardrop-shaped and consists of poorly-graded coarse sand and fine gravel material with a reddish-brown coloration. The surface of the pile is barren and devoid of any vegetative cover material. The overall pile measured approximately 35 feet long, by 15 feet wide and was estimated to be approximately 4 feet thick (approximately 77 cubic yards). One of two samples collected for laboratory analysis exceeded BLM SLs for arsenic (UMM-SS-28). This appears to be an isolated hot-spot within the spent ore pile and the volume estimated for removal was established as an excavated area of 10 feet by 10 feet by 1-foot- deep (approximately 4 cubic yards). A second sample UMM-SS-33 exceeded the BLM SL for mercury; this area is also assumed to contain approximately 4 cubic yards. A total of 8 cubic yards are estimated for removal. XRF measurements did not exceed criteria.

Powerhouse Soil Stockpile

An isolated soil stockpile with weathered plastic sheeting (visqueen) cover was present in the powerhouse area of the site. One laboratory (UMM-SS-7) and two XRF samples (XRF-6 and 7) exceeded the BLM SL for arsenic. The mercury SL was not exceeded in any samples from this stockpile. The soil stockpile measured approximately 15 feet by 15 feet by 5 feet thick (42 cubic yards). All 42 cubic yards are recommended for removal.

Surficial Soil

Elevated levels of metals in soils appear associated with localized "hot spots" that appear laterally discontinuous and surficial in nature. Therefore, the volume of soil for removal was established for each sample exceeding SLs as an excavation of 10-feet by 10-feet by 1–foot deep (approximately 4 cubic yards). Based on 7 samples exceeding BLM SLs for arsenic in soils (XRF 17, 19, 21, 22, 23 and UMM-SS-17, 34) we are estimating a total volume of 24 cubic yards. AI further estimates that 4 cubic yards of petroleum contaminated soil (UMM-SSP-1) will require removal and disposal. A total of 28 cubic yards is estimated for removal. (Note: XRF-17 and UMM-SS-17 are the same location and constitute one sample.)

The combined recommended removal volume of soil, spent ore and waste rock is 78 cubic yards, plus an additional 4 cubic yards of petroleum contaminated soil for a total volume of 82 cubic yards. This equates to eight single loads or four truck/pup loads, if the material is transported off-site.

A mini-excavator was used to evaluate potential soil cover borrow areas and potential repository locations. In addition, the excavator was also used to evaluate metals concentrations with depth. Four test pits were excavated on the road turnout in the upper processing area (UMT1 through UMT4). One test pit (UMT5) was excavated in the powerhouse area and two test pits (UMT6 and 7) were excavated along the access road in the main processing plant area. Results of test pit excavation indicated sufficient suitable borrow sources would be available for construction of an on-site repository. In addition, no shallow groundwater or bedrock was observed in test pit UMT7, adjacent to the existing non-engineered repository.

Excavated soils were screened with the XRF with depth. Field results show mercury concentrations decreased with depth. Arsenic concentrations remained at low, but consistent levels with depth (Table 1).

3.1.6 Debris Volume Estimates

The original mill structure and remaining process equipment - dominantly the rotary kiln and condenser - had been razed sometime after 2004 as discussed in Section 3.1.1. The wood debris and metal debris were stored in separate and lined but uncovered repositories. Small amounts of metal and wood debris were also left scattered about the site. Photos are provided in Appendix 2. Individual repository dimensions are illustrated in Figure 4. Material volumes are estimated as follows:

Wood Debris

The wood debris repository is 38 feet long by 25 feet wide with an average height of 5 feet for a total volume of 180 cubic yards of debris. This is the equivalent of 18 single loads or 9 truck/pup loads.

Metal Debris

The metal debris repository is 52 feet long by 25 feet wide with an average height of 6 feet for a total volume of 290 cubic yards. This is the equivalent of 30 single loads or 15 truck/pup loads.

The total amount of debris is estimated at 470 to 500 cubic yards. This equates to approximately 50 truckloads or 25 truck/pup loads, if the material is transported off-site.

3.2 Streamlined Risk Assessment

Mining activities at the site have been impacting the land since the early 1900s. Human receptors near the site may be exposed to contaminants via mine waste sources (process waste, waste rock, soil, spent ore). The area is used for recreation, fishing, and logging and generated mine waste has contributed to mercury in sediments, and soils.

Surface water and stream sediment samples as indicated in Tables 2 and 4 were obtained, and analyses indicates that no criteria were exceeded. This indicates minimal risk of these media to human health.

Groundwater sampling was not conducted as part of this investigation. Groundwater is not used for drinking water at the site and future use as a drinking source is not anticipated because BLM does not allow use of unpermitted wells. Therefore, groundwater is not included in this risk assessment.

Ecological risks are not considered for the Umpqua site for the following reasons: 1) the ecological habitat provided by the spent ore, process residuals and waste rock areas are of minimal ecological value, as these media are generally low in organic material and have limited shelter, vegetation and nutrients; 2) a review of government databases of sensitive ecological receptors (Section 2.7) identified a low potential for T&E species to be present in the area; and 3) the scope of this EE/CA is limited to human health assessment.

This section describes the streamlined risk assessment for the site and establishes the potential magnitude of risk to human health. Analytical results from the site characterization were compared to various regulatory and risk-based criteria to provide a screening-level risk assessment for human receptors. These criteria included:

- BLM Recreational SLs for human health risks from mine waste and soils; and
- US EPA MCLs for drinking water.

BLM Recreational SLs are concentrations of chemicals in soil that are intended to be protective of human health and the environment under a recreational use scenario (e.g., camping, hiking, hunting, biking, ATV riding, etc.). Recreational users are the most common visitors to BLM land. US EPA MCLs for drinking water are incorporated herein because there are sources of drinking water at the site. EPA Regional Screening Levels (RSLs) are incorporated in the tables only as a reference. These values are extremely conservative and assume residential or industrial occupation, neither of which are applicable at the Umpqua site. The BLM SLs are provided as appropriate in the tables. Concentrations above these levels indicate potential risk to human health of visitors and may warrant remedial action.

The following sections discuss the COC, the conceptual site model (CSM), and the streamlined risk evaluation.

3.2.1 Contaminants of Concern

COCs are compounds detected at the site that exceed risk-based screening levels and present potential risk to human health. Based on the site characterization results from the data gaps investigation, COCs in mine waste (spent ore, process residuals, waste rock and soil) include arsenic and mercury which are of concern with respect to human health risk as they exceed the BLM recreational SLs.

3.2.2 Conceptual Site Model

The CSM provides a framework for assessing risk by identifying the contaminant sources, transport mechanisms, and potential exposure pathways, exposure routes, and receptors. The CSM identifies:

- The environmental setting and contaminants known or suspected to exist at the site;
- Contaminant fate and transport mechanisms that may exist at the site;
- Mechanisms of toxicity associated with contaminants and potential receptors;
- Complete exposure pathways that may exist at the site; and
- Potentially exposed populations.

A CSM developed for the site is shown on Figure 7. The CSM is based on existing data and the current and likely future conditions at the site.

3.2.3 Human Health Risk Assessment

Potential human health risks exist from exposure to mine waste, spent ore and soil as seen on the CSM (Figure 7). To assess human health risks at the site, mine waste concentrations from the site characterization were compared to BLM SLs developed for recreational exposure scenarios. The recreational SLs take into account the limited exposures associated with most recreational activities, which is assumed to be 14 days per year with a 26-year exposure duration. This is based on the assumption that individuals are unlikely to spend more time at an individual site on an

annual basis. Recreational activities can include camping, hiking, hunting, biking, ATV riding, horseback riding, etc. Due to the current and likely future uses of the site, residential and occupational use scenarios were not evaluated. Petroleum contaminant concentrations were compared to EPA RSLs and Oregon Risk Based Concentrations (RBCs) as the BLM SLs do not include petroleum constituents.

BLM SLs were exceeded for arsenic in laboratory samples UMM-PW-1 and 2, UMM-SS-7, 17, 28, and 34 as well as XRF samples XRF-6, 7, 17, 19, 21, 22, 23, and 59. BLM SLs were also exceeded for mercury in laboratory sample UMM-SS-33, UMM-PW-1 and 2, and XRF sample XRF-17.

4. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs are "applicable" or "relevant and appropriate" federal and state environmental requirements used to:

1. Evaluate the extent of site cleanup needed;
2. Scope and develop removal action alternatives; and
3. Guide the implementation and operation of the preferred alternative.

Applicable requirements include cleanup standards and other substantive requirements, criteria, or limitations promulgated under federal or state laws that apply to hazardous substances and removal actions at the site. Relevant and appropriate requirements are not applicable to the site but may be suitable for use because they address issues or problems sufficiently similar to those present at the site. In addition to ARARs, federal and state environmental and public health guidance and proposed standards that are not legally binding but may prove useful are "to be considered" standards. The ARARs for the site are discussed below and summarized in Appendix 6.

The NCP (40CFR 300.415(j)) establishes that a removal action shall "to the extent practical, considering the exigencies of the situation, attain ARARs under federal environmental or state environmental facility siting laws." To determine whether compliance with ARARs is practicable, two factors are specified in 40 CFR 415(j):

- Urgency.
- Scope of the removal action.
    - The scope of the removal action is often directed at minimizing and mitigating a potential hazard rather than totally eliminating the hazard; even though a particular standard may be an ARAR for a particular medium, it may be outside the scope of the immediate problem the removal action is addressing.

The ARARs were used to determine the design specifications and performance standards for the project. They are grouped as federal or State of Oregon ARARs, and are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR, and whether the ARAR is applicable, or relevant and appropriate (see Appendix 6).

- Administrative requirements are not ARARs and thus do not apply to actions conducted entirely onsite. Administrative requirements are those that involve consultation, issuance of permits, documentation, reporting, record keeping, and enforcement.
- The CERCLA program has its own set of administrative procedures, which assure proper implementation of CERCLA. The preamble to the final NCP states that the application of additional or conflicting administrative requirements could result in delay or confusion.
- Provisions of statutes or regulations that contain general goals that merely express legislative intent about desired outcomes or conditions, but are non-binding, are not ARARs. In accordance with Section 121(e) of CERCLA, no permits are required for removal actions conducted onsite.

4.1 Soil Standards

The potential soil ARARs are based on Oregon state and federal standards for the protection of human health and are summarized in Appendix 6. Based on analytical results of surface soil/mine waste samples collected during the data gaps investigation, several COCs exceed soil quality ARARs:

- Results for arsenic and mercury exceed BLM recreational SLs; and
- Results for Total Petroleum Hydrocarbons exceed the Oregon RBC.

The numeric criteria derived from these ARARs are provided in Table 2 as derived directly from the BLM screening value memorandum (BLM, 2016). Specifically, the arsenic SL is 30.6 mg/kg and mercury is 271 mg/kg.

5. IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

This section discusses the goals and objectives of a CERCLA non-time critical removal action at the Umpqua site. The general goal of a removal action is to protect human health and the environment by preventing or minimizing the potential release of a hazardous substance and reducing the potential for direct contact and transport of contaminants to the environment.

Before developing treatment alternatives, removal action objectives (RAOs) were established based on the contaminants and media of interest, exposure pathways, and preliminary removal goals for the site. Based on results of previous site investigations and data collected as part of this EE/CA, the following COCs are of primary concern at the site:

- Mercury and arsenic in the fine-grained process residuals within the equipment located in the non-engineered repository;
- Arsenic in a soil stockpile of debris and the eastern waste rock pile from the powerhouse area;
- Mercury and arsenic in surficial soils within the main ore processing area; and
- Petroleum contaminated soil at the former location of the fuel oil tank.

Other risks are present associated with petroleum sludge within the petroleum storage tank and potential ACM in equipment located in the non-engineered repository. Human health exposure pathways that have been identified include: dermal contact with contaminated materials, inhalation of airborne contaminants in windblown mine waste, and ingestion of contaminated soil. The environmental pathways by which COCs in the mine waste or contaminated soil mobilize and migrate into the environment include:

- Overland flow (run-off) across the mine waste during precipitation events and snowmelt;
- Percolation through the mine waste and leaching of COCs into baseflow;
- Erosion during flooding or high precipitation events; and
- Wind transport and dispersion of mine waste.

The RAOs are aimed at protecting human health and the environment based upon chemical-specific ARARs (if available), site-specific risk-related factors (such as exposure to chemicals), and other available information. The chemical drivers for recommended action at the Umpqua site are arsenic (BLM SL = 30.6 mg/kg) and mercury (BLM SL = 271 mg/kg). The objectives allow for a range of treatment and (or) containment alternatives to be developed. Non-time-critical human health related RAOs established for the Umpqua site are to:

- Reduce or eliminate the potential risks to human health from contact exposure to metals in the mine waste and contaminated soil;
- Reduce or eliminate windblown and water dispersion (erosion) of fine-grained process residuals and spent ore/soil;
- Reduce or eliminate the potential risk to human health from exposure to petroleum contaminated soil; and
- Eliminate the potential risk to human health from the attractive nuisance posed by the scrap metal and abandoned process equipment on-site.

5.1 Removal Action Scope

The scope of removal actions evaluated in this EE/CA focus on:

1. Reducing or eliminating potential risks to human health from exposure to metals in mine waste.
2. Reducing or eliminating potential contaminant erosion.

Additional detail is provided in Section 6.2.

The EE/CA does not consider sediment that has already migrated to Stanley Creek for the following reasons: 1) sediment does not pose a significant human health risk; and 2) this EE/CA considers only impact to human health.

6. IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The selection of removal action alternatives is a tiered process involving (1) identifying and screening general removal technologies and processes applicable to the site, and (2) developing potential removal action alternatives capable of achieving the RAOs. The purpose of screening is to eliminate those technologies or processes that are not feasible and/or do not meet ARARs, while retaining potentially effective options for more detailed analysis. Typically, the proposed alternatives will consist of a combination of one or more of the retained removal actions and technologies.

Removal technologies and processes were identified and evaluated for the contaminated solid media only. No remedial evaluation was conducted for stream sediments primarily because reclamation of the contaminated soil and waste rock should eliminate or mitigate impacts to the other environmental media. Therefore, the alternatives were developed to focus on the primary waste sources (waste rock, process residuals, spent ore, metal contaminated soils, and hydrocarbon contaminated soil) and exposure routes (inhalation, dermal contact, and ingestion of solid media). If future monitoring at the site indicates that a significant risk exists from exposure to stream sediments, a separate removal action may be warranted.

All action alternatives are based on achieving protection of exposure to media that exceeds the BLM SLs of 30.6 mg/kg arsenic and 271 mg/kg mercury. Similarly, soil removal volume estimates are based on removal of soil exceeding these concentrations.

The following sections discuss the identification and screening of potential removal technologies, and the development of potential removal alternatives.

6.1 Identification and Screening of Removal Action Options and Alternatives

Potential general removal technologies and processes were identified from a review of technical literature and previous experience at similar sites. The general removal action categories include:

- **No Action** that involves leaving the site as is. The No Action alternative is used as a baseline to compare with the various alternatives;
- **Institutional Controls** that minimize or prevents public exposure by limiting access;
- **Engineering Controls (including disposal options)** that minimize uncontrolled migration and exposure to the environment or human contact; and
- **Treatment** that separates contaminants from the soil and waste material.

Within each of these categories, there are several potential removal technologies to be considered. During this initial screening step, the removal actions and potential technologies were evaluated based on the following criteria:

- Effectiveness;
- Compliance with ARARs;

- Implementability; and
- Cost.

Based on the screening results, each technology was either eliminated or retained for further consideration in the development of potential removal alternatives.

Available site information regarding contaminant types and concentrations, and on-site physical characteristics, was used in the screening process. Two factors that commonly influence technology screening are: (1) the presence or concentration and types of contaminants that limit the applicability of many types of treatment processes; and (2) site conditions that limit the ability to install or deploy certain technologies. Major site limitations often include limited area, steep topography, remoteness, absence of electrical power, and lack of adequate cover/growth media for reclamation.

The general removal action alternatives are discussed in the following sections and Table 6.

6.1.1 No Action

No action consists of leaving the site as is. This removal technology is **retained**, as required for consideration by the NCP, and serves as a baseline for comparison with other removal actions.

6.1.2 Institutional Controls

Institutional controls are administrative and/or legal controls that help minimize risk and/or protect the integrity of a remedy by limiting future land use or preventing access to the site. Examples include deed restrictions to prohibit residential use of the site, and fencing and warning signs to discourage access to the site. While such controls may not effectively achieve cleanup goals, they are often used to augment other removal alternatives. Therefore, institutional controls are ***retained*** for combination with other technologies but are ***not retained*** as a stand-alone alternative.

6.1.3 Engineering Controls

Engineering controls are engineered measures designed to minimize the potential for human exposure to contamination by either limiting direct contact with contaminated areas or controlling migration of contaminants through environmental media. Engineering controls typically consist of containment (repository disposal) and surface (erosion) controls. Containment may be on-site or off-site.

Containment

Containment controls are intended to eliminate direct contact and fugitive emissions from contaminated materials by placing a cover over the material. Containment is a presumptive remedy that is applicable to the site. The cover can also be designed to minimize infiltration of precipitation and surface water through the waste material, thereby reducing contaminant

leaching. Covering waste material in-place can be a viable alternative when excavation and treatment or disposal costs are prohibitive. However, covering waste in place usually requires capping large areas, particularly at sites where waste deposits are relatively shallow. Cover systems may also be employed to cap waste that has been consolidated or placed in a repository. Success of a cover system will depend on several factors such as the relative toxicity and mobility of contaminants in the waste, ability to establish a vegetative cover, amount of available soil, and surface water controls.

The cover design is a function of the level of hazard posed by the contaminated material, future land uses, and site-specific factors. Potential cover systems range from a simple soil cover to an engineered RCRA hazardous waste cap. A variety of cover materials are available and include materials ranging from natural soils to synthetic materials. These include:

- Soil Covers with vegetation;
- Synthetic Cover Systems with soil and vegetation;
- Clay Covers with soil and vegetation; and
- Shotcrete or Polyurethane Grout Covers. (This is not considered an option at this site because shotcrete is dominantly a structural support and polyurethane degrades and is susceptible to root penetration and burrowing animals).

Surface Controls

Surface controls are used to minimize contaminant migration resulting from surface water and wind erosion. Typical controls include consolidation, grading, surface water containment or diversion, erosion protection, and revegetation. These controls alone will not eliminate direct contact with the contaminated material, so they are usually used to augment other technologies such as containment. Surface controls are usually incorporated into all reclamation designs.

6.1.3.1 On-Site Disposal

On-site disposal consists of excavating, consolidating, and placing the untreated waste materials and debris in an engineered on-site repository. This applies to Bevill-exempt solid wastes from the processing of ores and minerals. Mine process reagents or other materials that are not Bevill-exempt may require disposal in a RCRA hazardous waste repository, if they fail to meet TCLP criteria. In the case of the Umpqua Mine the processing consisted only of comminution and thermal treatment of ore to volatilize mercury; no reagents were added.

The disposal area design is dependent on such things as available space for construction, toxicity, mobility, and type of waste. The design could range from simply consolidating the materials in an existing waste area to a fully-encapsulated repository with a leachate collection system.

On-site disposal will not apply to the sludge in the fuel storage tank and hydrocarbon contaminated soil. This material will be removed from the site to prevent mixing of Bevill-exempt and non-Bevill-exempt material in a single repository.

The presence of steep valley sidewalls significantly limits the available locations for a large on-site repository. However, the present location of the existing, uncapped on-site repository appears to be the most suitable location that is central to the site and easily accessible from other areas that contain metals contaminated soil and debris. An unlined repository is envisioned for this alternative. Capping alternatives for the repository were discussed above under containment. Several technical factors determine the cost or practicality of excavation and disposal. This is discussed in Sections 6.2 and 7. Improvements to the existing access road would be necessary to access the mine waste and borrow sources.

On-site disposal can be a permanent source control measure that effectively eliminates direct contact with the contaminated material and minimizes contaminant migration. However, depending on the level of design required, costs can be high. On-site disposal of mine waste and debris is ***retained*** for further consideration.

6.1.3.2 Off-Site Disposal

Off-site disposal involves excavating the waste materials and debris for transport to an off-site disposal facility permitted to accept such materials. Debris will be decontaminated prior to relocation on-site and before removal and transport. Off-site disposal options include a nearby, permitted solid-waste, Subpart D landfill or a distant RCRA Subpart C permitted facility. Non-Bevill exempt hazardous materials would require disposal in a RCRA Subpart C hazardous waste facility; although, no materials at the site have been identified as such. Less toxic materials and debris could be disposed of in a permitted solid waste Subpart D landfill. However, many Subpart D landfills will not accept mining waste. Petroleum contaminated soil and sludge from the petroleum storage tank and possibly the tank itself will likely require proper off-site disposal. Off-site disposal of waste material and debris is ***retained*** for further analysis due to the relatively small quantity of materials.

6.1.3.3 Combination of On-Site and Off-Site Disposal

No waste material samples failed TCLP criteria. Therefore, no material will require removal and transport to a Subpart C landfill. Some scrap metal may be eligible for recycling, and some waste material and soil that exceed any metal or organic criteria are eligible for disposable in a Subpart D landfill. A combination of on-site and off-site disposal is ***retained*** for further evaluation.

6.1.4 Treatment

Although many treatment technologies and process options are available and applicable for mine waste, most are not considered feasible for remote abandoned mine sites because of high costs or unproven technologies. Many of these technologies involve a variety of techniques related to

physical/chemical processes that would require extensive treatability studies to determine potential success based on site-specific conditions and would require extensive on-site construction and processing. Therefore, treatment was ***not retained*** on the basis of unproven effectiveness, high cost and implementability.

6.2 Components of the Removal Action Scope

Specific removal actions are required for debris, waste rock/soil, and spent ore to achieve the RAOs described in Section 5. Technologies described and retained above (Section 6.1) include: institutional controls (fencing, signs and land use restrictions) and engineering controls (consolidation of mine waste and debris in an on-site engineered repository, or off-site disposal). These technologies have been assembled into specific alternatives for comparative analysis and estimation of costs.

Five potential removal action alternatives to manage mine wastes and petroleum contaminated soil were developed from the general removal technologies retained from the preliminary screening process. These alternatives are described as follows:

- **Alternative 1 – No Action**: No removal actions would be performed and the site would remain as is. This alternative provides a basis for alternatives cost comparisons.
- **Alternative 2 – Institutional Controls:** Signs will be posted around the mine waste (waste rock and processed ore) and metal contaminated soil to notify the public of risks of dermal contact and ingestion, and informational placards will be installed at selected areas to inform the public of site risks. The existing debris repository, and all areas that exceed any criteria will be fenced.
- **Alternative 3 – Remove Waste Materials to an On-Site Repository, Cap and Revegetate:** Waste rock, processed ore and soil that exceeds any criteria, and all debris would be excavated and consolidated in a newly constructed repository near the existing non-engineered repository. All metal debris would be crushed to minimize repository volume. Material that exceeds any criteria will be placed separately in a part of the repository for later covering by liner. The entire repository will be capped with a 2- to 3-foot thick soil cover. A synthetic cover consisting of a geomembrane-supported geosynthetic clay liner composite with the 60-mil HDPE geomembrane bonded on top of the GCL or 60-mil HDPE geomembrane alone will be placed on top of the criteria waste prior to soil covering. The repository will be revegetated with fertilizer and a BLM approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler. Petroleum sludge and contaminated soil will be properly disposed of at an approved off-site facility.
- **Alternative 4 and 4a – Offsite Disposal:** All waste material and debris will be excavated and transported to the nearest RCRA Subpart D or Subpart C landfill for disposal. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler. Petroleum sludge and contaminated soil will be properly disposed of at an approved off-site facility.
- **Alternative 5 – A Combination of On-Site and Off-Site Disposal:** As much metal debris as possible will be tested for contamination in detail by XRF. That which is not contaminated may be transported to the nearest metal recycler. The fuel oil tank will be cleaned, cut

up, and transported to the nearest metal recycler. Petroleum sludge and contaminated soil will be properly disposed of at an approved off-site facility. All remaining material will be placed in an on-site repository as described in Alternative 3. The material volume and therefore repository size will be reduced. Recycling, an acknowledged preference, is also incorporated.

With the exception of the no-action alternative, the alternatives consist of a combination of one or more general removal technologies retained during screening. The retained removal action alternatives are summarized in Table 7 and further described in Section 7.

7. ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents an analysis and evaluation of the RAOs developed from the general removal technology screening. The following subsections present the evaluation criteria, construction elements common to all action alternatives, and a detailed analysis of the removal action alternatives.

7.1 Components of the Removal Action Scope

Each removal action alternative was evaluated based on the following criteria:

- Effectiveness;
- Ease of implementation; and
- Relative cost.

Effectiveness is defined as the ability of an alternative (relative to other options in the same technology sub-category) to:

- Achieve RAOs – pertains to the ability of an alternative to achieve, at least to some degree, the project RAOs;
- Protect human health and the environment – addresses whether the remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls;
- Comply with ARARs – addresses whether a remedy will meet state and federal environmental statutes;
- Provide long-term effectiveness and permanence – refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met;
- Provide short-term effectiveness – qualitatively addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Ease of implementation encompasses both the technical and administrative feasibility of implementing a removal action alternative. It also takes into account legal considerations. Factors of particular consideration include construction and operational feasibility; availability of equipment, and personnel; community acceptance; and the ability to obtain necessary permits for off-site actions.

The relative costs of each alternative are evaluated based on professional experience, engineering judgment, and standard cost estimating tools. Primary cost considerations include (1) capital costs, (2) approximated engineering and design costs, and (3) annual operation and maintenance (O&M) costs based on 2 to 3 years of post-construction monitoring and maintenance. The costs are estimated at the conceptual level, as defined by the American Association of Cost Engineers. The estimated costs are intended for alternative comparison only and are not for construction bid purposes. Assumptions specific to each alternative regarding construction tasks and post-construction maintenance and monitoring activities are discussed in the following Sections 7.2 and 7.3. The estimated costs for each task are summarized in Table 8 and described in detail in Appendix 7.

7.2 Construction Elements Common to All Action Alternatives

There are five elements common to all Action Alternatives except the No Action and Institutional Controls Alternatives:

- Mini Excavator Mobilization $ 2,000
- Light Truck Mobilization $ 750
- Tank & Petroleum Soil Disposal $10,000
- Signage $ 1,000
- Annual Monitoring w/Report $15,000

The total of these five common elements is **$28,750**.

Tank and Soil Disposal consists of the following tasks:

1. Cutting open the tank and removing the sludge;
2. Cutting the tank into small sections for disposal or recycling;
3. Excavation of petroleum-contaminated soil;
4. Off-site disposal of the sludge;
5. Offsite disposal or recycling of the tank pieces; and
6. Off-site disposal of the petroleum contaminated soil.

The other four items are self-explanatory.

7.3 Detailed Analysis of Alternatives

The following subsections and Table 8 present a detailed analysis of the removal action alternatives based on the criteria discussed above. The removal action alternatives are conceptual designs only. The estimated material quantities were rounded for consistency with cost estimating spreadsheets and to facilitate internal review and verification. Maintenance and monitoring costs were limited to a three-year period following removal action.

7.3.1 Alternative 1 – No Action

This alternative consists of leaving the site as is in the present condition. No reclamation would be performed and no further investigation or monitoring would be conducted.

Effectiveness
This alternative will not achieve any of the project RAOs or comply with ARARs. There would be no protection of human health and the environment. The exposed mine waste, processed ore, petroleum-contaminated soil would continue to be a human health and environmental hazard from direct contact and continued erosion. The debris would also continue to pose a physical hazard as well as an environmental and health hazard. The potential for contaminant migration to Stanley and Deadman Creeks would continue and flood events may result in erosion of the mining wastes and deposition in the stream channels.

Implementability
This alternative is both technically and administratively feasible. However, agency and public acceptance is not likely.

Cost
There are no capital or O&M costs associated with this alternative. However, there may be significant long-term costs associated with future impacts or releases.

Summary
This alternative is required for comparative purposes by the NCP.

7.3.2 Alternative 2 – Institutional Controls

This alternative consists only of warning signage and 8-ft.-tall chain link fencing. Only the areas exceeding a BLM recreation SLs will be fenced:

- The processed ore pile, criteria soil sites, tank and petroleum contaminated soil (260 ft.); and
- The existing repository (300 ft.).

Some minor consolidation of waste piles will occur.

This alternative will require two field days.

Effectiveness

This alternative will not achieve all the project RAOs. There would be significant protection of human health by preventing direct contact. Contact by large animals would be significantly reduced, but small animals and birds would still have access. The exposed mine waste, processed ore, petroleum-contaminated soil would continue to erode. The debris would also continue to pose an environmental hazard. The potential for contaminant migration to Stanley and Deadman Creeks would continue and flood events may result in significant erosion of the mining wastes and deposition in the stream channels. 8-ft-tall chain link fence would be required to keep deer from entering. Effectiveness is rated as low.

Implementability

This alternative is both technically and administratively feasible. However, agency and public acceptance is not likely, because of limited ARAR compliance. The alternative is easy to implement. Implementability is rated high.

Cost

There are significant capital costs and maintenance costs associated with this alternative. Tall chain link fence is expensive to install in remote locations. Also, in timbered areas such as the site, fence damage from falling trees and limbs is common. Vandalism and theft is also a potential problem. There may be significant long-term costs associated with future impacts or releases. There may also be non-monetary costs associated with ecological impacts. Total cost over a three-year period is estimated at **$60,511**. Cost details are provided in Appendix 7. Comparative cost is rated low.

Summary

Alternative 2 does not comply with all ARARs and is relatively expensive for limited protection. Also, short and long-term maintenance is high for fencing in remote, timbered areas such as the Umpqua Mine. Vandalism and theft also are a potential problem.

7.3.3 Alternative 3 – On-Site Disposal

On-Site Disposal requires construction of a repository. The final design of the repository will be field-engineered. However, a conceptual design has been developed for this EE/CA (Figure 8). The best location for a repository is where the current temporary repository is located. The location is near an access road, close to a borrow source, and away from surface water. The sequence of steps to construct the repository is as follows:

1. Improve a temporary location in the open area to the east of the existing repository as well as access roads;
2. Decontaminate the old rotary kiln furnace and separators using shovels and a vacuum system with HEPA filters. The contaminants are ACM and elevated metals;
3. Layout fabric in the prepared area to contain any particles falling from the debris;

4. Excavate a diversion uphill from the repository;
5. Move the debris from its existing temporary repository to the pad;
6. Excavate a new repository in the location of the temporary repository as illustrated in Figure 8;
7. Excavate a drain tile trench around the margin of the repository base as illustrated in Figure 8;
8. Install drain tile in bedded washed gravel in the trench sloped to drain at two discharge points;
9. Cover the top of the trench with geotextile fabric to prevent particle intrusion;
10. Move the contaminated wood debris to the new repository as illustrated in Figure 8. Mix the wood with the criteria soil excavated from the site, estimated at 78 cubic yards to fill voids. Cap this with smoothed fill designed to form a cap that slopes away from the debris for collection in the drain tile;
11. Cover this material with HDPE liner or a geosynthetic clay liner (GCL). GCL is preferred here, because it is easier to work with and does not require welding;
12. Crush the condenser pipe with the excavator to minimize volume;
13. Stack all metal from the entire site appropriately as illustrated in Figure 8. Add fill as the metal debris is moved to fill voids;
14. Cover the repository with a minimum of two to three feet of compacted fill;
15. Cap the area with 0.5 to 1 foot of growth media;
16. Reclaim site roads as appropriate; and
17. Revegetate all disturbed area with a BLM-approved seed mixture and fertilizer.

This alternative will require 14 field days.

Effectiveness

This alternative is both technically and administratively feasible. The alternative will comply with all ARARs, and agency and public acceptance is likely, because of ARAR compliance. However, the repository will require perpetual maintenance to prevent growth of large trees that would eventually compromise cap integrity. Effectiveness is rated as high.

Implementability

This alternative is both technically and administratively feasible. Agency and public acceptance is likely, because of ARAR compliance. The alternative is relatively easy to implement, because of the small site size and good access. Implementability is moderate.

Cost

There are significant capital costs and maintenance costs associated with this alternative. The primary maintenance cost is ensuring that only shallow-rooting brush and grasses grow on the repository cap. Large deep-rooting trees can penetrate the liner material, and root systems may be shallow because of the liner presence. This results in trees that are more prone to toppling by wind which would expose the liner. The roots of a toppled tree could also penetrate the liner. Total cost over a three-year period is estimated at **$151,910**. Cost details are provided in Appendix 7. Cost is rated as moderate.

Summary
Alternative 3 complies with all ARARs and is relatively inexpensive for good protection. The primary drawback is perpetual maintenance of the repository to ensure cap and cover integrity.

7.3.4 Alternative 4 – Off-Site Disposal in a RCRA Subpart D Landfill

Off-Site Disposal does not require construction of a repository, because all debris and criteria soil will be removed. The sequence of steps to complete removal is as follows:

1. Improve a temporary location in the open area to the east of the existing repository as well as access roads;
2. Decontaminate the old rotary kiln furnace and separators using shovels and a vacuum system with HEPA filters. The contaminants are ACM and elevated metals;
3. Layout fabric in the prepared area to contain any particles falling from the debris;
4. Move the debris from its existing temporary repository to the pad;
5. Crush the condenser pipe with the excavator to minimize volume;
6. Load all waste and debris into trucks and cover for transport to a nearby RCRA Subpart D landfill. Up to 30 truck and pup loads may be required;
7. Reclaim site roads and disturbed areas as appropriate; and
8. Revegetate all disturbed area with a BLM-approved seed mixture and fertilizer.

This alternative will require 13 field days.

Effectiveness
This alternative is both technically and administratively feasible. The alternative will comply with all ARARs, and agency and public acceptance is likely, because of ARAR compliance. There will be no repository that requires perpetual maintenance. Effectiveness is rated as high.

Implementability
This alternative is both technically and administratively feasible. Agency and public acceptance is likely due to ARAR compliance. The alternative is relatively easy to implement, because of the small site size and good access. Overall implementability is considered moderate.

Cost
There are no capital costs and maintenance costs associated with this alternative. Total cost over a three-year period is estimated at **$192,161**. Cost details are provided in Appendix 7. Cost is rated as moderate.

Summary
Alternative 4 complies with all ARARs and is relatively inexpensive for good protection.

7.3.5 Alternative 4a – Off-Site Disposal in a RCRA Subpart C Landfill

This Off-Site Disposal alternative is similar to Alternative 4. The only difference is that all debris and criteria soil is transported to the Chem Waste RCRA Subpart C land fill in Arlington, Oregon. This alternative does not require construction of a repository, because all debris and criteria soil will be removed. The sequence of steps to complete removal is as follows:

1. Improve a temporary location in the open area to the east of the existing repository as well as access roads;
2. Decontaminate the old rotary kiln furnace and separators using shovels and a vacuum system with HEPA filters. The contaminants are ACM and elevated metals;
3. Layout fabric in the prepared area to contain any particles falling from the debris;
4. Move the debris from its existing temporary repository to the pad;
5. Crush the condenser pipe with the excavator to minimize volume;
6. Load all debris into trucks and cover for transport to the Chem Waste RCRA Subpart C landfill in Arlington, Oregon. Up to 30 truck and pup loads may be required;
7. Reclaim site roads and disturbed areas as appropriate; and
8. Revegetate all disturbed area with a BLM-approved seed mixture and fertilizer.

This alternative will require 11 field days.

Effectiveness
This alternative is both technically and administratively feasible. The alternative will comply with all ARARs, and agency and public acceptance is likely, because of ARAR compliance. There will be no repository that requires perpetual maintenance. Effectiveness is rated as high.

Implementability
This alternative is both technically and administratively feasible. Agency and public acceptance is likely due to ARAR compliance. The alternative is relatively easy to implement, because of the small site size and good access. Overall implementability is considered moderate.

Cost
There are no capital costs and maintenance costs associated with this alternative. Total cost over a three-year period is estimated at **$331,346**. Cost details are provided in Appendix 7. Cost is rated as high.

Summary
Alternative 4a complies with all ARARs and is significantly more expensive than Alternative 4.

AI personnel contacted two local RCRA Subpart D landfills, and both indicated they would accept any material that did not fail TCLP. If at the time of any Removal Action this position changes, Alternative 4a then would become required over Alternative 4.

7.3.6 Alternative 5 – On-Site Disposal with Partial Recycling of Metal Debris

As in Alternative 3, this alternative requires construction of a repository. However, part of the scrap iron piping will be removed and transported to the nearest recycling center as is recommended where feasible. The large parts of the brick lined kilns, the fire box, and the particle separators will be placed in an on-site repository. The recycled scrap will consist largely of the condenser pipe, which will be tested for metal contaminants prior to segregation. Sections that are contaminated will be placed in the repository. On-Site Disposal requires construction of a repository. The final design of the repository will be field-engineered. However, a conceptual design has been developed for this EE/CA. The best location for a repository is where the current temporary repository is located. The location is near an access road, close to a borrow source, and away from surface water. The sequence of steps to construct the repository is as follows:

1. Improve a temporary location in the open area to the east of the existing repository as well as access roads;
2. Decontaminate the old rotary kiln furnace and separators using shovels and a vacuum system with HEPA filters. The contaminants are ACM and elevated metals that will be disposed appropriately off-site;
3. Layout fabric in the prepared area to contain any particles falling from the debris;
4. Excavate a diversion uphill from the repository;
5. Move the debris from its existing temporary repository to the pad;
6. Excavate a new repository in the location of the temporary repository as illustrated in Figure 8;
7. Excavate a drain tile trench around the margin of the repository base as illustrated in Figure 8;
8. Install drain tile in bedded washed gravel in the trench sloped to drain at two discharge points;
9. Cover the top of the trench with geotextile fabric to prevent particle intrusion;
10. Move the contaminated wood debris to the new repository as illustrated in Figure 8. Mix the wood with the criteria soil excavated from the site, estimated at 74 cubic yards, to fill voids. Cap this with smoothed fill designed to form a cap that slopes away from the debris for collection in the drain tile;
11. Cover this material with HDPE liner or a geosynthetic clay liner (GCL). GCL is preferred here, because it is easier to work with and does not require welding;
12. Crush the condenser pipe with the excavator to minimize volume;
13. Test the condenser pipe with an XRF and segregate clean pipe for recycling;
14. Stack all metal from the entire site appropriately as illustrated in Figure 8. Add fill as the metal debris is moved to fill voids;
15. Cover the repository with a minimum of two to three feet of compacted fill;
16. Cap the area with 0.5 to 1 foot of growth media;
17. Transport the recyclable metal to the nearest recycle center; an estimated seven truck and pup loads are required;
18. Reclaim site roads as appropriate; and
19. Revegetate all disturbed area with a BLM-approved seed mixture and fertilizer.

This alternative will require 17 field days. This is higher than time required for Alternatives 3 and 4 due to the added time to test, segregate, and transport metal to a recycle center.

Effectiveness

This alternative is both technically and administratively feasible. The alternative will comply with all ARARs, and agency and public acceptance is likely, because of ARAR compliance. However, the repository will require perpetual maintenance to prevent growth of large trees that would eventually compromise cap integrity. Effectiveness is rated as high.

Implementability

This alternative is both technically and administratively feasible. Agency and public acceptance is likely, because of ARAR compliance. The alternative is relatively easy to implement, because of the small site size and good access. Implementability is moderate.

Cost

There are significant capital costs and maintenance costs associated with this alternative. The primary maintenance cost is ensuring that only shallow-rooting brush and grasses grow on the repository cap. Large deep-rooting trees can penetrate the liner material, and root systems may be shallow because of the liner presence. This results in trees that are more prone to toppling by wind which would expose the liner. The roots of a toppled tree could also penetrate the liner. In addition, the extra effort of recycling will add to the cost of this alternative. Total cost over a three-year period is estimated at **$167,137**. Cost details are provided in Appendix 7. Cost is rated as moderate.

Summary

Alternative 5 complies with all ARARs but is relatively expensive because of the added time and cost to recycle part of the scrap metal. The major drawback is perpetual maintenance of the repository to ensure cap and cover integrity.

8. RECOMMENDED REMOVAL ACTION ALTERNATIVE

A Comparative Analysis of Removal Action Alternatives is provided in Table 8.

As is indicated in Table 8, Alternatives 2 through 5 are compliant with ARARs. However, Alternative 2 is not compliant for ecological receptors. Alternatives 4, 4a, and 5 comply with all ARARs but at a significantly increased cost over Alternative 3. The advantage of complete removal of all criteria soil and debris provided in Alternatives 4 and 4a is offset by their higher costs relative to Alternative 3. Alternative 5 satisfies agency desires to recycle when possible. However, the added cost of recycling is a disadvantage.

The preferred removal action alternative is **Alternative 3 – Remove Waste Materials to an On-Site Repository, Cap and Revegetate**.

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TABLES

Table 1. XRF Field Data

Field Sample No.	Date	Arsenic (ppm)	Mercury (ppm)	Notes
1	4/18/2017	16.7	8.1	Power house area
2	4/18/2017	13.1	24.8	Power house area
3	4/18/2017	9.1	<LOD	Power house area
4	4/18/2017	13.8	<LOD	Power house area
5	4/18/2017	11.5	<LOD	Power house area
6	4/18/2017	45.3	11.2	Power house area
7	4/18/2017	47.7	19.8	Power house area
8	4/18/2017	13.7	<LOD	Upper processing area
9	4/18/2017	9.3	<LOD	Upper processing area
10	4/18/2017	9.1	<LOD	Upper processing area
11	4/18/2017	19	<LOD	Main processing area
12	4/18/2017	9.5	<LOD	Main processing area
13	4/18/2017	8.1	<LOD	Main processing area
14	4/18/2017	9.1	27.5	Main processing area
15	4/18/2017	15.3	10	Main processing area
16	4/18/2017	20.7	129	Main processing area
17	4/18/2017	59.8	401	Main processing area
18	4/18/2017	30.2	<LOD	Main processing area
19	4/18/2017	56.8	21.6	Main processing area
20	4/18/2017	27.3	15.1	Main processing area
21	4/20/2017	50.8	13.3	Main processing area
22	4/18/2017	98.3	4	Main processing area
23	4/18/2017	50.7	9.4	Main processing area
24	4/18/2017	16	<LOD	Main processing area
25	4/18/2017	15.5	15.9	Main processing area
26	4/18/2017	18	5.4	Main processing area
27	4/18/2017	26.4	5.9	Main processing area
28	4/18/2017	29	3.9	Main processing area
29	4/20/2017	21.6	2.9	Main processing area
30	4/18/2017	13	<LOD	Main processing area
31	4/18/2017	9.6	7	Main processing area
32	4/18/2017	13.7	36.1	Main processing area
33	4/18/2017	13.4	34.8	Main processing area
34	4/18/2017	21.4	159	Main processing area
35	4/18/2017	15.1	<LOD	Main processing area
36	4/18/2017	19.1	18.4	Main processing area
37	4/18/2017	13.8	<LOD	Main processing area
38	4/18/2017	15.1	2.7	Main processing area

Field Sample No.	Date	Arsenic (ppm)	Mercury (ppm)	Notes
39	4/18/2017	14.5	11.8	Main processing area
40	4/18/2017	15.5	62.4	Main processing area
41	4/18/2017	6	37.9	Upper processing area
42	4/18/2017	10.8	29.3	Upper processing area
43	4/18/2017	12.5	32.7	Upper processing area
44	4/18/2017	6.8	30.6	Upper processing area
45	4/18/2017	15.4	29.5	Upper processing area
46	4/18/2017	15.8	33.6	Upper processing area
47	4/18/2017	12.9	57.8	Upper processing area
48	4/18/2017	15.2	55.8	Upper processing area
49	4/19/2017	19.9	3.1	Upper processing area
50	4/20/2017	13.5	10.2	Upper processing area
51	4/19/2017	18.7	23.6	Upper processing area
52	4/19/2017	17.5	9.1	Upper processing area
53	4/20/2017	16.2	42.2	Upper processing area
54	4/20/2017	16.8	8	Upper processing area
57	4/20/2017	11.8	<LOD	Upper processing area
58	4/20/2017	15.7	23.2	Power house area
59	4/20/2017	58.1	7.8	Power house area
60	4/20/2017	14.7	30.2	Power house area
TP-1	4/19/2017	16.5	3.8	Test Pit, Depth: 0-2 ft
TP-1	4/19/2017	16.5	<LOD	Test Pit, Depth: 2-4 ft
TP-1	4/19/2017	9.9	<LOD	Test Pit, Depth: 4-6 ft
TP-2	4/19/2017	11.2	5	Test Pit, Depth: 0-2 ft
TP-2	4/19/2017	13.3	3.7	Test Pit, Depth: 2-4.5 ft
TP-2	4/19/2017	21.8	<LOD	Test Pit, Depth: 4.5-6 ft
TP-2	4/19/2017	12.3	3	Test Pit, Depth: 6.5 ft
TP-3	4/19/2017	11.2	<LOD	Test Pit, Depth: 0-2 ft
TP-3	4/19/2017	12.9	30.6	Test Pit, Depth: 2-4 ft
TP-3	4/19/2017	16.6	<LOD	Test Pit, Depth: 4-6 ft
TP-4	4/19/2017	10.9	70.5	Test Pit, Depth: 0-2 ft
TP-4	4/19/2017	10	55.8	Test Pit, Depth: 2-4 ft
TP-4	4/19/2017	13.4	26.4	Test Pit, Depth: 4-5.5 ft
TP-5	4/19/2017	10.4	19.7	Test Pit, Depth: 0-1 ft
TP-5	4/19/2017	10.4	8.8	Test Pit, Depth: 2 ft
TP-5	4/19/2017	11.3	5.7	Test Pit, Depth: 2-4 ft
TP-5	4/19/2017	24.4	<LOD	Test Pit, Depth: 4-5.7 ft

Shaded – Above BLM Recreational Screening Level (Arsenic = 30.6 ppm, Mercury = 271 ppm)
LOD – level of detection
ppm – parts per million

Table 2. Soil, Sediment, and Mine Waste Analytical Results - Metals

Sample ID	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Methylmercury	Selenium	Silver	Paste pH
	mg/kg									
Criteria										
BLM SLs	30.6	390,000	1,780	1,000,000	800	271	NS	9,780	9,780	NS
EPA RSL	3.0	220,000	9,800	1,800,000	800	46	120	5,800	5,800	NS
UMM-BKG-1	10.1	188	0.3	31.4	8.7	0.385	NA	ND (<4.0)	1.39	5.6
UMM-BKG-2	6.4	331	0.23	50	9.5	0.215	NA	ND (<4.0)	1.49	5.4
UMM-BKG-3	21.1	131	ND (<0.2)	60.5	5.3	0.207	NA	ND (<4.0)	1.33	5.9
UMM-PW-1	102	132	ND (<2.0)	57.2	9.1	6,730	NA	ND (<40)	5.32	4.5
UMM-PW-2	64.8	47	ND (<2.0)	68.2	57.4	10,100	NA	ND (<40)	13.9	6.9
UMM-SED-1	16.9	98.5	ND (<0.2)	30.2	2.9	0.088	NA	ND (<4.0)	1.26	NA
UMM-SED-2	8.3	138	ND (<0.2)	46.6	6.8	42.2	NA	ND (<4.0)	1.32	NA
UMM-SED-3	23.9	107	ND (<0.2)	26.5	4.6	3.84	NA	ND (<4.0)	1.46	NA
UMM-SED-4	9.8	426	0.59	33	19.9	ND (<0.033)	0.000015	ND (<4.0)	1.11	NA
UMM-SED-5	10.4	133	ND (<0.2)	29.7	6.7	0.163	0.000015	ND (<4.0)	1.27	NA
UMM-SS-1	12.2	110	1.86	30.9	26.3	9.67	NA	ND (<4.0)	1.26	5.2
UMM-SS-7	44	87.6	0.94	21.3	35.5	13.5	NA	ND (<4.0)	1.45	7.5
UMM-SS-14	11	97.3	ND (<0.2)	70.2	11.8	21.2	NA	ND (<4.0)	1.45	5.3
UMM-SS-16	21.3	114	0.27	54.5	12.4	230	NA	ND (<4.0)	1.51	7.2
UMM-SS-17	32.8	85.2	0.31	40	8.8	258	NA	ND (<4.0)	1.53	6.4
UMM-SS-24	8.2	139	ND (<0.2)	60.9	4.9	1.85	NA	ND (<4.0)	1.61	5.1
UMM-SS-26	11.5	75.2	ND (<0.2)	11.9	1.7	3.12	NA	ND (<4.0)	1.25	6.4
UMM-SS-28	57.3	89.6	0.21	17.6	2.4	1.77	NA	ND (<4.0)	3.62	7.2
UMM-SS-30	12.6	87.5	ND (<0.2)	70.3	7.9	0.552	NA	ND (<4.0)	1.5	5.4
UMM-SS-33	14	113	ND (<0.2)	72.7	15.6	287	NA	ND (<4.0)	1.55	6.2
UMM-SS-34	43.1	131	0.51	24	20.5	150	NA	ND (<4.0)	ND (<0.5)	5
UMM-SS-41	8.5	110	0.26	57	37.1	127	NA	ND (<4.0)	ND (<0.5)	6.7
UMM-SS-44	5.9	70.3	0.32	29.8	18.1	153	NA	ND (<4.0)	ND (<0.5)	6.4

Table 2. Soil, Sediment, and Mine Waste Analytical Results – Metals (continued)

Sample ID	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Methylmercury	Selenium	Silver	Paste pH
	mg/kg									
Criteria										
BLM SLs	30.6	390,000	1,780	1,000,000	800	271	NS	9,780	9,780	NS
EPA RSL	3.0	220,000	9,800	1,800,000	800	46	120	5,800	5,800	NS
UMM-SS-46	13.7	83.2	0.33	10.2	9.5	125	NA	ND (<4.0)	ND (<0.5)	6.7
UMM-SS-49	4.9	131	ND (<0.2)	96.4	10.1	ND (<0.033)	NA	ND (<4.0)	ND (<0.5)	5.9
UMM-SS-50	7.1	128	ND (<0.2)	78.8	10.5	4.5	NA	ND (<4.0)	ND (<0.5)	6.8
UMM-SS-54	6.8	99.2	ND (<0.2)	53.3	9.3	14	NA	ND (<4.0)	ND (<0.5)	7.1
UMM-SS-57	8.5	106	ND (<0.2)	76.6	48.1	2.22	NA	ND (<4.0)	ND (<0.5)	6
UMM-SS-65[a]	125	125	ND (<2.0)	50.4	11.7	7,580	NA	ND (<40)	ND (<5.0)	4.5
UMM-SS-66[b]	8.5	64.2	ND (<0.2)	10.3	3	1.47	NA	ND (<4.0)	ND (<0.5)	6.3

[a] Duplicate of UMM-PW-1
[b] Duplicate of UMM-SS-26
Shaded – Above BLM Recreational SL (BLM, 2016)
BKG – Background sample
NA – not analyzed
ND – not detected
NS – No standard
SED – Stream sediment sample
SS – Surface soil sample
PW – Processed waste sample

Table 3. Soil Petroleum Analytical Results

Sample ID	Depth (ft)	Benzene	Toluene	Ethylbenzene	m+p-Xylene	o-Xylene	Diesel	Lube Oil
		mg/kg						
UMM-SSP-1	1	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<1.0)	ND (<0.5)	140,000	71,743
UMM-SSP-2	1	ND (<0.005)	ND (<0.005)	ND (<0.005)	ND (<0.01)	ND (<0.005)	2,770	1,980
UMM-SSP-3	1	ND (<0.005)	ND (<0.005)	ND (<0.005)	ND (<0.01)	ND (<0.005)	3,374	7,640
UMM-SSP-4	3	ND (<0.005)	ND (<0.005)	ND (<0.005)	ND (<0.01)	ND (<0.005)	ND (<125)	1,470
Criteria								
BLM SLs		NS	NS	NS	NS	NS	NS	NS
EPA RSL		5.1	47,000	25	2,400	2,800	NS	NS
OR RBC		380.0	28,000	1700	20,000[a]	20,000[a]	4,600	4,600

[a] Screening level for total xylenes
Shaded – Above OR RBC
ND – not detected
OR RBC – State of Oregon Risk-Based Concentrations (OR DEQ, http://www.oregon.gov/deq/FilterDocs/RBDMTable.pdf)
SSP – Surface soil petroleum sample

Table 4. Surface Water Quality Analytical Results

Sample ID	Arsenic	Barium	Cadmium	Chromium	Lead	Magnesium	Mercury	Selenium	Silver	Hardness (as CaCO3)	pH	Total Dissolved Solids	Sulfate (as SO4)
	mg/L												
UMM-SW-1	ND (<0.025)	0.0318	ND (<0.002)	ND (<0.006)	ND (<0.0075)	2.64	ND (<0.0002)	ND (<0.04)	ND (<0.005)	34.7	7.68	78	0.56
UMM-SW-2	ND (<0.025)	0.135	ND (<0.002)	ND (<0.006)	ND (<0.0075)	19.2	ND (<0.0002)	ND (<0.04)	ND (<0.005)	164	7.75	194	6.29
UMM-SW-3	ND (<0.025)	0.0338	ND (<0.002)	ND (<0.006)	ND (<0.0075)	3.75	ND (<0.0002)	ND (<0.04)	ND (<0.005)	42.1	7.76	71	1.07
UMM-SW-4	ND (<0.025)	0.0155	ND (<0.002)	ND (<0.006)	ND (<0.0075)	1.85	ND (<0.0002)	ND (<0.04)	ND (<0.005)	22.6	7.44	49	1.22
UMM-SW-5	ND (<0.025)	0.0208	ND (<0.002)	ND (<0.006)	ND (<0.0075)	2.16	ND (<0.0002)	ND (<0.04)	ND (<0.005)	25.9	7.52	53	1.03
Screening Levels													
MCL	0.01	2.0	0.005	NS	0.015	NS	0.002	0.05	NS	NS	NS	NS	NS
EPA RSL	0.000052	3.8	0.0092	22	0.015	NS	0.00063	0.1	0.094	NS	NS	NS	NS
HHS	0.0021	1.0	NS	NS	NS	NS	NS	0.12	NS	NS	NS	NS	NS

HHS – Oregon & EPA Human Health (Water + Organisms) 06/01/10
MCL – Federal Drinking Water Standard Maximum Contaminant Level
ND – Not detected
NS – No standard
RSL – EPA Regional Screening Level for tapwater

Table 5. TCLP Analytical Results

Analyte	UMM-PW-1	UMM-PW-2	UMM-SS-17	TCLP Regulatory Max Conc.
Arsenic	ND (<0.05)	ND (<0.05)	ND (<0.05)	5.0
Barium	ND (<1.0)	ND (<1.0)	ND (<1.0)	100
Cadmium	ND (<0.01)	ND (<0.01)	ND (<0.01)	1.0
Chromium	ND (<0.05)	ND (<0.05)	ND (<0.05)	5.0
Lead	ND (<0.05)	0.353	ND (<0.05)	5.0
Mercury	0.097	0.00498	0.00077	0.2
Selenium	ND (<0.05)	ND (<0.05)	ND (<0.05)	1.0
Silver	ND (<0.05)	ND (<0.05)	ND (<0.05)	5.0
pH	4.95	5.19	5.02	NS
% Dry Solids	68.7	75.7	72.2	NS

ND – Not detected
NS – No standard

Table 6. Removal Action Technology Screening Matrix

Technology Class	Process Option	Description	Effectiveness	Implementability	Cost	O&M	Land Impact	Pros	Cons	Retained?
No Action										
No action	No action	Leave feature(s) as is	0	0	0	None	None	Low cost, simple	No risk reduction	Yes
Institutional Controls										
Access Restrictions, Community Education and Outreach	Fencing and signs	Fences Installed around Mine Waste and signs posted to notify public of risks	Low	High	Low	High	Minimal	Low cost, simple	Does not stop contaminant migration or prevent small animal contact	Yes
On-Site Repository										
Engineering Controls	On-site repository	Excavate a drained repository and locate all wood/metal debris and criteria soil within and cap.	High	Moderate	Moderate	Moderate	Moderate	Effective	Very effective, prevents contaminant erosion and human contact	Yes
Off-Site Disposal - Subpart D Landfill										
Engineering Controls	Off-site disposal	Haul mine waste to off-site RCRA-D permitted landfill for disposal	High	Moderate	Moderate	Low	Low	Very effective	Higher cost	Yes
Off-Site Disposal - Subpart C Landfill										
Engineering Controls	Off-site disposal	Haul mine waste to off-site RCRA-C permitted landfill for disposal	High	Moderate	High	Low	Low	Very effective	Highest cost	Yes
On-Site Disposal w/Partial Recycling										
Engineering Controls	On-site repository w/partial off-site recycling	Excavate a drained repository and locate all wood and some metal debris and criteria soil within and cap. Segregate uncontaminated metal for local recycling	High	Moderate	Moderate	Moderate	Moderate	Effective. Promotes recycling	Higher cost	Yes
On-Site Treatment										
Treatment	On-site treatment of contaminated media	Evaluate and apply appropriate on-site treatment methods to capture or isolate contaminants	Low	Low	High	High	High	Probably not effective	Very high cost and treatment technologies have not been well developed for this type of mine waste	**No**

Table 7. Removal Action Alternatives Developed for Analysis

Alternative	Description	Applies To
1 - No Action	Site remains as is.	Entire site
2 - Institutional Controls	Signs will be posted around the mine waste, metal contaminated soil and adit discharge areas to notify the public of risks, and informational placards will be installed at selected areas to inform the public of site risks. The existing debris repository, and all areas that exceed any criteria will be fenced.	Entire site
3 - On-Site Disposal	Waste rock, processed ore and soil that exceeds any criteria, and all debris would be excavated and consolidated in a newly constructed repository near the existing debris stockpile. Material that exceeds any criteria will be isolated in the repository for later covering by liner. The entire repository will be capped with a 2- to 3-foot thick soil cover. A synthetic cover consisting of a geosynthetic clay liner composite will be placed on the criteria waste prior to soil covering. The repository will be revegetated with fertilizer and a BLM approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler; sludge and contaminated soil will be disposed of at an approved off-site facility.	Entire site
4 - Off-Site Disposal RCRA Subpart D	Waste rock, processed ore and soil that exceeds any criteria, and all debris would be excavated and transported to a RCRA Subpart D landfill. All disturbed areas will be revegetated with fertilizer and a BLM approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler; sludge and contaminated soil will be disposed of at an approved off-site facility.	Entire site
5 - Off-Site Disposal RCRA Subpart C	Waste rock, debris, processed ore and soil that exceeds any criteria and if local Subpart D landfill will not accept, would be excavated and transported to a RCRA Subpart C landfill. All disturbed areas will be revegetated with fertilizer and a BLM approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler; sludge and contaminated soil will be disposed of at an approved off-site facility.	Entire site

Alternative	Description	Applies To
6 - On-Site Disposal w/ Partial Recycling	Waste rock, processed ore and soil that exceeds any criteria, and part of the debris would be excavated and consolidated in a newly constructed repository near the existing debris stockpile pile. Material that exceeds any criteria will be isolated in the repository for later covering by liner. The entire repository will be capped with a 2- to 3-foot thick soil cover. A synthetic cover consisting of a geosynthetic clay liner composite will be placed on the criteria waste prior to soil covering. Part of the metal such as the condenser and miscellaneous debris will be tested by XRF and if approved would be transported from the site and recycled. The repository will be revegetated with fertilizer and a BLM approved seed mix. The fuel oil tank will be cleaned, cut up, and transported to the nearest metal recycler; sludge and contaminated soil will be disposed of at an approved off-site facility.	Entire site

Table 8. Comparative Analysis of Removal Action Alternatives

Assessment Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 On-Site Disposal	Alternative 4 Off-Site Disposal RCRA Subpart D	Alternative 4a Off-Site Disposal RCRA Subpart C	Alternative 5 On-Site Disposal w/ Partial Recycling
Overall Protectiveness of Public Health, Safety, and Welfare	No protection	Moderate to Low - Reduces public exposure to metals in mine water/waste through fencing and signage. Not effective for ecological receptors.	High - Access to waste by people and biota is precluded. Erosion is minimal.	High - No toxic material remains on-site.	High - No toxic material remains on-site.	High - Access to waste by people and biota is precluded. Erosion is minimal.
Compliance with ARARs	Does not comply	Compliant	Compliant	Compliant	Compliant	Compliant
Long-term Effectiveness and Permanence	None	Low - Signs and fencing will require periodic replacement due to vandalism and damage.	High - Access to waste by people and biota is precluded.	High - No toxic material remains on-site.	High - No toxic material remains on-site.	High - Access to waste by people and biota is precluded.
Reduction in Toxicity, Mobility, and Volume	None	Low - Does not reduce mobility, toxicity or volume. Applies to site access and public education. Not a treatment or reduction technology.	Moderate - Mobility and access is reduced but not toxicity or volume.	High - No toxic material remains on-site. Mobility, toxicity, and volume are eliminated.	High - No toxic material remains on-site. Mobility, toxicity, and volume are eliminated.	Moderate - Mobility and access is reduced but not toxicity. Slight reduction in volume.
Short-term Effectiveness	None	Moderate - Will limit access initially, but subject to damage and vandalism.	High - Access is eliminated and erosion is reduced.	High - No toxic material remains on-site.	High - No toxic material remains on-site.	High - Access is eliminated and erosion is reduced.
Implementability	Not applicable	High - Rapidly implementable with placement of signs and fencing.	Moderate - Significant construction is required.	Moderate - Significant construction is required.	Moderate - Significant construction is required.	Moderate - Significant construction is required.

Assessment Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 On-Site Disposal	Alternative 4 Off-Site Disposal RCRA Subpart D	Alternative 4a Off-Site Disposal RCRA Subpart C	Alternative 5 On-Site Disposal w/ Partial Recycling
State and Community Acceptance	Not acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Cost	**$0**	**$60,511.00**	**$151,910.00**	**$192,161.00**	**$331,346.00**	**$167,137.00**

FIGURES

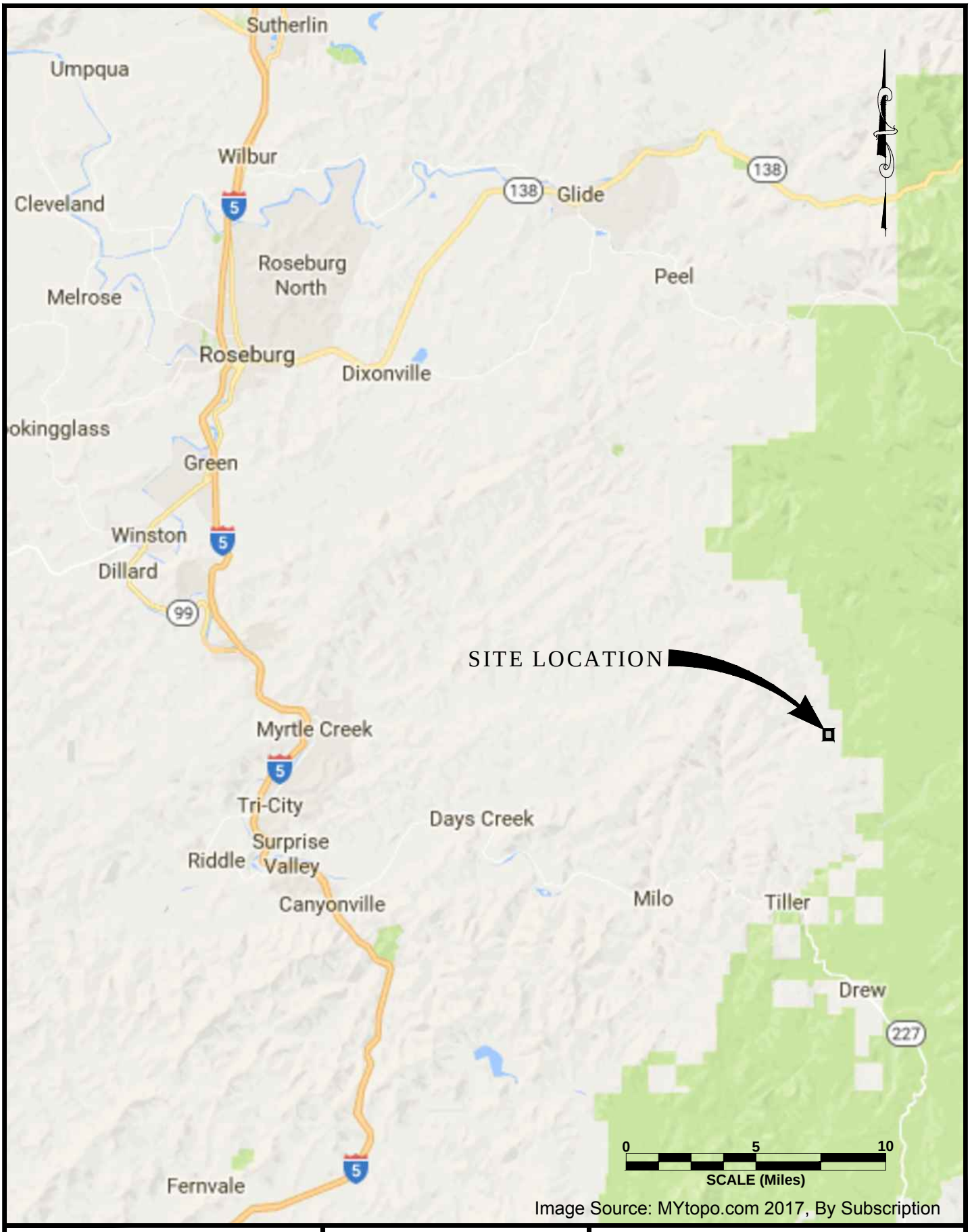

Image Source: MYtopo.com 2017, By Subscription

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Boise, Idaho 83706

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UMPQUA MINE
Douglas County, Oregon

FIGURE 1
SITE VICINITY MAP

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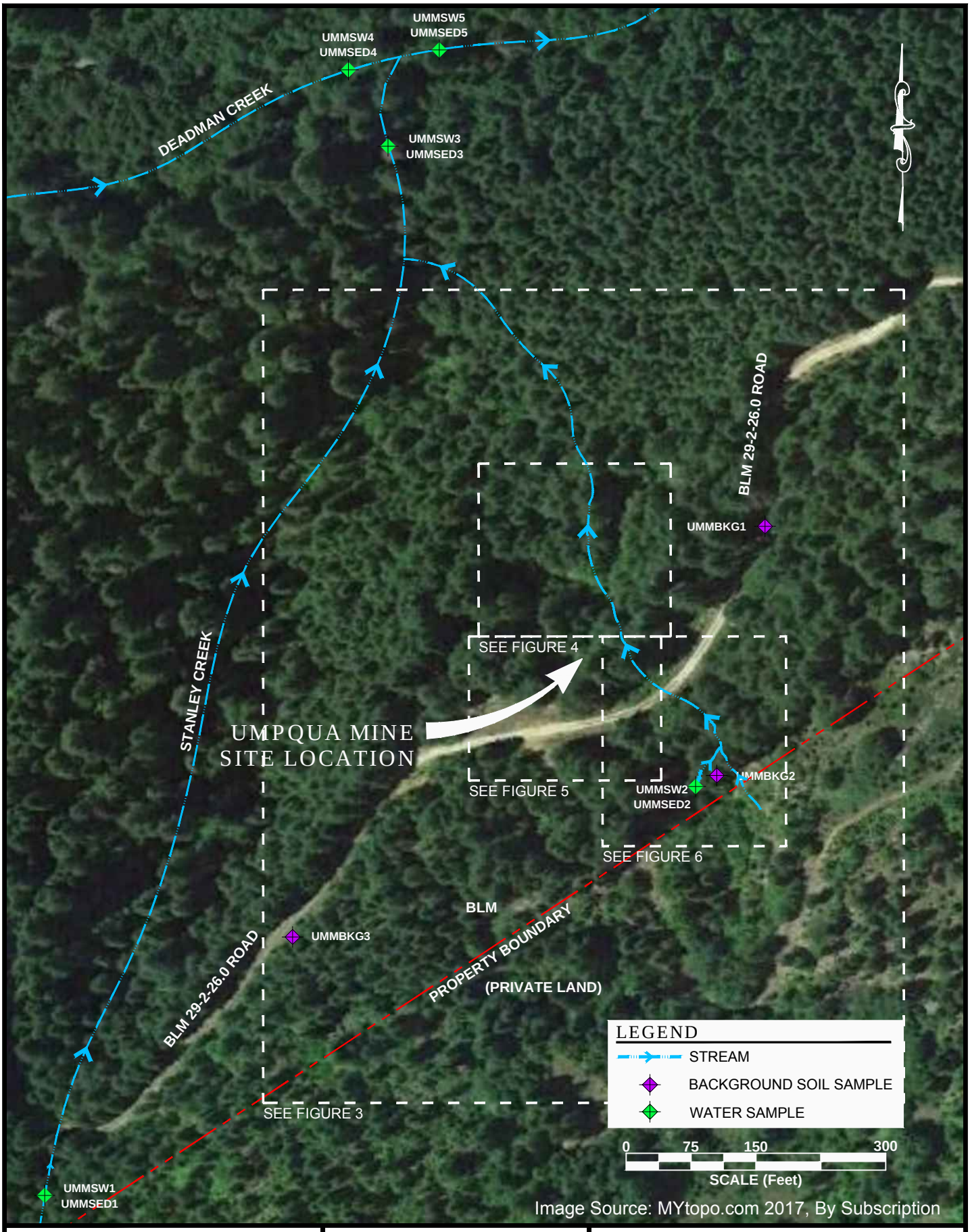

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Douglas County, Oregon

FIGURE 2
SITE MAP WITH BACKGROUND SOIL AND SURFACE WATER SAMPLE LOCATIONS

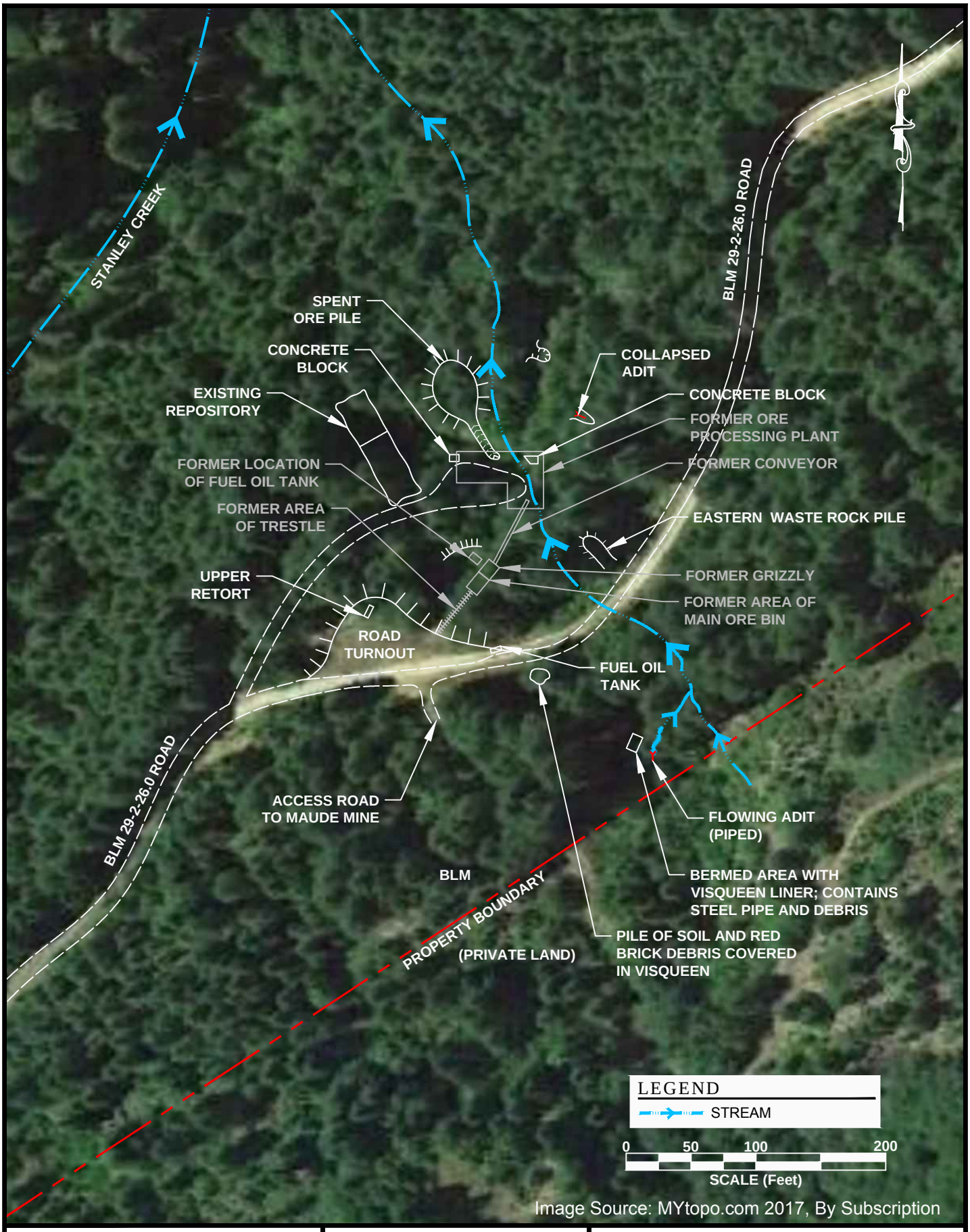

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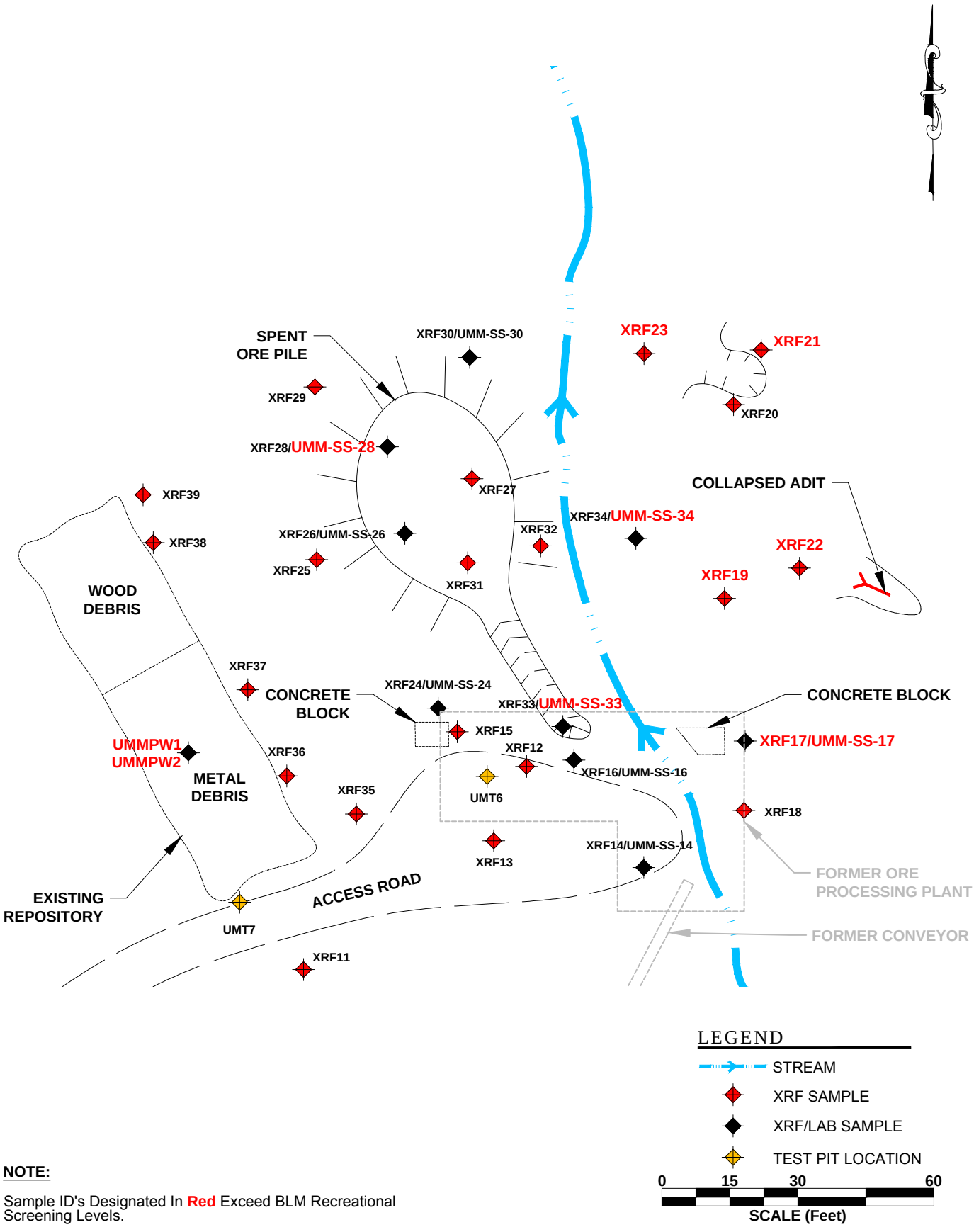
FIGURE 3
GENERAL SITE FEATURES MAP



NOTE:

Sample ID's Designated In **Red** Exceed BLM Recreational Screening Levels.

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FIGURE 4
MAIN PROCESSING PLANT

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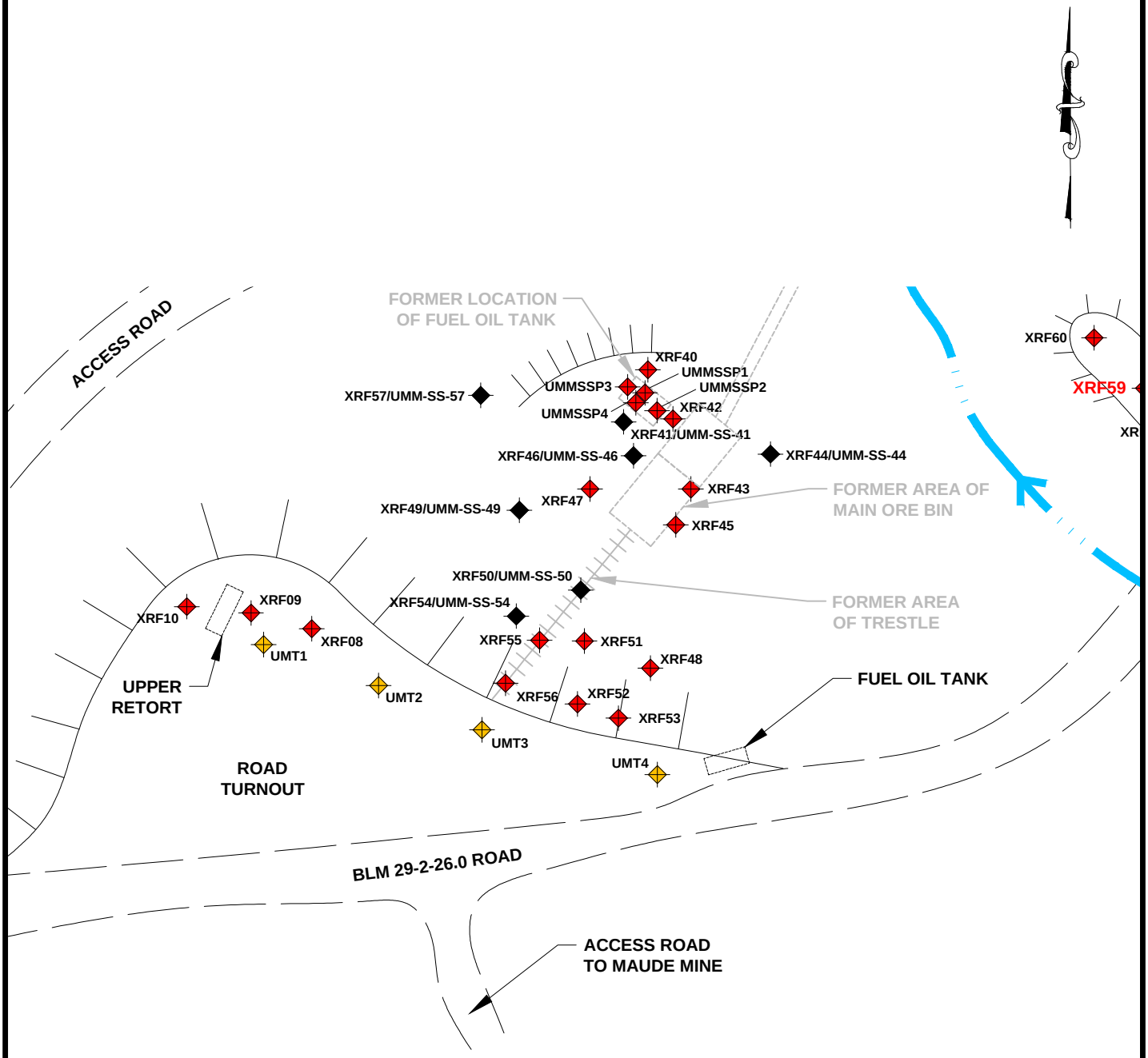

NOTE:

Sample ID's Designated In **Red** Exceed BLM Recreational Screening Levels.

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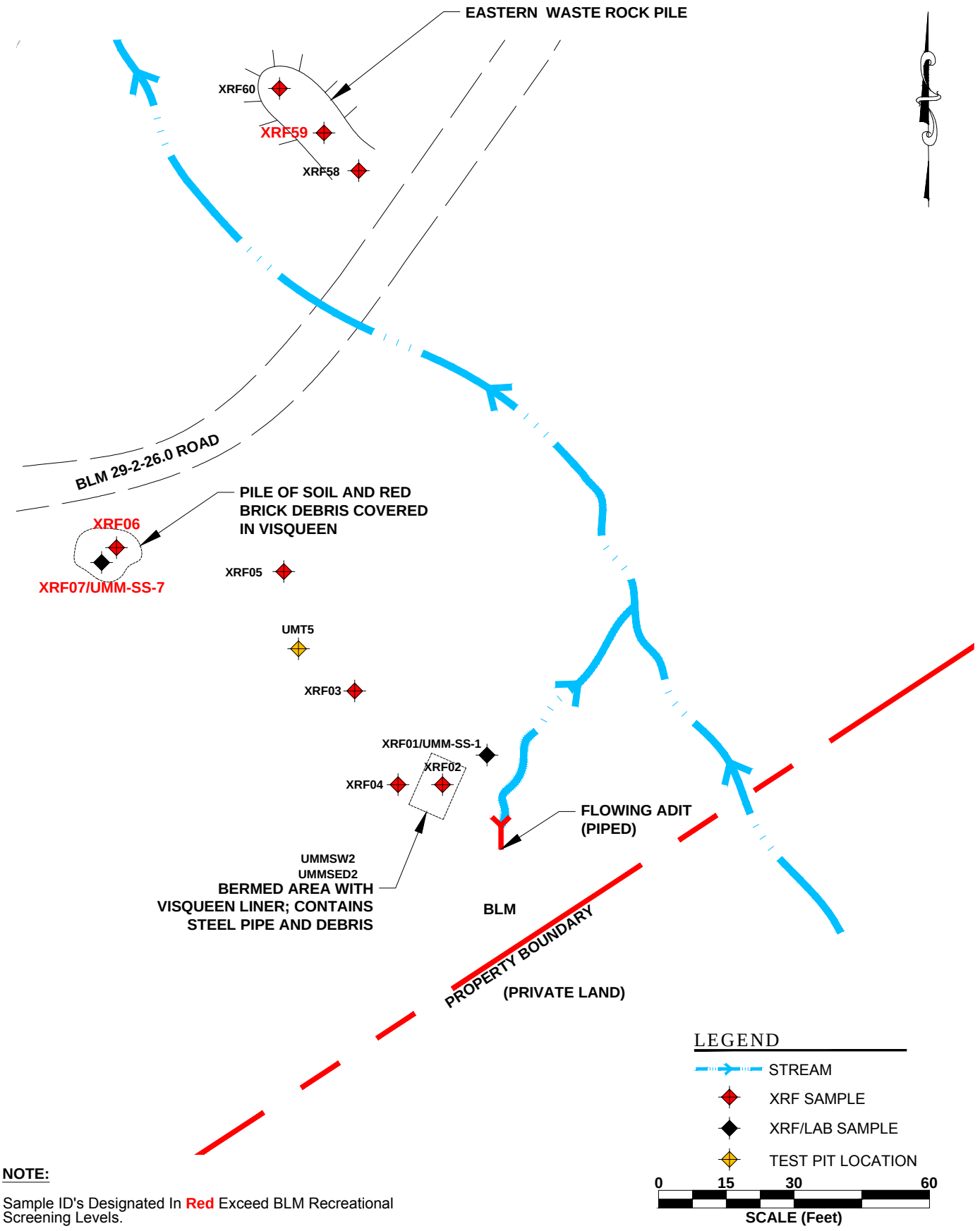
FIGURE 5
UPPER PROCESSING AREA



NOTE:

Sample ID's Designated In **Red** Exceed BLM Recreational Screening Levels.

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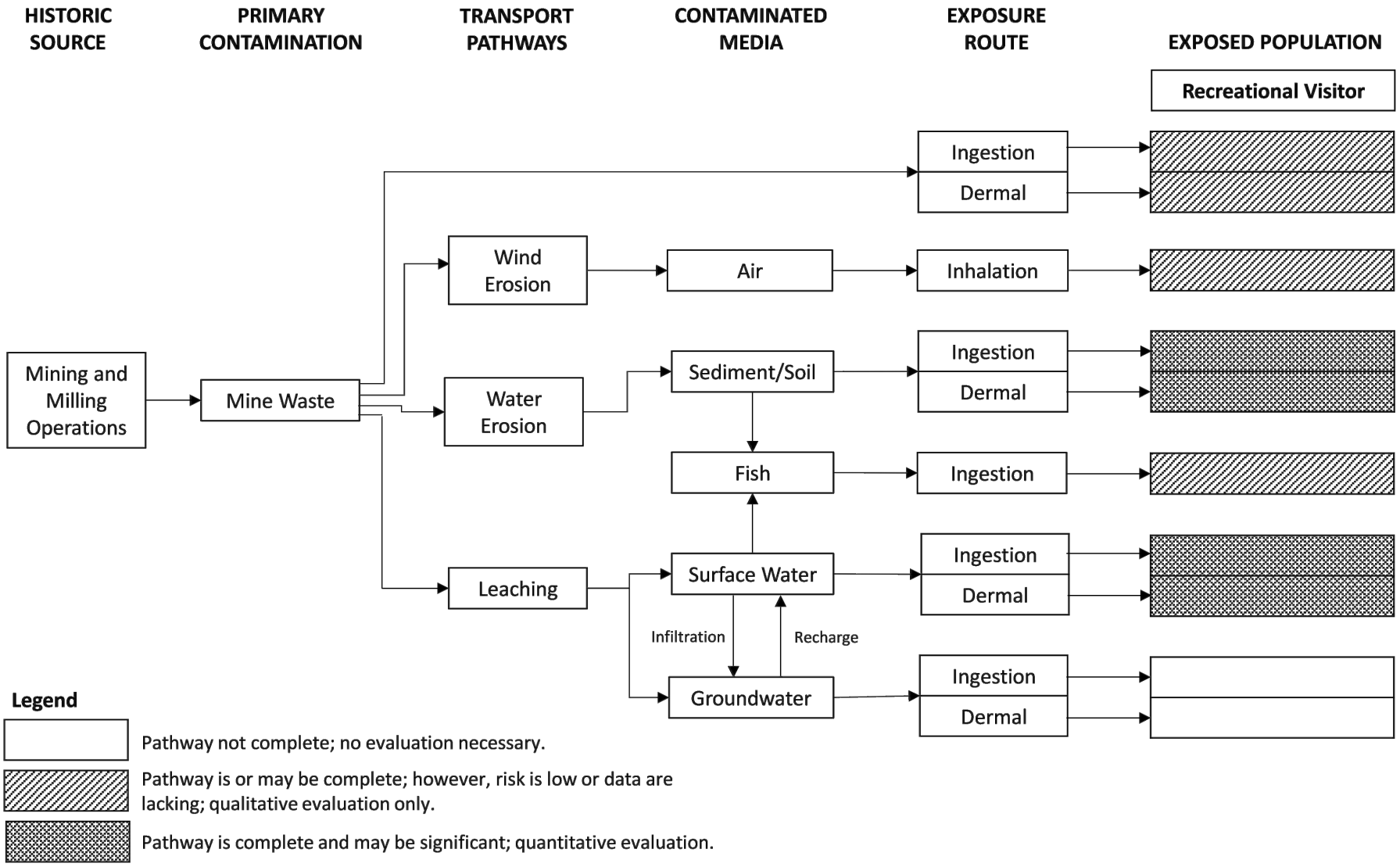
FIGURE 6
POWER HOUSE AREA



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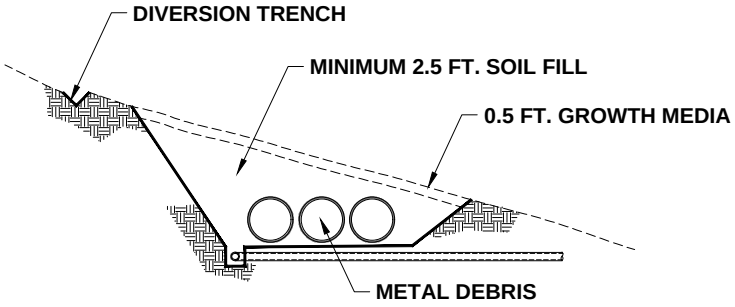
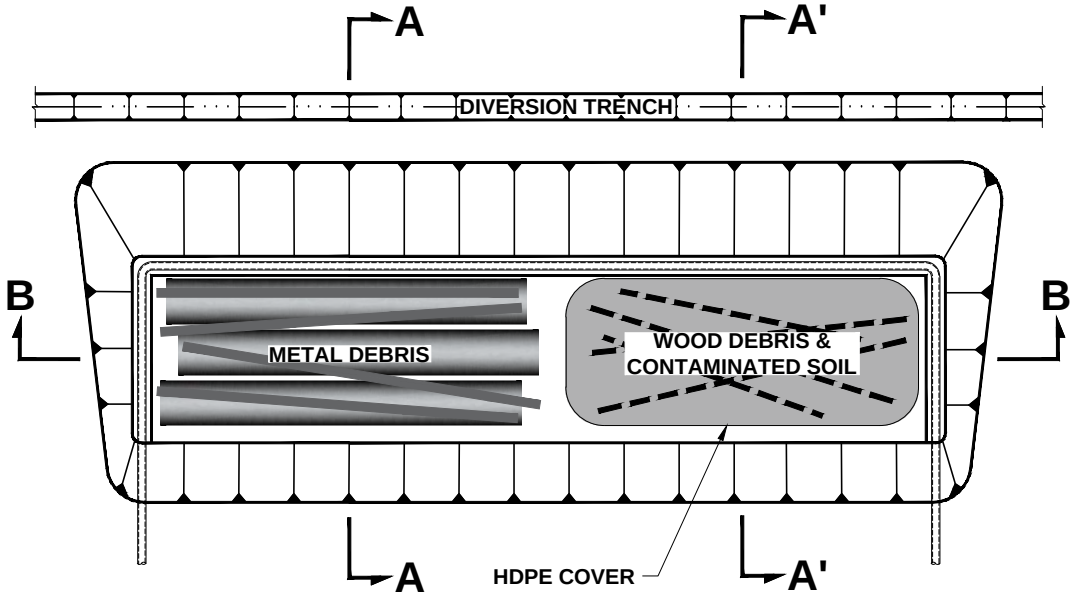
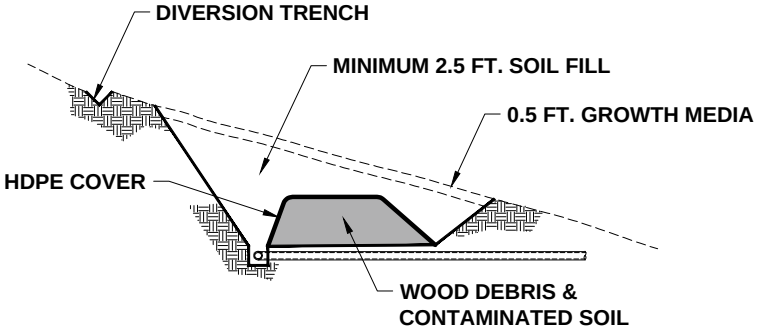
Douglas County, Oregon

FIGURE 7
CONCEPTUAL SITE MODEL



SECTION A-A





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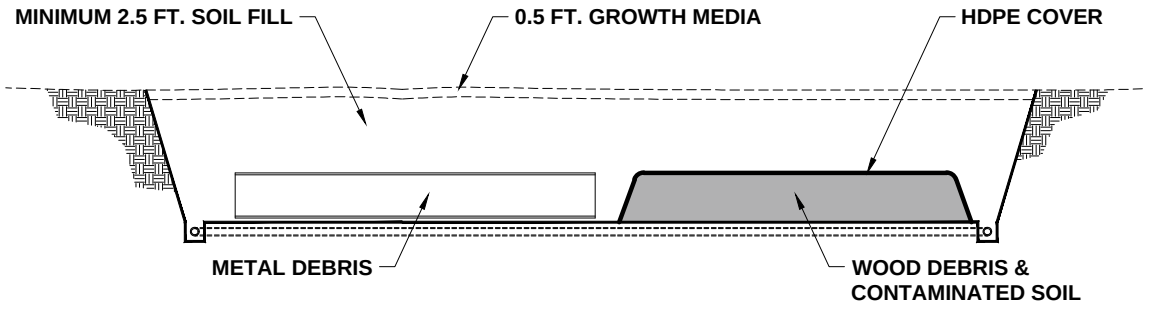

SECTION B-B

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Douglas County, Oregon

FIGURE 8
CONCEPTUAL* REPOSITORY SCHEMATIC
* THE FINAL DESIGN WILL BE FIELD-ENGINEERED

APPENDIX 1

Ecological Resource Database Results

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Douglas County, Oregon

Local office

Oregon Fish And Wildlife Office

(503) 231-6179
(503) 231-6195

2600 Southeast 98th Avenue, Suite 100
Portland, OR 97266-1398

https://www.fws.gov/oregonfwo/articles.cfm?id=149489416

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.

5. Click REQUEST SPECIES LIST.

Listed species[1] are managed by the Endangered Species Program of the U.S. Fish and Wildlife Service.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Northern Spotted Owl Strix occidentalis caurina There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. https://ecos.fws.gov/ecp/species/1123	Threatened

Flowering Plants

NAME	STATUS
Kincaid's Lupine Lupinus sulphureus ssp. kincaidii There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. https://ecos.fws.gov/ecp/species/3747	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Northern Spotted Owl Strix occidentalis caurina https://ecos.fws.gov/ecp/species/1123#crithab	Final designated

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any activity that results in the take (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service[3]. There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Conservation measures for birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Year-round bird occurrence data http://www.birdscanada.org/birdmon/default/datasummaries.jsp

The migratory birds species listed below are species of particular conservation concern (e.g. Birds of Conservation Concern) that may be potentially affected by activities in this location. It is not a list of every bird species you may find in this location, nor a guarantee that all of the bird species on this list will be found on or near this location. Although it is important to try to avoid and minimize impacts to all birds, special attention should be made to avoid and minimize impacts to birds of priority concern. To view available data on other bird species that may occur in your project area, please visit the AKN Histogram Tools and Other Bird Data Resources. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

NAME	SEASON(S)

Bald Eagle Haliaeetus leucocephalus https://ecos.fws.gov/ecp/species/1626	Year-round
Calliope Hummingbird Stellula calliope https://ecos.fws.gov/ecp/species/9526	Breeding
Flammulated Owl Otus flammeolus https://ecos.fws.gov/ecp/species/7728	Breeding
Fox Sparrow Passerella iliaca	Breeding
Least Bittern Ixobrychus exilis https://ecos.fws.gov/ecp/species/6175	Breeding
Lewis's Woodpecker Melanerpes lewis https://ecos.fws.gov/ecp/species/9408	Wintering
Loggerhead Shrike Lanius ludovicianus https://ecos.fws.gov/ecp/species/8833	Breeding
Oak Titmouse Baeolophus inornatus https://ecos.fws.gov/ecp/species/9656	Year-round
Olive-sided Flycatcher Contopus cooperi https://ecos.fws.gov/ecp/species/3914	Breeding
Oregon Vesper Sparrow Pooecetes gramineus ssp. affinis https://ecos.fws.gov/ecp/species/5141	Breeding
Peregrine Falcon Falco peregrinus https://ecos.fws.gov/ecp/species/8831	Breeding
Purple Finch Carpodacus purpureus	Year-round
Rufous Hummingbird selasphorus rufus https://ecos.fws.gov/ecp/species/8002	Breeding
Short-eared Owl Asio flammeus https://ecos.fws.gov/ecp/species/9295	Year-round
Western Grebe aechmophorus occidentalis https://ecos.fws.gov/ecp/species/6743	Breeding
White Headed Woodpecker Picoides albolarvatus https://ecos.fws.gov/ecp/species/9411	Year-round
Willow Flycatcher Empidonax traillii https://ecos.fws.gov/ecp/species/3482	Breeding

What does IPaC use to generate the list of migratory bird species potentially occurring in my specified location?

Landbirds:

Migratory birds that are displayed on the IPaC species list are based on ranges in the latest edition of the National Geographic Guide, Birds of North America (6th Edition, 2011 by Jon L. Dunn, and Jonathan Alderfer). Although these ranges are coarse in nature, a number of U.S. Fish and Wildlife Service migratory bird biologists agree that these maps are some of the best range maps to date. These ranges were clipped to a specific Bird Conservation Region (BCR) or USFWS Region/Regions, if it was indicated in the 2008 list of Birds of Conservation Concern (BCC) that a species was a BCC species only in a particular Region/Regions. Additional modifications have been made to some ranges based on more local or refined range information and/or information provided by U.S. Fish and Wildlife Service biologists with species expertise. All migratory birds that show in areas on land in IPaC are those that appear in the 2008 Birds of Conservation Concern report.

Atlantic Seabirds:

Ranges in IPaC for birds off the Atlantic coast are derived from species distribution models developed by the National Oceanic and Atmospheric Association (NOAA) National Centers for Coastal Ocean Science (NCCOS) using the best available seabird survey data for the offshore Atlantic Coastal region to date. NOAANCCOS assisted USFWS in developing seasonal species ranges from their models for specific use in IPaC. Some of these birds are not BCC species but were of interest for

inclusion because they may occur in high abundance off the coast at different times throughout the year, which potentially makes them more susceptible to certain types of development and activities taking place in that area. For more refined details about the abundance and richness of bird species within your project area off the Atlantic Coast, see the Northeast Ocean Data Portal. The Portal also offers data and information about other types of taxa that may be helpful in your project review.

About the NOAANCCOS models: the models were developed as part of the NOAANCCOS project: Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf. The models resulting from this project are being used in a number of decision-support/mapping products in order to help guide decision-making on activities off the Atlantic Coast with the goal of reducing impacts to migratory birds. One such product is the Northeast Ocean Data Portal, which can be used to explore details about the relative occurrence and abundance of bird species in a particular area off the Atlantic Coast.

All migratory bird range maps within IPaC are continuously being updated as new and better information becomes available.

Can I get additional information about the levels of occurrence in my project area of specific birds or groups of birds listed in IPaC?

Landbirds:

The Avian Knowledge Network (AKN) provides a tool currently called the "Histogram Tool", which draws from the data within the AKN (latest,survey, point count, citizen science datasets) to create a view of relative abundance of species within a particular location over the course of the year. The results of the tool depict the frequency of detection of a species in survey events, averaged between multiple datasets within AKN in a particular week of the year. You may access the histogram tools through the Migratory Bird Programs AKN Histogram Tools webpage.

The tool is currently available for 4 regions (California, Northeast U.S., Southeast U.S. and Midwest), which encompasses the following 32 states: Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North, Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin.

In the near future, there are plans to expand this tool nationwide within the AKN, and allow the graphs produced to appear with the list of trust resources generated by IPaC, providing you with an additional level of detail about the level of occurrence of the species of particular concern potentially occurring in your project area throughout the course of the year.

Atlantic Seabirds:

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAANCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Facilities

Wildlife refuges

Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGES AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

THERE ARE NO KNOWN WETLANDS AT THIS LOCATION.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX 2

Site Photographs

Soil Background Sample UMM-BKG-3

Powerhouse Area Soil Stockpile

Powerhouse Area Steel and Debris Repository

Upper Adit Discharge Stream, Powerhouse Area

Posted Signage Near Upper Adit

Powerhouse Area Soil Stockpile

Fuel Oil Tank Next to BLM Road

Upper Retort, Upper Processing Area

Former Ore Processing Plant Area, Looking East, Note Stream Flowing Through the Area

Soil XRF-60 Sample Location, Eastern Waste Rock Pile, Looking North

Metal Debris in non-Engineered Repository

Metal Debris in non-Engineered Repository, Note Torn Visqueen Liner

Rotary Kiln in non-Engineered Repository

Concrete Block Near Former Ore Processing Plant, Looking Northwest

Concrete Block Near Former Ore Processing Plant, Note Stream, Looking East

View of Upper Ravine Above Spent Ore Pile, Looking North

View of Former Trestle Area and Main Ore Bin

View of Collapsed Adit, Main Processing Plant Area

View of Former Ore Processing Plant Area from Spent Ore Pile, Looking South

View of Former Ore Processing Plant Area, Looking Southwest, Note Sample Location XRF-21 in Foreground

View of Spent Ore Pile, Looking South

Spent Ore Pile Looking North, Note Steel Rail

View of Brick-Lined Rotary Kiln in Scrap Repository, Note Process Residuals and Torn Visqueen

Excavating Test Pit Using Mini Excavator

Test Pit UMT1

Test Pit UMT2

Test Pit UMT3

Test Pit UMT4

 **Test Pit UMT5**	

APPENDIX 3

XRF Correlation Data

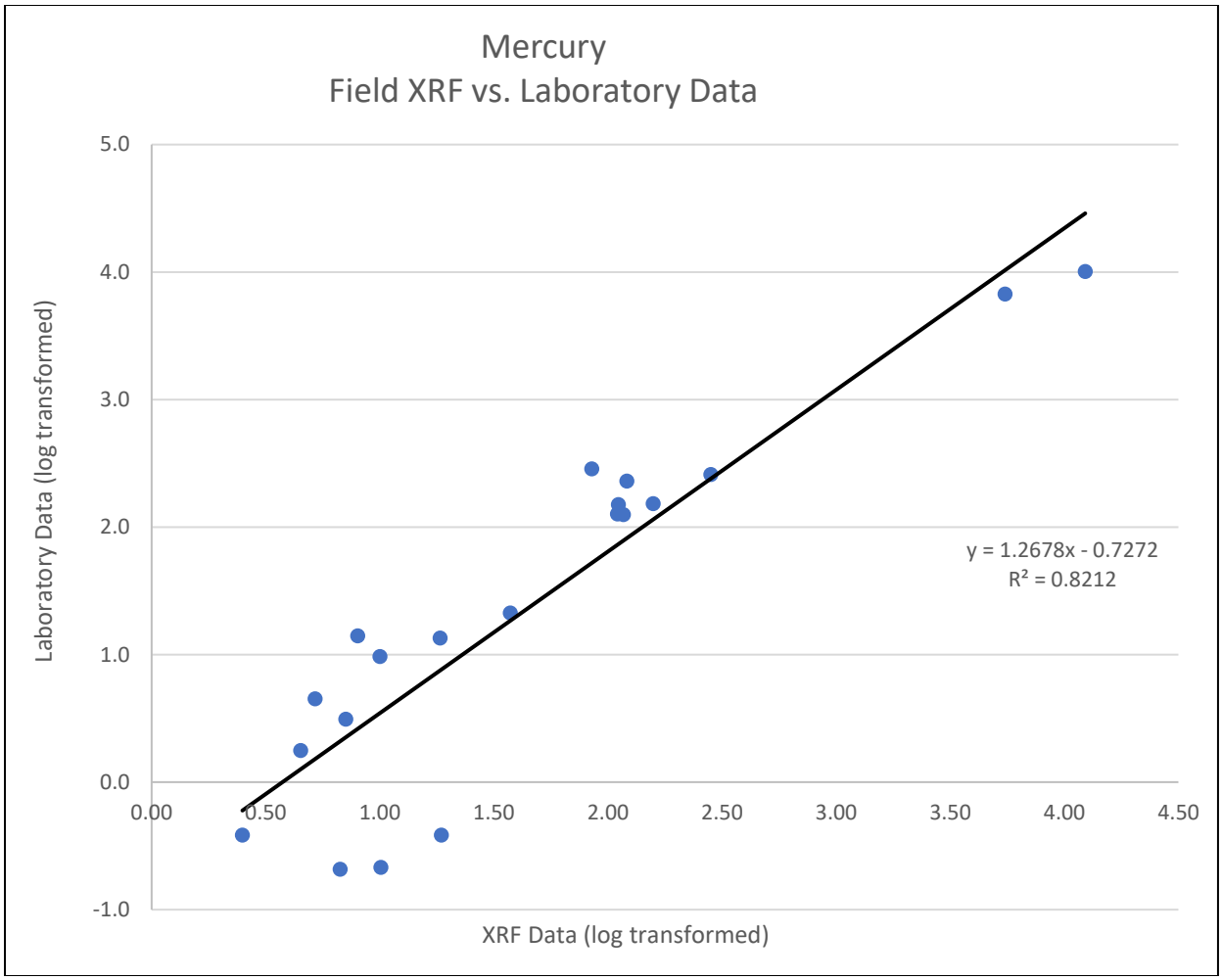

Table A. Correlation between Field XRF and Laboratory Data - Mercury

XRF Reading No.	Sample No.	XRF (ppm)	Lab (mg/kg)	XRF Log Transformed	Lab Log Transformed
48	UMM-BKG-1	18.6	0.385	1.3	-0.4
49	UMM-BKG-2	10.1	0.215	1.0	-0.7
50	UMM-BKG-3	6.7	0.207	0.8	-0.7
10	UMM-BKG-1	2.5	0.385	0.4	-0.4
11	UMM-BKG-2	<LOD	0.215	NA	-0.7
12	UMM-BKG-3	<LOD	0.207	NA	-0.7
13	UMM-SS-1	10	9.67	1.0	1.0
14	UMM-SS-7	18.4	13.5	1.3	1.1
17	UMM-SS-14	37.3	21.2	1.6	1.3
18	UMM-SS-16	121	230	2.1	2.4
19	UMM-SS-17	282	258	2.5	2.4
20	UMM-SS-24	<LOD	1.85	NA	0.3

XRF Reading No.	Sample No.	XRF (ppm)	Lab (mg/kg)	XRF Log Transformed	Lab Log Transformed
21	UMM-MW/SS-26	7.1	3.12	0.9	0.5
22	UMM-MW/SS-28	4.5	1.77	0.7	0.2
23	UMM-SS-30	<LOD	0.552	NA	-0.3
24	UMM-SS-33	85	287	1.9	2.5
25	UMM-SS-34	111	150	2.0	2.2
26	UMM-SS-41	110	127	2.0	2.1
29	UMM-SS-44	158	153	2.2	2.2
27	UMM-SS-46	117	125	2.1	2.1
28	UMM-SS-49	<LOD	ND (<0.033)	NA	NA
30	UMM-SS-50	5.2	4.5	0.7	0.7
31	UMM-SS-54	8	14	0.9	1.1
32	UMM-SS-57	<LOD	2.22	NA	0.3
33	UMM-PW-1	5501	6730	3.7	3.8
34	UMM-PW-2	12353	10100	4.1	4.0

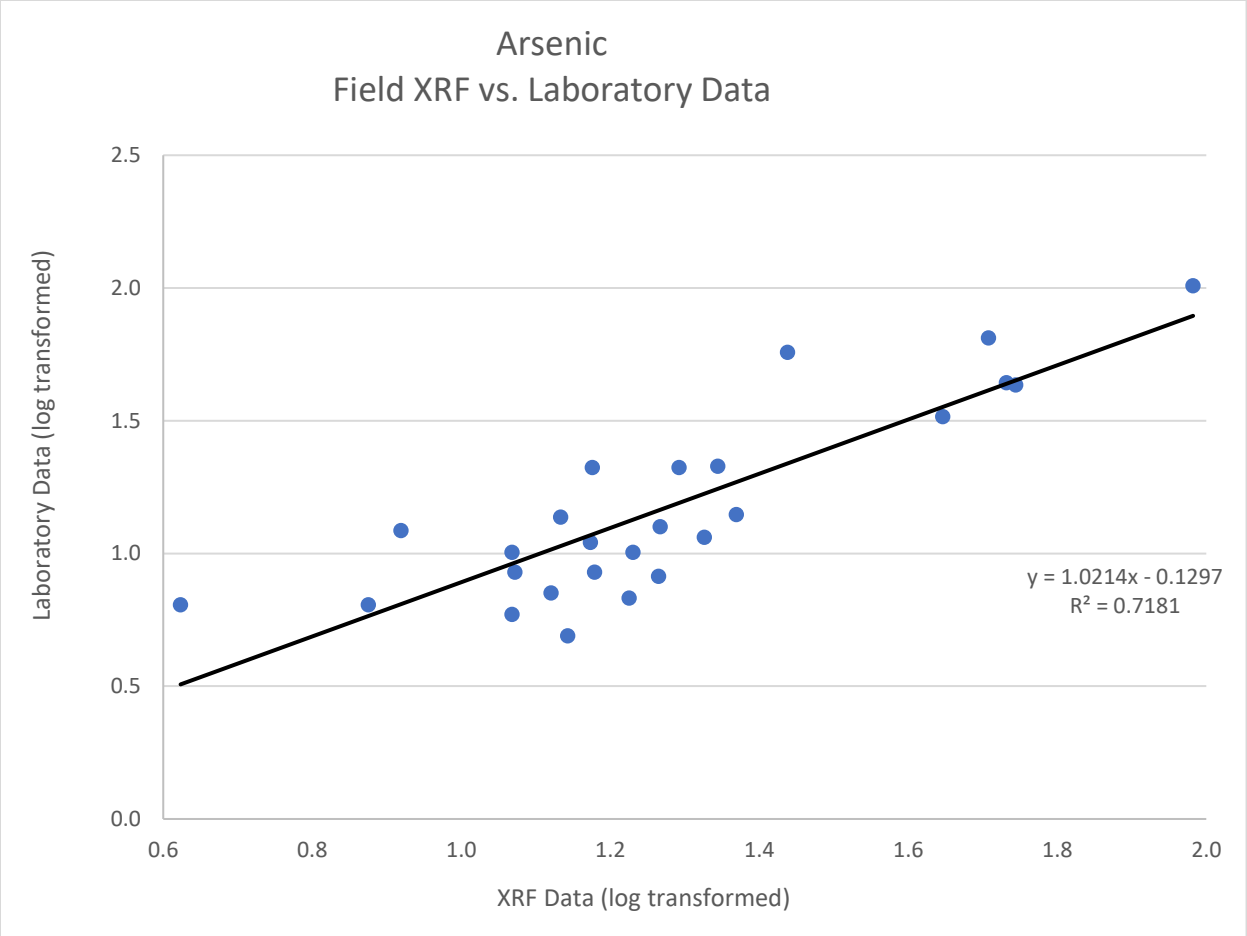

Table B. Correlation between Field XRF and Laboratory Data - Arsenic

XRF Reading No.	Sample No.	XRF (ppm)	Lab (mg/kg)	XRF	Lab
				Log Transformed	
48	UMM-BKG-1	17	10.1	1.2	1.0
49	UMM-BKG-2	7.5	6.4	0.9	0.8
50	UMM-BKG-3	15	21.1	1.2	1.3
10	UMM-BKG-1	11.7	10.1	1.1	1.0
11	UMM-BKG-2	4.2	6.4	0.6	0.8
12	UMM-BKG-3	19.6	21.1	1.3	1.3
13	UMM-SS-1	8.3	12.2	0.9	1.1
14	UMM-SS-7	53.9	44	1.7	1.6
17	UMM-SS-14	14.9	11	1.2	1.0
18	UMM-SS-16	22.1	21.3	1.3	1.3
19	UMM-SS-17	44.3	32.8	1.6	1.5
20	UMM-SS-24	18.4	8.2	1.3	0.9
21	UMM-MW/SS-26	21.2	11.5	1.3	1.1
22	UMM-MW/SS-28	27.4	57.3	1.4	1.8

XRF Reading No.	Sample No.	XRF (ppm)	Lab (mg/kg)	XRF	Lab
				Log Transformed	
23	UMM-SS-30	18.5	12.6	1.3	1.1
24	UMM-SS-33	23.4	14	1.4	1.1
25	UMM-SS-34	55.5	43.1	1.7	1.6
26	UMM-SS-41	15.1	8.5	1.2	0.9
29	UMM-SS-44	11.7	5.9	1.1	0.8
27	UMM-SS-46	13.6	13.7	1.1	1.1
28	UMM-SS-49	13.9	4.9	1.1	0.7
30	UMM-SS-50	13.2	7.1	1.1	0.9
31	UMM-SS-54	16.8	6.8	1.2	0.8
32	UMM-SS-57	11.8	8.5	1.1	0.9
33	UMM-PW-1	96	102	2.0	2.0
34	UMM-PW-2	51	64.8	1.7	1.8

APPENDIX 4

Laboratory Reports

www.svl.net One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Applied Intellect
345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received	Notes
UMM-PW-1	X7D0465-01	Waste	19-Apr-17 14:40	PH	25-Apr-2017	
UMM-PW-2	X7D0465-02	Waste	19-Apr-17 15:00	PH	25-Apr-2017	
UMM-BKG-3	X7D0465-07	Soil	19-Apr-17 16:00	BL	25-Apr-2017	
UMM-BKG-1	X7D0465-08	Soil	19-Apr-17 15:30	BL	25-Apr-2017	
UMM-BKG-2	X7D0465-09	Soil	19-Apr-17 15:40	BL	25-Apr-2017	
UMM-SS-1	X7D0465-10	Soil	19-Apr-17 14:25	PH	25-Apr-2017	
UMM-SS-7	X7D0465-11	Soil	19-Apr-17 14:35	PH	25-Apr-2017	
UMM-SS-14	X7D0465-12	Soil	19-Apr-17 15:38	PH	25-Apr-2017	
UMM-SS-16	X7D0465-13	Soil	19-Apr-17 14:50	PH	25-Apr-2017	
UMM-SS-17	X7D0465-14	Soil	19-Apr-17 15:00	PH	25-Apr-2017	
UMM-SS-24	X7D0465-15	Soil	19-Apr-17 15:15	PH	25-Apr-2017	
UMM-SS-26	X7D0465-16	Soil	19-Apr-17 15:22	PH	25-Apr-2017	
UMM-SS-28	X7D0465-17	Soil	19-Apr-17 15:26	PH	25-Apr-2017	
UMM-SS-30	X7D0465-18	Soil	19-Apr-17 15:30	PH	25-Apr-2017	
UMM-SS-33	X7D0465-19	Soil	19-Apr-17 15:20	PH	25-Apr-2017	
UMM-SS-34	X7D0465-20	Soil	19-Apr-17 15:10	PH	25-Apr-2017	
UMM-SS-41	X7D0465-21	Soil	19-Apr-17 15:40	PH	25-Apr-2017	
UMM-SS-46	X7D0465-22	Soil	19-Apr-17 15:43	PH	25-Apr-2017	
UMM-SS-49	X7D0465-23	Soil	19-Apr-17 15:44	PH	25-Apr-2017	
UMM-SS-44	X7D0465-24	Soil	19-Apr-17 15:58	PH	25-Apr-2017	
UMM-SS-50	X7D0465-25	Soil	19-Apr-17 15:50	PH	25-Apr-2017	
UMM-SS-54	X7D0465-26	Soil	19-Apr-17 15:53	PH	25-Apr-2017	
UMM-SS-57	X7D0465-27	Soil	19-Apr-17 16:00	PH	25-Apr-2017	
UMM-SS-65	X7D0465-28	Soil	19-Apr-17 14:40	PH	25-Apr-2017	
UMM-SS-66	X7D0465-29	Soil	19-Apr-17 15:22	PH	25-Apr-2017	

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

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Applied Intellect
345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-PW-1**
SVL Sample ID: **X7D0465-01 (Waste)**

Sampled: 19-Apr-17 14:40
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	102	mg/kg	25.0	6.2	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	**Barium**	132	mg/kg	2.00	0.68	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	Cadmium	< 2.00	mg/kg	2.00	0.51	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	**Chromium**	57.2	mg/kg	6.00	1.30	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	**Lead**	9.1	mg/kg	7.5	3.0	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	Selenium	< 40.0	mg/kg	40.0	14.0	10	X718021	DT	05/09/17 12:25	D1
EPA 6010D	**Silver**	5.32	mg/kg	5.00	1.40	10	X718021	DT	05/09/17 12:25	D1
EPA 7471B	**Mercury**	6730	mg/kg	330	90.0	10000	X717182	MWD	04/28/17 16:32	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.3°C**	4.5	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	68.8	%	0.1			X718028	JAA	05/02/17 08:05	
TCLP Extraction Parameters										
EPA 1311	**Final pH**	4.95	pH Units				X717156	ESB	04/28/17 10:20	
EPA 1311	**% Dry Solids**	68.7	%				X717156	ESB	04/28/17 10:20	
TCLP Leachates (Metals) Extracted: 04/28/17 10:20										
EPA 6010D	Arsenic	< 0.050	mg/L Extract	0.050	0.008		X717253	DT	05/05/17 13:23	
EPA 6010D	Barium	< 1.00	mg/L Extract	1.00	0.0010		X717253	DT	05/05/17 13:23	
EPA 6010D	Cadmium	< 0.0100	mg/L Extract	0.0100	0.0009		X717253	DT	05/05/17 13:23	
EPA 6010D	Chromium	< 0.0500	mg/L Extract	0.0500	0.0015		X717253	DT	05/05/17 13:23	
EPA 6010D	Lead	< 0.0500	mg/L Extract	0.0500	0.0036		X717253	DT	05/05/17 13:23	
EPA 6010D	Selenium	< 0.050	mg/L Extract	0.050	0.018		X717253	DT	05/05/17 13:23	
EPA 6010D	Silver	< 0.0500	mg/L Extract	0.0500	0.0016		X717253	DT	05/05/17 13:23	
EPA 7470A	**Mercury**	0.0970	mg/L Extract	0.0200	0.00760	100	X718038	MWD	05/01/17 15:16	D2,M4

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

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Applied Intellect
345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-PW-2**
SVL Sample ID: **X7D0465-02 (Waste)**

Sampled: 19-Apr-17 15:00
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	64.8	mg/kg	25.0	6.2	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	**Barium**	47.0	mg/kg	2.00	0.68	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	Cadmium	< 2.00	mg/kg	2.00	0.51	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	**Chromium**	68.2	mg/kg	6.00	1.30	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	**Lead**	57.4	mg/kg	7.5	3.0	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	Selenium	< 40.0	mg/kg	40.0	14.0	10	X718021	DT	05/09/17 12:35	D1
EPA 6010D	**Silver**	13.9	mg/kg	5.00	1.40	10	X718021	DT	05/09/17 12:35	D1
EPA 7471B	**Mercury**	10100	mg/kg	330	90.0	10000	X717182	MWD	04/28/17 16:34	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.8°C**	6.9	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	75.9	%	0.1			X718028	JAA	05/02/17 08:05	
TCLP Extraction Parameters										
EPA 1311	**Final pH**	5.19	pH Units				X717156	ESB	04/28/17 10:20	
EPA 1311	**% Dry Solids**	75.7	%				X717156	ESB	04/28/17 10:20	
TCLP Leachates (Metals) Extracted: 04/28/17 10:20										
EPA 6010D	Arsenic	< 0.050	mg/L Extract	0.050	0.008		X717253	DT	05/05/17 13:34	
EPA 6010D	Barium	< 1.00	mg/L Extract	1.00	0.0010		X717253	DT	05/05/17 13:34	
EPA 6010D	Cadmium	< 0.0100	mg/L Extract	0.0100	0.0009		X717253	DT	05/05/17 13:34	
EPA 6010D	Chromium	< 0.0500	mg/L Extract	0.0500	0.0015		X717253	DT	05/05/17 13:34	
EPA 6010D	**Lead**	0.353	mg/L Extract	0.0500	0.0036		X717253	DT	05/05/17 13:34	
EPA 6010D	Selenium	< 0.050	mg/L Extract	0.050	0.018		X717253	DT	05/05/17 13:34	
EPA 6010D	Silver	< 0.0500	mg/L Extract	0.0500	0.0016		X717253	DT	05/05/17 13:34	
EPA 7470A	**Mercury**	0.00498	mg/L Extract	0.00020	0.000076		X718038	MWD	05/01/17 15:32	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-BKG-3**
SVL Sample ID: **X7D0465-07 (Soil)**

Sampled: 19-Apr-17 16:00
Received: 25-Apr-17
Sampled By: BL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	21.1	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:39	
EPA 6010D	**Barium**	131	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:39	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:39	
EPA 6010D	**Chromium**	60.5	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:39	
EPA 6010D	**Lead**	5.3	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:39	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:39	
EPA 6010D	**Silver**	1.33	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:39	
EPA 7471B	**Mercury**	0.207	mg/kg	0.033	0.009		X717182	MWD	04/28/17 18:35	
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.6°C**	5.9	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	85.0	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-BKG-1**
SVL Sample ID: **X7D0465-08 (Soil)**

Sampled: 19-Apr-17 15:30
Received: 25-Apr-17
Sampled By: BL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	10.1	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:42	
EPA 6010D	**Barium**	188	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:42	
EPA 6010D	**Cadmium**	0.30	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:42	
EPA 6010D	**Chromium**	31.4	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:42	
EPA 6010D	**Lead**	8.7	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:42	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:42	
EPA 6010D	**Silver**	1.39	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:42	
EPA 7471B	**Mercury**	0.385	mg/kg	0.033	0.009		X717182	MWD	04/28/17 18:37	M1
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.7°C**	5.6	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	76.7	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-BKG-2**
SVL Sample ID: **X7D0465-09 (Soil)**

Sampled: 19-Apr-17 15:40
Received: 25-Apr-17
Sampled By: BL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	6.4	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:45	
EPA 6010D	**Barium**	331	mg/kg	2.00	0.68	10	X718021	DT	05/09/17 13:17	D2
EPA 6010D	**Cadmium**	0.23	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:45	
EPA 6010D	**Chromium**	50.0	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:45	
EPA 6010D	**Lead**	9.5	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:45	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:45	
EPA 6010D	**Silver**	1.49	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:45	
EPA 7471B	**Mercury**	0.215	mg/kg	0.033	0.009		X717182	MWD	04/28/17 18:44	
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.7°C**	5.4	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	81.8	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-1**
SVL Sample ID: **X7D0465-10 (Soil)**

Sampled: 19-Apr-17 14:25
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	12.2	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:48	
EPA 6010D	**Barium**	110	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:48	
EPA 6010D	**Cadmium**	1.86	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:48	
EPA 6010D	**Chromium**	30.9	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:48	
EPA 6010D	**Lead**	26.3	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:48	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:48	
EPA 6010D	**Silver**	1.26	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:48	
EPA 7471B	**Mercury**	9.67	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 17:51	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.0°C**	5.2	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	74.2	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-7**
SVL Sample ID: **X7D0465-11 (Soil)**

Sampled: 19-Apr-17 14:35
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	44.0	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:51	
EPA 6010D	**Barium**	87.6	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:51	
EPA 6010D	**Cadmium**	0.94	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:51	
EPA 6010D	**Chromium**	21.3	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:51	
EPA 6010D	**Lead**	35.5	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:51	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:51	
EPA 6010D	**Silver**	1.45	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:51	
EPA 7471B	**Mercury**	13.5	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 17:53	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.7°C**	7.5	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	77.7	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-14**
SVL Sample ID: **X7D0465-12 (Soil)**

Sampled: 19-Apr-17 15:38
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	11.0	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:55	
EPA 6010D	**Barium**	97.3	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:55	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:55	
EPA 6010D	**Chromium**	70.2	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:55	
EPA 6010D	**Lead**	11.8	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:55	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:55	
EPA 6010D	**Silver**	1.45	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:55	
EPA 7471B	**Mercury**	21.2	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 17:55	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.8°C**	5.3	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	71.5	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-16**
SVL Sample ID: **X7D0465-13 (Soil)**

Sampled: 19-Apr-17 14:50
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	21.3	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:58	
EPA 6010D	**Barium**	114	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:58	
EPA 6010D	**Cadmium**	0.27	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:58	
EPA 6010D	**Chromium**	54.5	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:58	
EPA 6010D	**Lead**	12.4	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:58	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:58	
EPA 6010D	**Silver**	1.51	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:58	
EPA 7471B	**Mercury**	230	mg/kg	33.0	9.00	1000	X717182	MWD	04/28/17 18:01	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.0°C**	7.2	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	74.6	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-17**
SVL Sample ID: **X7D0465-14 (Soil)**

Sampled: 19-Apr-17 15:00
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	32.8	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:01	
EPA 6010D	**Barium**	85.2	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:01	
EPA 6010D	**Cadmium**	0.31	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:01	
EPA 6010D	**Chromium**	40.0	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:01	
EPA 6010D	**Lead**	8.8	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:01	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:01	
EPA 6010D	**Silver**	1.53	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:01	
EPA 7471B	**Mercury**	258	mg/kg	33.0	9.00	1000	X717182	MWD	04/28/17 18:03	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.7°C**	6.4	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	73.4	%	0.1			X718028	JAA	05/02/17 08:05	
TCLP Extraction Parameters										
EPA 1311	**Final pH**	5.02	pH Units				X717156	ESB	04/28/17 10:20	
EPA 1311	**% Dry Solids**	72.2	%				X717156	ESB	04/28/17 10:20	
TCLP Leachates (Metals) Extracted: 04/28/17 10:20										
EPA 6010D	Arsenic	< 0.050	mg/L Extract	0.050	0.008		X717253	DT	05/05/17 13:37	
EPA 6010D	Barium	< 1.00	mg/L Extract	1.00	0.0010		X717253	DT	05/05/17 13:37	
EPA 6010D	Cadmium	< 0.0100	mg/L Extract	0.0100	0.0009		X717253	DT	05/05/17 13:37	
EPA 6010D	Chromium	< 0.0500	mg/L Extract	0.0500	0.0015		X717253	DT	05/05/17 13:37	
EPA 6010D	Lead	< 0.0500	mg/L Extract	0.0500	0.0036		X717253	DT	05/05/17 13:37	
EPA 6010D	Selenium	< 0.050	mg/L Extract	0.050	0.018		X717253	DT	05/05/17 13:37	
EPA 6010D	Silver	< 0.0500	mg/L Extract	0.0500	0.0016		X717253	DT	05/05/17 13:37	
EPA 7470A	**Mercury**	0.00077	mg/L Extract	0.00020	0.000076		X718038	MWD	05/01/17 15:34	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-24**
SVL Sample ID: **X7D0465-15 (Soil)**

Sampled: 19-Apr-17 15:15
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	8.2	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:20	
EPA 6010D	**Barium**	139	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:20	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:20	
EPA 6010D	**Chromium**	60.9	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:20	
EPA 6010D	**Lead**	4.9	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:20	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:20	
EPA 6010D	**Silver**	1.61	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:20	
EPA 7471B	**Mercury**	1.85	mg/kg	0.066	0.018	2	X717182	MWD	04/28/17 19:04	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.8°C**	5.1	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	71.5	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-26**
SVL Sample ID: **X7D0465-16 (Soil)**

Sampled: 19-Apr-17 15:22
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	11.5	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:24	
EPA 6010D	**Barium**	75.2	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:24	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:24	
EPA 6010D	**Chromium**	11.9	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:24	
EPA 6010D	**Lead**	1.7	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:24	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:24	
EPA 6010D	**Silver**	1.25	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:24	
EPA 7471B	**Mercury**	3.12	mg/kg	0.330	0.090	10	X717182	MWD	04/28/17 18:48	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.1°C**	6.4	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	79.8	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-28**
SVL Sample ID: **X7D0465-17 (Soil)**

Sampled: 19-Apr-17 15:26
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	57.3	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:27	
EPA 6010D	**Barium**	89.6	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:27	
EPA 6010D	**Cadmium**	0.21	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:27	
EPA 6010D	**Chromium**	17.6	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:27	
EPA 6010D	**Lead**	2.4	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:27	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:27	
EPA 6010D	**Silver**	3.62	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:27	
EPA 7471B	**Mercury**	1.77	mg/kg	0.066	0.018	2	X717182	MWD	04/28/17 19:07	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.3°C**	7.2	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	79.9	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-30**
SVL Sample ID: **X7D0465-18 (Soil)**

Sampled: 19-Apr-17 15:30
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	12.6	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:30	
EPA 6010D	**Barium**	87.5	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:30	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:30	
EPA 6010D	**Chromium**	70.3	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:30	
EPA 6010D	**Lead**	7.9	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:30	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:30	
EPA 6010D	**Silver**	1.50	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:30	
EPA 7471B	**Mercury**	0.552	mg/kg	0.033	0.009		X717182	MWD	04/28/17 18:57	
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.5°C**	5.4	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	72.1	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-33**
SVL Sample ID: **X7D0465-19 (Soil)**

Sampled: 19-Apr-17 15:20
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	14.0	mg/kg	2.5	0.6		X718021	DT	05/09/17 13:33	
EPA 6010D	**Barium**	113	mg/kg	0.20	0.07		X718021	DT	05/09/17 13:33	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 13:33	
EPA 6010D	**Chromium**	72.7	mg/kg	0.60	0.13		X718021	DT	05/09/17 13:33	
EPA 6010D	**Lead**	15.6	mg/kg	0.8	0.3		X718021	DT	05/09/17 13:33	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 13:33	
EPA 6010D	**Silver**	1.55	mg/kg	0.50	0.14		X718021	DT	05/09/17 13:33	
EPA 7471B	**Mercury**	287	mg/kg	33.0	9.00	1000	X717182	MWD	04/28/17 18:14	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.4°C**	6.2	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	72.4	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-34**
SVL Sample ID: **X7D0465-20 (Soil)**

Sampled: 19-Apr-17 15:10
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	43.1	mg/kg	2.5	0.6		X718022	DT	05/09/17 14:31	
EPA 6010D	**Barium**	131	mg/kg	0.20	0.07		X718022	DT	05/09/17 14:31	M2
EPA 6010D	**Cadmium**	0.51	mg/kg	0.20	0.05		X718022	DT	05/09/17 14:31	
EPA 6010D	**Chromium**	24.0	mg/kg	0.60	0.13		X718022	DT	05/09/17 14:31	
EPA 6010D	**Lead**	20.5	mg/kg	0.8	0.3		X718022	DT	05/09/17 14:31	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 14:31	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 14:31	
EPA 7471B	**Mercury**	150	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 18:16	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @17.7°C**	5.0	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	69.2	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-41**
SVL Sample ID: **X7D0465-21 (Soil)**

Sampled: 19-Apr-17 15:40
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	8.5	mg/kg	2.5	0.6		X718022	DT	05/09/17 14:44	
EPA 6010D	**Barium**	110	mg/kg	0.20	0.07		X718022	DT	05/09/17 14:44	
EPA 6010D	**Cadmium**	0.26	mg/kg	0.20	0.05		X718022	DT	05/09/17 14:44	
EPA 6010D	**Chromium**	57.0	mg/kg	0.60	0.13		X718022	DT	05/09/17 14:44	
EPA 6010D	**Lead**	37.1	mg/kg	0.8	0.3		X718022	DT	05/09/17 14:44	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 14:44	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 14:44	
EPA 7471B	**Mercury**	127	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 18:18	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @19.1°C**	6.7	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	76.1	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-46**
SVL Sample ID: **X7D0465-22 (Soil)**

Sampled: 19-Apr-17 15:43
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	13.7	mg/kg	2.5	0.6		X718022	DT	05/09/17 14:47	
EPA 6010D	**Barium**	83.2	mg/kg	0.20	0.07		X718022	DT	05/09/17 14:47	
EPA 6010D	**Cadmium**	0.33	mg/kg	0.20	0.05		X718022	DT	05/09/17 14:47	
EPA 6010D	**Chromium**	10.2	mg/kg	0.60	0.13		X718022	DT	05/09/17 14:47	
EPA 6010D	**Lead**	9.5	mg/kg	0.8	0.3		X718022	DT	05/09/17 14:47	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 14:47	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 14:47	
EPA 7471B	**Mercury**	125	mg/kg	3.30	0.900	100	X717182	MWD	04/28/17 18:21	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @19.1°C**	6.7	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	78.0	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-49**
SVL Sample ID: **X7D0465-23 (Soil)**

Sampled: 19-Apr-17 15:44
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	4.9	mg/kg	2.5	0.6		X718022	DT	05/09/17 14:50	
EPA 6010D	**Barium**	131	mg/kg	0.20	0.07		X718022	DT	05/09/17 14:50	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718022	DT	05/09/17 14:50	
EPA 6010D	**Chromium**	96.4	mg/kg	0.60	0.13		X718022	DT	05/09/17 14:50	
EPA 6010D	**Lead**	10.1	mg/kg	0.8	0.3		X718022	DT	05/09/17 14:50	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 14:50	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 14:50	
EPA 7471B	Mercury	< 0.033	mg/kg	0.033	0.009		X717182	MWD	04/28/17 18:59	
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @19.4°C**	5.9	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	73.8	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-44**
SVL Sample ID: **X7D0465-24 (Soil)**

Sampled: 19-Apr-17 15:58
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	5.9	mg/kg	2.5	0.6		X718022	DT	05/09/17 14:53	
EPA 6010D	**Barium**	70.3	mg/kg	0.20	0.07		X718022	DT	05/09/17 14:53	
EPA 6010D	**Cadmium**	0.32	mg/kg	0.20	0.05		X718022	DT	05/09/17 14:53	
EPA 6010D	**Chromium**	29.8	mg/kg	0.60	0.13		X718022	DT	05/09/17 14:53	
EPA 6010D	**Lead**	18.1	mg/kg	0.8	0.3		X718022	DT	05/09/17 14:53	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 14:53	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 14:53	
EPA 7471B	**Mercury**	153	mg/kg	6.60	1.80	200	X717182	MWD	04/28/17 19:01	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @19.4°C**	6.4	pH Units				X718065	AGF	05/02/17 10:30	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	75.8	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-50**
SVL Sample ID: **X7D0465-25 (Soil)**

Sampled: 19-Apr-17 15:50
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	7.1	mg/kg	2.5	0.6		X718022	DT	05/09/17 15:52	
EPA 6010D	**Barium**	128	mg/kg	0.20	0.07		X718022	DT	05/09/17 15:52	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718022	DT	05/09/17 15:52	
EPA 6010D	**Chromium**	78.8	mg/kg	0.60	0.13		X718022	DT	05/09/17 15:52	
EPA 6010D	**Lead**	10.5	mg/kg	0.8	0.3		X718022	DT	05/09/17 15:52	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 15:52	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 15:52	
EPA 7471B	**Mercury**	4.50	mg/kg	3.30	0.900	100	X717183	MWD	04/28/17 20:42	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.4°C**	6.8	pH Units				X718066	AGF	05/02/17 15:15	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	70.0	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-54**
SVL Sample ID: **X7D0465-26 (Soil)**

Sampled: 19-Apr-17 15:53
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	6.8	mg/kg	2.5	0.6		X718022	DT	05/09/17 15:55	
EPA 6010D	**Barium**	99.2	mg/kg	0.20	0.07		X718022	DT	05/09/17 15:55	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718022	DT	05/09/17 15:55	
EPA 6010D	**Chromium**	53.3	mg/kg	0.60	0.13		X718022	DT	05/09/17 15:55	
EPA 6010D	**Lead**	9.3	mg/kg	0.8	0.3		X718022	DT	05/09/17 15:55	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 15:55	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 15:55	
EPA 7471B	**Mercury**	14.0	mg/kg	3.30	0.900	100	X717183	MWD	04/28/17 20:44	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.4°C**	7.1	pH Units				X718066	AGF	05/02/17 15:15	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	80.0	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-57**
SVL Sample ID: **X7D0465-27 (Soil)**

Sampled: 19-Apr-17 16:00
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	8.5	mg/kg	2.5	0.6		X718022	DT	05/09/17 15:58	
EPA 6010D	**Barium**	106	mg/kg	0.20	0.07		X718022	DT	05/09/17 15:58	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718022	DT	05/09/17 15:58	
EPA 6010D	**Chromium**	76.6	mg/kg	0.60	0.13		X718022	DT	05/09/17 15:58	
EPA 6010D	**Lead**	48.1	mg/kg	0.8	0.3		X718022	DT	05/09/17 15:58	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 15:58	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 15:58	
EPA 7471B	**Mercury**	2.22	mg/kg	0.330	0.090	10	X717183	MWD	04/28/17 20:53	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.6°C**	6.0	pH Units				X718066	AGF	05/02/17 15:15	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	77.1	%	0.1			X718029	JAA	05/02/17 09:10	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

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345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-65**
SVL Sample ID: **X7D0465-28 (Soil)**

Sampled: 19-Apr-17 14:40
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	125	mg/kg	25.0	6.2	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	**Barium**	125	mg/kg	2.00	0.68	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	Cadmium	< 2.00	mg/kg	2.00	0.51	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	**Chromium**	50.4	mg/kg	6.00	1.30	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	**Lead**	11.7	mg/kg	7.5	3.0	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	Selenium	< 40.0	mg/kg	40.0	14.0	10	X718022	DT	05/09/17 16:01	D1
EPA 6010D	Silver	< 5.00	mg/kg	5.00	1.40	10	X718022	DT	05/09/17 16:01	D1
EPA 7471B	**Mercury**	7580	mg/kg	330	90.0	10000	X717183	MWD	04/28/17 20:25	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.6°C**	4.5	pH Units				X718066	AGF	05/02/17 15:15	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	67.4	%	0.1			X718029	JAA	05/02/17 09:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Client Sample ID: **UMM-SS-66**
SVL Sample ID: **X7D0465-29 (Soil)**

Sampled: 19-Apr-17 15:22
Received: 25-Apr-17
Sampled By: PH

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	8.5	mg/kg	2.5	0.6		X718022	DT	05/09/17 16:05	
EPA 6010D	**Barium**	64.2	mg/kg	0.20	0.07		X718022	DT	05/09/17 16:05	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718022	DT	05/09/17 16:05	
EPA 6010D	**Chromium**	10.3	mg/kg	0.60	0.13		X718022	DT	05/09/17 16:05	
EPA 6010D	**Lead**	3.0	mg/kg	0.8	0.3		X718022	DT	05/09/17 16:05	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718022	DT	05/09/17 16:05	
EPA 6010D	Silver	< 0.50	mg/kg	0.50	0.14		X718022	DT	05/09/17 16:05	
EPA 7471B	**Mercury**	1.47	mg/kg	0.330	0.090	10	X717183	MWD	04/28/17 20:55	D2
Classical Chemistry Parameters										
EPA 600/2-78-054 mod	**Paste pH @18.0°C**	6.3	pH Units				X718066	AGF	05/02/17 15:15	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	78.2	%	0.1			X718029	JAA	05/02/17 09:10	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods								
EPA 6010D	Arsenic	mg/kg	<2.5	0.6	2.5	X718021	09-May-17	
EPA 6010D	Arsenic	mg/kg	<2.5	0.6	2.5	X718022	09-May-17	
EPA 6010D	Barium	mg/kg	<0.20	0.07	0.20	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	<0.20	0.07	0.20	X718022	09-May-17	
EPA 6010D	Cadmium	mg/kg	<0.20	0.05	0.20	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	<0.20	0.05	0.20	X718022	09-May-17	
EPA 6010D	Chromium	mg/kg	<0.60	0.13	0.60	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	<0.60	0.13	0.60	X718022	09-May-17	
EPA 6010D	Lead	mg/kg	<0.8	0.3	0.8	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	<0.8	0.3	0.8	X718022	09-May-17	
EPA 6010D	Selenium	mg/kg	<4.0	1.4	4.0	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	<4.0	1.4	4.0	X718022	09-May-17	
EPA 6010D	Silver	mg/kg	<0.50	0.14	0.50	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	<0.50	0.14	0.50	X718022	09-May-17	
EPA 7471B	Mercury	mg/kg	<0.033	0.009	0.033	X717182	28-Apr-17	
EPA 7471B	Mercury	mg/kg	<0.033	0.009	0.033	X717183	28-Apr-17	
TCLP Extraction Parameters								
EPA 1311	Final pH	pH Units	4.93			X717156	28-Apr-17	

Quality Control - EXTRACTION BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
TCLP Leachates (Metals) Extracted: 04/28/17 10:20 Batch: X717156								
EPA 6010D	Arsenic	mg/L Extract	<0.050	0.008	0.050	X717253	05-May-17	
EPA 6010D	Barium	mg/L Extract	<1.00	0.0010	1.00	X717253	05-May-17	
EPA 6010D	Cadmium	mg/L Extract	<0.0100	0.0009	0.0100	X717253	05-May-17	
EPA 6010D	Chromium	mg/L Extract	<0.0500	0.0015	0.0500	X717253	05-May-17	
EPA 6010D	Lead	mg/L Extract	<0.0500	0.0036	0.0500	X717253	05-May-17	
EPA 6010D	Selenium	mg/L Extract	<0.050	0.018	0.050	X717253	05-May-17	
EPA 6010D	Silver	mg/L Extract	<0.0500	0.0016	0.0500	X717253	05-May-17	
EPA 7470A	Mercury	mg/L Extract	<0.00020	0.000076	0.00020	X718038	01-May-17	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods									
EPA 6010D	Arsenic	mg/kg	98.8	100	98.8	80 - 120	X718021	09-May-17	
EPA 6010D	Arsenic	mg/kg	98.0	100	98.0	80 - 120	X718022	09-May-17	
EPA 6010D	Barium	mg/kg	99.8	100	99.8	80 - 120	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	97.0	100	97.0	80 - 120	X718022	09-May-17	
EPA 6010D	Cadmium	mg/kg	101	100	101	80 - 120	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	99.7	100	99.7	80 - 120	X718022	09-May-17	
EPA 6010D	Chromium	mg/kg	99.5	100	99.5	80 - 120	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	100	100	100	80 - 120	X718022	09-May-17	
EPA 6010D	Lead	mg/kg	98.8	100	98.8	80 - 120	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	99.3	100	99.3	80 - 120	X718022	09-May-17	
EPA 6010D	Selenium	mg/kg	96.9	100	96.9	80 - 120	X718021	09-May-17	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods (Continued)									
EPA 6010D	Selenium	mg/kg	95.6	100	95.6	80 - 120	X718022	09-May-17	
EPA 6010D	Silver	mg/kg	4.90	5.00	97.9	80 - 120	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	4.91	5.00	98.3	80 - 120	X718022	09-May-17	
EPA 7471B	Mercury	mg/kg	0.810	0.833	97.2	80 - 120	X717182	28-Apr-17	
EPA 7471B	Mercury	mg/kg	0.825	0.833	99.0	80 - 120	X717183	28-Apr-17	
Classical Chemistry Parameters									
EPA 600/2-78-054 mod	Paste pH @18.2°C	pH Units	7.3	7.40	98.6	93.7 - 106.3	X718065	02-May-17	
EPA 600/2-78-054 mod	Paste pH @17.2°C	pH Units	7.3	7.40	99.2	93.7 - 106.3	X718066	02-May-17	
TCLP Leachates (Metals)									
EPA 6010D	Arsenic	mg/L Extract	1.05	1.00	105	80 - 120	X717253	05-May-17	
EPA 6010D	Barium	mg/L Extract	20.2	20.0	101	80 - 120	X717253	05-May-17	
EPA 6010D	Cadmium	mg/L Extract	0.215	0.200	107	80 - 120	X717253	05-May-17	
EPA 6010D	Chromium	mg/L Extract	0.995	1.00	99.5	80 - 120	X717253	05-May-17	
EPA 6010D	Lead	mg/L Extract	0.961	1.00	96.1	80 - 120	X717253	05-May-17	
EPA 6010D	Selenium	mg/L Extract	0.221	0.200	111	80 - 120	X717253	05-May-17	
EPA 6010D	Silver	mg/L Extract	1.08	1.00	108	80 - 120	X717253	05-May-17	
EPA 7470A	Mercury	mg/L Extract	0.00490	0.00500	98.0	80 - 120	X718038	01-May-17	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
EPA 600/2-78-054 mod	Paste pH @18.4°C	pH Units	4.7	4.5	3.3	20	X718065	02-May-17	
EPA 600/2-78-054 mod	Paste pH @18.1°C	pH Units	6.9	6.8	1.6	20	X718066	02-May-17	
Percent Solids / Percent Moisture									
Percent Solids	% Solids	%	62.4	61.9	0.8	20	X718028	02-May-17	
Percent Solids	% Solids	%	69.2	69.2	0.1	20	X718029	02-May-17	

Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	Arsenic	mg/kg	119	16.9	100	102	75 - 125	X718021	09-May-17	
EPA 6010D	Arsenic	mg/kg	134	43.1	100	90.5	75 - 125	X718022	09-May-17	
EPA 6010D	Barium	mg/kg	195	98.5	100	96.7	75 - 125	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	184	131	100	53.3	75 - 125	X718022	09-May-17	M2
EPA 6010D	Cadmium	mg/kg	106	<0.20	100	105	75 - 125	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	102	0.51	100	101	75 - 125	X718022	09-May-17	
EPA 6010D	Chromium	mg/kg	146	30.2	100	116	75 - 125	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	129	24.0	100	105	75 - 125	X718022	09-May-17	
EPA 6010D	Lead	mg/kg	99.8	2.9	100	96.9	75 - 125	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	122	20.5	100	101	75 - 125	X718022	09-May-17	
EPA 6010D	Selenium	mg/kg	99.2	<4.0	100	99.2	75 - 125	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	95.0	<4.0	100	95.0	75 - 125	X718022	09-May-17	
EPA 6010D	Silver	mg/kg	6.34	1.26	5.00	102	75 - 125	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	5.11	<0.50	5.00	102	75 - 125	X718022	09-May-17	
EPA 7471B	Mercury	mg/kg	0.995	0.385	0.333	183	75 - 125	X717182	28-Apr-17	M1

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0465**
Reported: 10-May-17 09:02

Quality Control - MATRIX SPIKE Data (Continued)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods (Continued)										
EPA 7471B	Mercury	mg/kg	0.342	<0.033	0.333	99.5	75 - 125	X717183	28-Apr-17	
TCLP Leachates (Metals)										
EPA 6010D	Arsenic	mg/L Extract	1.06	<0.050	1.00	106	75 - 125	X717253	05-May-17	
EPA 6010D	Barium	mg/L Extract	20.1	<1.00	20.0	99.6	75 - 125	X717253	05-May-17	
EPA 6010D	Cadmium	mg/L Extract	0.214	<0.0100	0.200	107	75 - 125	X717253	05-May-17	
EPA 6010D	Chromium	mg/L Extract	0.968	<0.0500	1.00	96.8	75 - 125	X717253	05-May-17	
EPA 6010D	Lead	mg/L Extract	0.952	<0.0500	1.00	94.5	75 - 125	X717253	05-May-17	
EPA 6010D	Selenium	mg/L Extract	0.221	<0.050	0.200	110	75 - 125	X717253	05-May-17	
EPA 6010D	Silver	mg/L Extract	1.06	<0.0500	1.00	106	75 - 125	X717253	05-May-17	
EPA 7470A	Mercury	mg/L Extract	0.0758	0.0970	0.00100	R > 4S	70 - 130	X718038	01-May-17	D2,M4

Quality Control - MATRIX SPIKE DUPLICATE Data

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	%R	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods											
EPA 6010D	Arsenic	mg/kg	118	119	100	101	1.3	20	X718021	09-May-17	
EPA 6010D	Arsenic	mg/kg	131	134	100	87.4	2.3	20	X718022	09-May-17	
EPA 6010D	Barium	mg/kg	200	195	100	102	2.7	20	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	186	184	100	55.0	0.9	20	X718022	09-May-17	M2
EPA 6010D	Cadmium	mg/kg	104	106	100	104	1.7	20	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	103	102	100	102	1.2	20	X718022	09-May-17	
EPA 6010D	Chromium	mg/kg	149	146	100	119	2.0	20	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	131	129	100	107	1.8	20	X718022	09-May-17	
EPA 6010D	Lead	mg/kg	99.7	99.8	100	96.8	0.1	20	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	114	122	100	93.6	6.5	20	X718022	09-May-17	
EPA 6010D	Selenium	mg/kg	97.3	99.2	100	97.3	2.0	20	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	96.0	95.0	100	96.0	1.0	20	X718022	09-May-17	
EPA 6010D	Silver	mg/kg	6.30	6.34	5.00	101	0.7	20	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	5.22	5.11	5.00	104	2.1	20	X718022	09-May-17	
EPA 7471B	Mercury	mg/kg	1.03	0.995	0.333	193	3.3	20	X717182	28-Apr-17	M1
EPA 7471B	Mercury	mg/kg	0.350	0.342	0.333	102	2.4	20	X717183	28-Apr-17	
TCLP Leachates (Metals)											
EPA 6010D	Arsenic	mg/L Extract	1.07	1.06	1.00	107	1.3	20	X717253	05-May-17	
EPA 6010D	Barium	mg/L Extract	20.4	20.1	20.0	101	1.6	20	X717253	05-May-17	
EPA 6010D	Cadmium	mg/L Extract	0.217	0.214	0.200	108	1.1	20	X717253	05-May-17	
EPA 6010D	Chromium	mg/L Extract	0.982	0.968	1.00	98.2	1.5	20	X717253	05-May-17	
EPA 6010D	Lead	mg/L Extract	0.952	0.952	1.00	94.6	0.0	20	X717253	05-May-17	
EPA 6010D	Selenium	mg/L Extract	0.225	0.221	0.200	112	1.8	20	X717253	05-May-17	
EPA 6010D	Silver	mg/L Extract	1.09	1.06	1.00	109	2.9	20	X717253	05-May-17	
EPA 7470A	Mercury	mg/L Extract	0.0737	0.0758	0.00100	R > 4S	2.7	20	X718038	01-May-17	D2,M4

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Applied Intellect	**Project Name: Umpqua EE/CA 2016**
345 Bobwhite Court - Suite 230	Work Order: **X7D0465**
Boise, ID 83706	Reported: 10-May-17 09:02

Notes and Definitions

D1	Sample required dilution due to matrix.
D2	Sample required dilution due to high concentration of target analyte.
M1	Matrix spike recovery was high, but the LCS recovery was acceptable.
M2	Matrix spike recovery was low, but the LCS recovery was acceptable.
M4	The analysis of the spiked sample required a dilution such that the spike recovery calculation does not provide useful information. The LCS recovery was acceptable.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received	Notes
UMM-SW-1	X7D0450-01	Surface Water	20-Apr-17 12:30	RL	25-Apr-2017	
UMM-SED-1	X7D0450-02	Sediment	20-Apr-17 12:30	RL	25-Apr-2017	
UMM-SW-5	X7D0450-03	Surface Water	20-Apr-17 13:50	RL	25-Apr-2017	Q5
UMM-SED-5	X7D0450-04	Sediment	20-Apr-17 13:50	RL	25-Apr-2017	
UMM-SW-2	X7D0450-05	Surface Water	20-Apr-17 12:40	RL	25-Apr-2017	
UMM-SED-2	X7D0450-06	Sediment	20-Apr-17 12:40	RL	25-Apr-2017	
UMM-SED-4	X7D0450-07	Sediment	20-Apr-17 13:40	RL	25-Apr-2017	
UMM-SW-4	X7D0450-08	Surface Water	20-Apr-17 13:40	RL	25-Apr-2017	Q5
UMM-SW-3	X7D0450-09	Surface Water	20-Apr-17 13:30	RL	25-Apr-2017	Q5
UMM-SED-3	X7D0450-10	Sediment	20-Apr-17 13:30	RL	25-Apr-2017	

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SW-1**
SVL Sample ID: **X7D0450-01 (Surface Water)**

Sampled: 20-Apr-17 12:30
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	< 0.00020	mg/L	0.00020	0.000076		X718036	MWD	05/02/17 12:39	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	< 0.025	mg/L	0.025	0.008		X717109	DT	05/05/17 09:59	
EPA 6010D	**Barium**	0.0318	mg/L	0.0020	0.0010		X717109	DT	05/05/17 09:59	
EPA 6010D	Cadmium	< 0.0020	mg/L	0.0020	0.0009		X717109	DT	05/05/17 09:59	
EPA 6010D	**Calcium**	9.53	mg/L	0.100	0.041		X717109	DT	05/05/17 09:59	
EPA 6010D	Chromium	< 0.0060	mg/L	0.0060	0.0015		X717109	DT	05/05/17 09:59	
EPA 6010D	Lead	< 0.0075	mg/L	0.0075	0.0036		X717109	DT	05/05/17 09:59	
EPA 6010D	**Magnesium**	2.64	mg/L	0.20	0.08		X717109	DT	05/05/17 12:03	
EPA 6010D	Selenium	< 0.040	mg/L	0.040	0.018		X717109	DT	05/05/17 09:59	
EPA 6010D	Silver	< 0.0050	mg/L	0.0050	0.0016		X717109	DT	05/05/17 09:59	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
SM 2340B	**Hardness (as CaCO3)**	34.7	mg/L	1.07	0.424		N/A		05/05/17 12:03	
Classical Chemistry Parameters										
SM 2540 C	**Total Diss. Solids**	78	mg/L	10			X717106	RS	04/26/17 10:15	
SM 4500 H B	**pH @19.4°C**	7.68	pH Units				X717116	DKS	04/26/17 10:01	H5
Anions by Ion Chromatography										
EPA 300.0	**Sulfate as SO4**	0.56	mg/L	0.30	0.12		X717119	SMB	05/03/17 12:26	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SED-1**
SVL Sample ID: **X7D0450-02 (Sediment)**

Sampled: 20-Apr-17 12:30
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	16.9	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:03	
EPA 6010D	**Barium**	98.5	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:03	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:03	
EPA 6010D	**Chromium**	30.2	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:03	
EPA 6010D	**Lead**	2.9	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:03	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:03	
EPA 6010D	**Silver**	1.26	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:03	
EPA 7471B	**Mercury**	0.088	mg/kg	0.033	0.009		X717183	MWD	04/28/17 19:35	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	61.9	%	0.1			X718028	JAA	05/02/17 08:05	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SW-5**
SVL Sample ID: **X7D0450-03 (Surface Water)**

Sampled: 20-Apr-17 13:50
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	< 0.00020	mg/L	0.00020	0.000076		X718036	MWD	05/02/17 12:41	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	< 0.025	mg/L	0.025	0.008		X717109	DT	05/05/17 10:09	
EPA 6010D	**Barium**	0.0208	mg/L	0.0020	0.0010		X717109	DT	05/05/17 10:09	
EPA 6010D	Cadmium	< 0.0020	mg/L	0.0020	0.0009		X717109	DT	05/05/17 10:09	
EPA 6010D	**Calcium**	6.80	mg/L	0.100	0.041		X717109	DT	05/05/17 10:09	
EPA 6010D	Chromium	< 0.0060	mg/L	0.0060	0.0015		X717109	DT	05/05/17 10:09	
EPA 6010D	Lead	< 0.0075	mg/L	0.0075	0.0036		X717109	DT	05/05/17 10:09	
EPA 6010D	**Magnesium**	2.16	mg/L	0.20	0.08		X717109	DT	05/05/17 12:12	
EPA 6010D	Selenium	< 0.040	mg/L	0.040	0.018		X717109	DT	05/05/17 10:09	
EPA 6010D	Silver	< 0.0050	mg/L	0.0050	0.0016		X717109	DT	05/05/17 10:09	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
SM 2340B	**Hardness (as CaCO3)**	25.9	mg/L	1.07	0.424		N/A		05/05/17 12:12	
Classical Chemistry Parameters										
SM 2540 C	**Total Diss. Solids**	53	mg/L	10			X717106	RS	04/26/17 10:15	
SM 4500 H B	**pH @19.1°C**	7.52	pH Units				X717116	DKS	04/26/17 10:03	H5
Anions by Ion Chromatography										
EPA 300.0	**Sulfate as SO4**	1.03	mg/L	0.30	0.12		X717119	SMB	05/03/17 16:10	

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SED-5**
SVL Sample ID: **X7D0450-04 (Sediment)**

Sampled: 20-Apr-17 13:50
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	10.4	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:12	
EPA 6010D	**Barium**	133	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:12	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:12	
EPA 6010D	**Chromium**	29.7	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:12	
EPA 6010D	**Lead**	6.7	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:12	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:12	
EPA 6010D	**Silver**	1.27	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:12	
EPA 7471B	**Mercury**	0.163	mg/kg	0.033	0.009		X717183	MWD	04/28/17 19:37	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	75.3	%	0.1			X718028	JAA	05/02/17 08:05	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SW-2**
SVL Sample ID: **X7D0450-05 (Surface Water)**

Sampled: 20-Apr-17 12:40
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	< 0.00020	mg/L	0.00020	0.000076		X718036	MWD	05/02/17 12:52	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	< 0.025	mg/L	0.025	0.008		X717109	DT	05/05/17 10:12	
EPA 6010D	**Barium**	0.135	mg/L	0.0020	0.0010		X717109	DT	05/05/17 10:12	
EPA 6010D	Cadmium	< 0.0020	mg/L	0.0020	0.0009		X717109	DT	05/05/17 10:12	
EPA 6010D	**Calcium**	33.8	mg/L	0.100	0.041		X717109	DT	05/05/17 10:12	
EPA 6010D	Chromium	< 0.0060	mg/L	0.0060	0.0015		X717109	DT	05/05/17 10:12	
EPA 6010D	Lead	< 0.0075	mg/L	0.0075	0.0036		X717109	DT	05/05/17 10:12	
EPA 6010D	**Magnesium**	19.2	mg/L	0.20	0.08		X717109	DT	05/05/17 12:16	
EPA 6010D	Selenium	< 0.040	mg/L	0.040	0.018		X717109	DT	05/05/17 10:12	
EPA 6010D	Silver	< 0.0050	mg/L	0.0050	0.0016		X717109	DT	05/05/17 10:12	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
SM 2340B	**Hardness (as CaCO3)**	164	mg/L	1.07	0.424		N/A		05/05/17 12:16	
Classical Chemistry Parameters										
SM 2540 C	**Total Diss. Solids**	194	mg/L	10			X717106	RS	04/26/17 10:15	
SM 4500 H B	**pH @19.7°C**	7.75	pH Units				X717116	DKS	04/26/17 10:05	H5
Anions by Ion Chromatography										
EPA 300.0	**Sulfate as SO4**	6.29	mg/L	0.30	0.12		X717119	SMB	05/03/17 16:25	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SED-2**
SVL Sample ID: **X7D0450-06 (Sediment)**

Sampled: 20-Apr-17 12:40
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	8.3	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:15	
EPA 6010D	**Barium**	138	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:15	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:15	
EPA 6010D	**Chromium**	46.6	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:15	
EPA 6010D	**Lead**	6.8	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:15	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:15	
EPA 6010D	**Silver**	1.32	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:15	
EPA 7471B	**Mercury**	42.2	mg/kg	3.30	0.900	100	X717183	MWD	04/28/17 20:37	D2
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	70.5	%	0.1			X718028	JAA	05/02/17 08:05	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SED-4**
SVL Sample ID: **X7D0450-07 (Sediment)**

Sampled: 20-Apr-17 13:40
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	9.8	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:18	
EPA 6010D	**Barium**	426	mg/kg	2.00	0.68	10	X718021	DT	05/09/17 13:04	D2
EPA 6010D	**Cadmium**	0.59	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:18	
EPA 6010D	**Chromium**	33.0	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:18	
EPA 6010D	**Lead**	19.9	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:18	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:18	
EPA 6010D	**Silver**	1.11	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:18	
EPA 7471B	Mercury	< 0.033	mg/kg	0.033	0.009		X717183	MWD	04/28/17 19:49	
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	77.9	%	0.1			X718028	JAA	05/02/17 08:05	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SW-4**
SVL Sample ID: **X7D0450-08 (Surface Water)**

Sampled: 20-Apr-17 13:40
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	< 0.00020	mg/L	0.00020	0.000076		X718036	MWD	05/02/17 12:54	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	< 0.025	mg/L	0.025	0.008		X717109	DT	05/05/17 10:15	
EPA 6010D	**Barium**	0.0155	mg/L	0.0020	0.0010		X717109	DT	05/05/17 10:15	
EPA 6010D	Cadmium	< 0.0020	mg/L	0.0020	0.0009		X717109	DT	05/05/17 10:15	
EPA 6010D	**Calcium**	5.99	mg/L	0.100	0.041		X717109	DT	05/05/17 10:15	
EPA 6010D	Chromium	< 0.0060	mg/L	0.0060	0.0015		X717109	DT	05/05/17 10:15	
EPA 6010D	Lead	< 0.0075	mg/L	0.0075	0.0036		X717109	DT	05/05/17 10:15	
EPA 6010D	**Magnesium**	1.85	mg/L	0.20	0.08		X717109	DT	05/05/17 12:19	
EPA 6010D	Selenium	< 0.040	mg/L	0.040	0.018		X717109	DT	05/05/17 10:15	
EPA 6010D	Silver	< 0.0050	mg/L	0.0050	0.0016		X717109	DT	05/05/17 10:15	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
SM 2340B	**Hardness (as CaCO3)**	22.6	mg/L	1.07	0.424		N/A		05/05/17 12:19	
Classical Chemistry Parameters										
SM 2540 C	**Total Diss. Solids**	49	mg/L	10			X717106	RS	04/26/17 10:15	
SM 4500 H B	**pH @18.0°C**	7.44	pH Units				X717116	DKS	04/26/17 10:11	H5
Anions by Ion Chromatography										
EPA 300.0	**Sulfate as SO4**	1.22	mg/L	0.30	0.12		X717119	SMB	05/03/17 16:40	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SW-3**
SVL Sample ID: **X7D0450-09 (Surface Water)**

Sampled: 20-Apr-17 13:30
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	< 0.00020	mg/L	0.00020	0.000076		X718036	MWD	05/02/17 12:56	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	< 0.025	mg/L	0.025	0.008		X717109	DT	05/05/17 10:19	
EPA 6010D	**Barium**	0.0338	mg/L	0.0020	0.0010		X717109	DT	05/05/17 10:19	
EPA 6010D	Cadmium	< 0.0020	mg/L	0.0020	0.0009		X717109	DT	05/05/17 10:19	
EPA 6010D	**Calcium**	10.7	mg/L	0.100	0.041		X717109	DT	05/05/17 10:19	
EPA 6010D	Chromium	< 0.0060	mg/L	0.0060	0.0015		X717109	DT	05/05/17 10:19	
EPA 6010D	Lead	< 0.0075	mg/L	0.0075	0.0036		X717109	DT	05/05/17 10:19	
EPA 6010D	**Magnesium**	3.75	mg/L	0.20	0.08		X717109	DT	05/05/17 12:23	
EPA 6010D	Selenium	< 0.040	mg/L	0.040	0.018		X717109	DT	05/05/17 10:19	
EPA 6010D	Silver	< 0.0050	mg/L	0.0050	0.0016		X717109	DT	05/05/17 10:19	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
SM 2340B	**Hardness (as CaCO3)**	42.1	mg/L	1.07	0.424		N/A		05/05/17 12:23	
Classical Chemistry Parameters										
SM 2540 C	**Total Diss. Solids**	71	mg/L	10			X717106	RS	04/26/17 10:15	
SM 4500 H B	**pH @18.3°C**	7.76	pH Units				X717116	DKS	04/26/17 10:13	H5
Anions by Ion Chromatography										
EPA 300.0	**Sulfate as SO4**	1.07	mg/L	0.30	0.12		X717119	SMB	05/03/17 16:55	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Client Sample ID: **UMM-SED-3**
SVL Sample ID: **X7D0450-10 (Sediment)**

Sampled: 20-Apr-17 13:30
Received: 25-Apr-17
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	**Arsenic**	23.9	mg/kg	2.5	0.6		X718021	DT	05/09/17 12:22	
EPA 6010D	**Barium**	107	mg/kg	0.20	0.07		X718021	DT	05/09/17 12:22	
EPA 6010D	Cadmium	< 0.20	mg/kg	0.20	0.05		X718021	DT	05/09/17 12:22	
EPA 6010D	**Chromium**	26.5	mg/kg	0.60	0.13		X718021	DT	05/09/17 12:22	
EPA 6010D	**Lead**	4.6	mg/kg	0.8	0.3		X718021	DT	05/09/17 12:22	
EPA 6010D	Selenium	< 4.0	mg/kg	4.0	1.4		X718021	DT	05/09/17 12:22	
EPA 6010D	**Silver**	1.46	mg/kg	0.50	0.14		X718021	DT	05/09/17 12:22	
EPA 7471B	**Mercury**	3.84	mg/kg	0.132	0.036	4	X717183	MWD	04/28/17 20:40	D2
Percent Solids / Percent Moisture										
Percent Solids	**% Solids**	61.3	%	0.1			X718028	JAA	05/02/17 08:05	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total)								
EPA 7470A	Mercury	mg/L	<0.00020	0.000076	0.00020	X718036	02-May-17	
Metals (Total) by EPA 6000/7000 Methods								
EPA 6010D	Arsenic	mg/kg	<2.5	0.6	2.5	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	<0.20	0.07	0.20	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	<0.20	0.05	0.20	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	<0.60	0.13	0.60	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	<0.8	0.3	0.8	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	<4.0	1.4	4.0	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	<0.50	0.14	0.50	X718021	09-May-17	
EPA 7471B	Mercury	mg/kg	<0.033	0.009	0.033	X717183	28-Apr-17	
Metals (Total Recoverable)								
EPA 6010D	Arsenic	mg/L	<0.025	0.008	0.025	X717109	05-May-17	
EPA 6010D	Barium	mg/L	<0.0020	0.0010	0.0020	X717109	05-May-17	
EPA 6010D	Cadmium	mg/L	<0.0020	0.0009	0.0020	X717109	05-May-17	
EPA 6010D	Calcium	mg/L	<0.100	0.041	0.100	X717109	05-May-17	
EPA 6010D	Chromium	mg/L	<0.0060	0.0015	0.0060	X717109	05-May-17	
EPA 6010D	Lead	mg/L	<0.0075	0.0036	0.0075	X717109	05-May-17	
EPA 6010D	Magnesium	mg/L	<0.20	0.08	0.20	X717109	05-May-17	
EPA 6010D	Selenium	mg/L	<0.040	0.018	0.040	X717109	05-May-17	
EPA 6010D	Silver	mg/L	<0.0050	0.0016	0.0050	X717109	05-May-17	
Classical Chemistry Parameters								
SM 2540 C	Total Diss. Solids	mg/L	<10		10	X717106	26-Apr-17	
Anions by Ion Chromatography								
EPA 300.0	Sulfate as SO4	mg/L	<0.30	0.12	0.30	X717119	02-May-17	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 7470A	Mercury	mg/L	0.00487	0.00500	97.4	80 - 120	X718036	02-May-17	
Metals (Total) by EPA 6000/7000 Methods									
EPA 6010D	Arsenic	mg/kg	98.8	100	98.8	80 - 120	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	99.8	100	99.8	80 - 120	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	101	100	101	80 - 120	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	99.5	100	99.5	80 - 120	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	98.8	100	98.8	80 - 120	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	96.9	100	96.9	80 - 120	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	4.90	5.00	97.9	80 - 120	X718021	09-May-17	
EPA 7471B	Mercury	mg/kg	0.825	0.833	99.0	80 - 120	X717183	28-Apr-17	
Metals (Total Recoverable)									
EPA 6010D	Arsenic	mg/L	0.962	1.00	96.2	80 - 120	X717109	05-May-17	
EPA 6010D	Barium	mg/L	1.09	1.00	109	80 - 120	X717109	05-May-17	
EPA 6010D	Cadmium	mg/L	0.972	1.00	97.2	80 - 120	X717109	05-May-17	
EPA 6010D	Calcium	mg/L	21.1	20.0	106	80 - 120	X717109	05-May-17	
EPA 6010D	Chromium	mg/L	0.946	1.00	94.6	80 - 120	X717109	05-May-17	
EPA 6010D	Lead	mg/L	0.953	1.00	95.3	80 - 120	X717109	05-May-17	
EPA 6010D	Magnesium	mg/L	19.5	20.0	97.7	80 - 120	X717109	05-May-17	
EPA 6010D	Selenium	mg/L	0.961	1.00	96.1	80 - 120	X717109	05-May-17	

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Applied Intellect
345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable) (Continued)									
EPA 6010D	Silver	mg/L	0.0503	0.0500	101	80 - 120	X717109	05-May-17	
Anions by Ion Chromatography									
EPA 300.0	Sulfate as SO4	mg/L	10.7	10.0	107	90 - 110	X717119	02-May-17	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
SM 2540 C	Total Diss. Solids	mg/L	298	300	0.7	10	X717106	26-Apr-17	
SM 4500 H B	pH @21.0°C	pH Units	7.50	7.60	1.3	20	X717116	26-Apr-17	
Percent Solids / Percent Moisture									
Percent Solids	% Solids	%	62.4	61.9	0.8	20	X718028	02-May-17	

Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)										
EPA 7470A	Mercury	mg/L	0.00101	<0.00020	0.00100	101	75 - 125	X718036	02-May-17	
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	Arsenic	mg/kg	119	16.9	100	102	75 - 125	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	195	98.5	100	96.7	75 - 125	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	106	<0.20	100	105	75 - 125	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	146	30.2	100	116	75 - 125	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	99.8	2.9	100	96.9	75 - 125	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	99.2	<4.0	100	99.2	75 - 125	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	6.34	1.26	5.00	102	75 - 125	X718021	09-May-17	
EPA 7471B	Mercury	mg/kg	0.342	<0.033	0.333	99.5	75 - 125	X717183	28-Apr-17	
Metals (Total Recoverable)										
EPA 6010D	Arsenic	mg/L	0.971	<0.025	1.00	97.1	75 - 125	X717109	05-May-17	
EPA 6010D	Barium	mg/L	1.09	0.0318	1.00	106	75 - 125	X717109	05-May-17	
EPA 6010D	Cadmium	mg/L	0.975	<0.0020	1.00	97.5	75 - 125	X717109	05-May-17	
EPA 6010D	Calcium	mg/L	30.1	9.53	20.0	103	75 - 125	X717109	05-May-17	
EPA 6010D	Chromium	mg/L	0.924	<0.0060	1.00	92.2	75 - 125	X717109	05-May-17	
EPA 6010D	Lead	mg/L	0.956	<0.0075	1.00	95.6	75 - 125	X717109	05-May-17	
EPA 6010D	Magnesium	mg/L	22.3	2.64	20.0	98.5	75 - 125	X717109	05-May-17	
EPA 6010D	Selenium	mg/L	0.970	<0.040	1.00	97.0	75 - 125	X717109	05-May-17	
EPA 6010D	Silver	mg/L	0.0498	<0.0050	0.0500	99.6	75 - 125	X717109	05-May-17	
Anions by Ion Chromatography										
EPA 300.0	Sulfate as SO4	mg/L	16.9	5.81	10.0	111	90 - 110	X717119	02-May-17	M1
EPA 300.0	Sulfate as SO4	mg/L	577	568	10.0	92.2	90 - 110	X717119	03-May-17	D2

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Applied Intellect
345 Bobwhite Court - Suite 230
Boise, ID 83706

Project Name: Umpqua EE/CA 2016
Work Order: **X7D0450**
Reported: 09-May-17 15:33

Quality Control - MATRIX SPIKE DUPLICATE Data

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	%R	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total)											
EPA 7470A	Mercury	mg/L	0.00100	0.00101	0.00100	100	1.0	20	X718036	02-May-17	
Metals (Total) by EPA 6000/7000 Methods											
EPA 6010D	Arsenic	mg/kg	118	119	100	101	1.3	20	X718021	09-May-17	
EPA 6010D	Barium	mg/kg	200	195	100	102	2.7	20	X718021	09-May-17	
EPA 6010D	Cadmium	mg/kg	104	106	100	104	1.7	20	X718021	09-May-17	
EPA 6010D	Chromium	mg/kg	149	146	100	119	2.0	20	X718021	09-May-17	
EPA 6010D	Lead	mg/kg	99.7	99.8	100	96.8	0.1	20	X718021	09-May-17	
EPA 6010D	Selenium	mg/kg	97.3	99.2	100	97.3	2.0	20	X718021	09-May-17	
EPA 6010D	Silver	mg/kg	6.30	6.34	5.00	101	0.7	20	X718021	09-May-17	
EPA 7471B	Mercury	mg/kg	0.350	0.342	0.333	102	2.4	20	X717183	28-Apr-17	
Metals (Total Recoverable)											
EPA 6010D	Arsenic	mg/L	0.962	0.971	1.00	96.2	0.9	20	X717109	05-May-17	
EPA 6010D	Barium	mg/L	1.08	1.09	1.00	104	1.7	20	X717109	05-May-17	
EPA 6010D	Cadmium	mg/L	0.968	0.975	1.00	96.8	0.8	20	X717109	05-May-17	
EPA 6010D	Calcium	mg/L	29.7	30.1	20.0	101	1.3	20	X717109	05-May-17	
EPA 6010D	Chromium	mg/L	0.933	0.924	1.00	93.2	1.0	20	X717109	05-May-17	
EPA 6010D	Lead	mg/L	0.948	0.956	1.00	94.8	0.8	20	X717109	05-May-17	
EPA 6010D	Magnesium	mg/L	22.0	22.3	20.0	96.6	1.7	20	X717109	05-May-17	
EPA 6010D	Selenium	mg/L	0.954	0.970	1.00	95.4	1.6	20	X717109	05-May-17	
EPA 6010D	Silver	mg/L	0.0498	0.0498	0.0500	99.6	0.0	20	X717109	05-May-17	
Anions by Ion Chromatography											
EPA 300.0	Sulfate as SO4	mg/L	15.5	16.9	10.0	97.4	8.3	20	X717119	02-May-17	

Notes and Definitions

D2	Sample required dilution due to high concentration of target analyte.
H5	This test is specified to be performed in the field within 15 minutes of sampling; sample was received and analyzed past the regulatory holding time.
M1	Matrix spike recovery was high, but the LCS recovery was acceptable.
Q5	Sample was received with inadequate preservation, but preserved by the laboratory.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

May 19, 2017

Applied Intellect
ATTN: Robert Lambeth
15321 N. Columbus St.
Spokane, WA 99208-8534
bob.lambeth@ap-in.com

RE: Project AIT-SP1601 Client Project: Umpqua Mine EE/CA

Dear Robert Lambeth,

This report contains results for the 2 samples received by Brooks Applied Labs (BAL) on April 21, 2017. The samples were logged-in for the contracted analyses according to the chain-of-custody form(s). The samples were received, prepared, analyzed, and stored according to BAL SOPs and EPA methodology.

The results were method blank corrected as described in the calculations section of the relevant BAL SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details. All data was reported without qualification (with the exception of concentration qualifiers), and all associated quality control sample results meet the acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more details, please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Lydia Greaves

Lydia Greaves
Client Services Manager
lydia@brooksapplied.com

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	standard reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 9/23/09)

J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J-1	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
umm-sed-4	1716045-01	Sediment	Sample	04/20/2017	04/21/2017
umm-sed-5	1716045-02	Sediment	Sample	04/20/2017	04/21/2017

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
%TS	Soil/Sediment	SM 2540G	04/24/2017	05/01/2017	B170981	N/A
MeHg	Soil/Sediment	EPA 1630	04/24/2017	04/26/2017	B170999	1700496

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
umm-sed-4										
1716045-01	%TS	Sediment	NA	82.64		0.09	0.32	%	B170981	N/A
1716045-01	MeHg	Sediment	dry	≤ 0.015	U	0.015	0.044	ng/g	B170999	1700496
umm-sed-5										
1716045-02	%TS	Sediment	NA	76.81		0.09	0.32	%	B170981	N/A
1716045-02	MeHg	Sediment	dry	≤ 0.016	U	0.016	0.049	ng/g	B170999	1700496

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Accuracy & Precision Summary

Batch: B170981
Lab Matrix: Soil/Sediment
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B170981-DUP1	**Duplicate, (1716047-03)**						
	%TS	90.43		90.37	%		0.07% 15

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Accuracy & Precision Summary

Batch: B170999
Lab Matrix: Soil/Sediment
Method: EPA 1630

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B170999-SRM1	**Standard Reference Material (1709003, Methyl Mercury in Sediment)**						
	MeHg		10.00	10.83	ng/g	108% 65-135	
B170999-MS2	**Matrix Spike (1716047-03)**						
	MeHg	2.746	86.80	81.39	ng/g	91% 65-135	
B170999-MSD2	**Matrix Spike Duplicate (1716047-03)**						
	MeHg	2.746	88.68	79.16	ng/g	86% 65-135	5% 35

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Method Blanks & Reporting Limits

Batch: B170981
Matrix: Soil/Sediment
Method: SM 2540G
Analyte: %TS

Sample	Result	Units
B170981-BLK1	0.03	%
B170981-BLK2	-0.01	%

Average: 0.01
Limit: 0.32

MDL: 0.09
MRL: 0.32

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Method Blanks & Reporting Limits

Batch: B170999
Matrix: Soil/Sediment
Method: EPA 1630
Analyte: MeHg

Sample	Result	Units
B170999-BLK1	0.001	ng/g
B170999-BLK2	0.0009	ng/g
B170999-BLK3	0.0006	ng/g
B170999-BLK4	0.0006	ng/g

Average: 0.001
Limit: 0.024

MDL: 0.012
MRL: 0.036

Project ID: AIT-SP1601
PM: Amanda Royal -

Client PM: Robert Lambeth
Client Project: Umpqua Mine EE/CA

Sample Containers

Lab ID: 1716045-01
Sample: umm-sed-4
Report Matrix: Sediment
Sample Type: Sample
Collected: 04/20/2017
Received: 04/21/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1716045-02
Sample: umm-sed-5
Report Matrix: Sediment
Sample Type: Sample
Collected: 04/20/2017
Received: 04/21/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Shipping Containers

Cooler

Received: April 21, 2017 9:00
Tracking No: 786310288052 via FedEx
Coolant Type: Ice
Temperature: 4.0 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: ir#12

Custody seals present? Yes
Custody seals intact? Yes
COC present? Yes

Chain-of-Custody Form

BROOKS APPLIED LABS

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only
Received by: Jen Walk Date: 4/21/17 BAL Report 1716045
Work Order ID: 1716045 Time: 9:00
Project ID: AIT-SP1601

Client: Applied Intellect PO Number: Mailing Address:
Contact: Paul Hunter Phone: (208)899-6714
Client Project ID: Umpqua Mine Email: paul.hunter@ap-inv.com Email Receipt Confirmation? (Yes/No)
Samples Collected By: R.H. Lambeth BAL PM:

Requested TAT (business days)	Collection		Client Sample Info				BAL Analyses Required								Comments
☐ 20 (standard) ☐ 15* ☐ 10* ☒ 5* ☐ Other ____ *Surcharges may apply to expedited TATs	Date	Time	Matrix Type	Number of Containers	Field Filtered? (Yes/No)	Preservation Type HCl/HNO_3/Other	Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify) InOrg, III, V, MMA, DMA	Se Species (specify) Se(IV), Se(VI), SeCN, Uknown	Filtration	Other (specify)	Other (specify)	Specify Here
Sample ID															
1 Umn-Sed-4	4-12-17	1:50	Sediment	1	N	N/A		✓							
2 Umn-Sed-5	4-12-17	1:40	Sediment	1	N	N/A		✓							
3															
4															
5															
6															
7															
8															
9															
10															
Trip Blank	N/A														

Relinquished By: RHL	Date: 4-20-17	Time: 5:00	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page 1 of 1 List Hazardous Contaminants: None

samples@brooksapplied.com | brooksapplied.com

APPENDIX 5

Quality Assurance / Quality Control

QA/QC objectives were developed for the Site to provide guidelines for field and laboratory operations. The goal was to produce data of known and acceptable quality, allowing the site investigators to fully assess the degree and extent of Compounds of Potential Concern (COPCs) in the media present at the Site. During the course of environmental activities, the standard procedures outlined in the SAP were followed to maximize sample integrity to produce acceptable levels of accuracy, precision, completeness, representativeness, and comparability.

Data Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property usually under prescribed conditions and calculated as the relative percent difference (RPD). Field duplicate samples were used to determine the precision of the sampling process. Acceptable RPDs were determined to range from 0% to 50% for soil samples, as defined in the SAP. Precision for field duplicates was estimated on the basis of calculated RPD of parameters. RPDs for soil samples ranged from 0% to 71.9%. Only two analytes in samples UMM-SS-26 and UMM-SS-66 (the duplicate) exceeded the 50% limit; the rest of the sample RPDs ranged from 0% to 30%. The two high RPDs were attributed to sample heterogeneity typical of soil samples. RPD calculations are presented in Table 1 below.

Table 1. RPDs for detected Soil Samples and Associated Duplicates

Sample ID	Analyte	Result	RPD
UMM-SS-26	Arsenic	11.5	30.0%
UMM-SS-66	Arsenic	8.5	
UMM-PW-1	Arsenic	102	-20.3%
UMM-SS-65	Arsenic	125	
UMM-SS-26	Barium	75.2	15.8%
UMM-SS-66	Barium	64.2	
UMM-PW-1	Barium	132	5.4%
UMM-SS-65	Barium	125	
UMM-SS-26	Chromium	11.9	14.4%
UMM-SS-66	Chromium	10.3	
UMM-PW-1	Chromium	57.2	12.6%
UMM-SS-65	Chromium	50.4	
UMM-SS-26	Lead	1.7	-55.3%
UMM-SS-66	Lead	3	
UMM-PW-1	Lead	9.1	-25.0%
UMM-SS-65	Lead	11.7	
UMM-SS-26	Mercury	3.12	71.9%
UMM-SS-66	Mercury	1.47	
UMM-PW-1	Mercury	6730	-11.9%
UMM-SS-65	Mercury	7580	
UMM-SS-26	Paste pH	6.4	1.6%

Sample ID	Analyte	Result	RPD
UMM-SS-66	Paste pH	6.3	
UMM-PW-1	Paste pH	4.5	0.0%
UMM-SS-65	Paste pH	4.5	
UMM-SS-26	Silver	1.25	NA
UMM-SS-66	Silver	<0.5	
UMM-PW-1	Silver	5.32	NA
UMM-SS-65	Silver	<5	

NA – not applicable; cannot calculate a RPD using a non-detect value.
RPD – relative percent difference

Accuracy was estimated on the basis of laboratory matrix spike/matrix spike duplicate (MS/MSD) recoveries. Accuracy is maximized by the use of standard sampling, shipping and analysis procedures, and the use of disposable sampling equipment to reduce the potential for sample contamination. Acceptable spike recovery ranges differ by analyte and were defined by SVL Analytical. There were three soil spike recoveries outside of QC limits, one of which was due to sample dilution necessary for the analysis that voided the recovery calculation. Although there were a few analytes outside of recovery limits, laboratory control samples and instrument calibration performed concurrently were within control limits. This indicates the analysis was within control limits and these two samples were affected by matrix interferences.

Data Representativeness, Comparability, and Completeness

Representativeness is defined as the degree to which the sample data accurately and precisely represents a characteristic of the environmental condition. Representativeness is evaluated by collecting sufficient samples, properly chosen with respect to location and time, and then comparing the results for field duplicate samples. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis. Representativeness is considered acceptable for this evaluation on the basis of a sufficient number of samples being collected at locations that properly defined the extent of potential contamination.

Comparability is defined as the confidence with which one data set can be compared to another data set. Comparability was maximized by using standard sampling and analysis procedures, and is considered acceptable for this evaluation.

Completeness is defined as the percentage of valid data obtained in comparison to the amount that was planned. The data has been validated and all analytical samples are considered usable to determine compliance with applicable regulations.

Additional Field and Laboratory QC Checks

Laboratory Control Spike

A laboratory control spike (LCS) is a sample of an uncontaminated reference matrix (such as reagent water, clean sand, or other matrix material) that has had a known amount of the target analyte added to it in the laboratory before analysis. Laboratories commonly use LCS and LCS duplicate (LCSD) analyses to maintain quality control over the analytical process. All LCS and LCSD recoveries were found to be acceptable by SVL Analytical.

Holding Times

All samples were analyzed within the specified holding times.

Calibration

Instrument calibration verifications performed by SVL Analytical were all found to be within acceptable limits.

Field Records

Field documentation ensures sample integrity and provides sufficient technical information to recreate each field event. All field data was reviewed to ensure that:

- Proper field procedures were implemented;
- Appropriate documentation is available for each activity;
- Field instruments were calibrated as required;
- Required number and type of field QC samples were collected;
- Numerical value and units of each field measurement were documented; and
- Field equipment was decontaminated or disposable single-use materials were used as specified.

Review of field documentation shows documentation to be clear, comprehensive, and acceptable.

APPENDIX 6

Potential Applicable or Relevant and Appropriate Requirements

CHEMICAL-SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Primary & Secondary Drinking Water Regulations	42 USC § 300f et seq. 40 CFR Part 141 40 CFR Part 142 49 CFR Part 143	No	No	No	Establishes health-based and aesthetic standards (maximum contaminant levels [MCLs]) for public drinking water systems. Groundwater will not be addressed by this removal action or any proposed removal alternatives.
National Ambient Water Quality Criteria (AWQC)	33 USC § 1314 40 CFR Part 131	Yes	No	No	Sets criteria for water quality based on toxicity to aquatic organisms and human health. The State of Oregon has been delegated this program. Applicable by reference in ORS 468B.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC § 7401 et seq. 40 CFR Part 50.6	No	No	No	Establishes air quality levels that protect public health. Sets standards on ambient concentrations of carbon monoxide, lead, nitrogen dioxide, PM|$_0$, ozone and sulfur oxides. Not an ARAR - only “major” sources are subject to requirements related to NAAQS. Emissions associated with proposed removal actions will be limited to fugitive dust emissions associated with earth moving activities on site. These activities will not constitute a major source. Defer to state regulation of fugitive dust emissions. Considered applicable by reference through OAR 340-202.
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are anticipated for this removal action.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260-270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Defines solids wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262265 and Parts 124, 270, and 271. Exempts mining waste from RCRA Subtitle C, Bevill exempt. Even if TCLP testing confirmed a characteristic waste (Subpart C), it is still exempt.
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258, 261.2	No	Yes	No	Regulates the storage and handling of solid waste. Wastes at this site are classified as exempt under the Bevill Amendment and therefore are considered a solid waste. Requirements for solid wastes under RCRA Subtitle D may be relevant and appropriate at this site.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Regional Screening Levels (RSL) for soil, water, and air	Regional Screening Level (RSL) Table June 2017	No	Yes	No	Regional Screening Levels (RSL) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist in initial screening-level evaluations of environmental risks. RSLs should be viewed as Agency guidelines, not legally enforceable standards. They are used for site "screening" and as initial cleanup goals if applicable.
BLM Risk Management Criteria (RMC)	Technical Note 390 rev.	No	No	Yes	Suggests acceptable multimedia risk-based criteria for heavy metals as they relate to recreational use and wildlife habitat on BLM lands.
Hazardous Waste Operations and Emergency Response (HAZWOPER)	29 CFR 1910.120 and 40 CFR 311	Yes	No	No	Worker protection during hazardous waste cleanup and CERCLA removal actions.
STATE OF OREGON					
Hazardous Substance Remedial Action Rules	OAR 340-122-0084 & 1115	No	Yes	No	Establishes Oregon Department of Environmental Quality (ODEQ) guidelines for assessing human health and ecological risk assessments on potential adverse effects from contamination according to ODEQ risk guidelines and levels. Criteria may be relevant and appropriate for this site. however, BLM retains its CERCLA authority for work on this site.
Hazardous Substance Occupational Exposure	OAR 437	Yes	No	No	Establishes OR-OSHA Permissible Exposure Limits (PEL). OR-OSHA exposure limits mirror the federal chemical specific limits (refer to NIOSH Pocket Guide to Chemical Hazards for details on individual chemicals).
Oregon Soil Cleanup Standards	OAR 340-122-045 Residential) & OAR 340122-046 (Industrial) ORS 465.200 through 465.455 and 465.900	No	Yes	No	Establishes standards and procedures to be used under Oregon's Environmental Cleanup Law (ORS 465.200 through 465.455 and 465.900) for the determination of removal and remedial actions necessary to assure protection of the present and future public health, safety and welfare, and the environment in the event of a release or threat of a release of a hazardous substance. Criteria may be relevant or appropriate for this site. However, BLM retains its CERCLA authority for work on this site.
Oregon Water Quality Criteria for Protection of Human Health and Aquatic Life	OAR 340-041	Yes	No	No	State of Oregon is authorized by the EPA to implement the Clean Water Act in Oregon. Establishes acceptable contaminant levels for ingestion of aquatic organisms and for intake by aquatic organisms in surface water.
Oregon Primary Drinking Water Standards	OAR 340-041	No	No	No	Health-based standards (MCL) for public drinking water systems. Groundwater is not addressed by this removal action or any proposed removal alternatives.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Oregon Water Pollution Control Statutes	ORS 468B.005 through ORS 468B.190	No	Yes	No	Addresses effluent standards, permit requirements for discharges to U.S. waters and minimum Federal water quality criteria. Covers the protection of surface water during removal activities. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Groundwater Quality Protection Program	OAR 340-040	No	No	No	Establishes the mandatory minimum groundwater quality protection requirements for federal and state agencies, cities, counties, industries, and citizens. Applicable to groundwater monitoring of a subsurface treatment system. No subsurface treatment systems are planned for this site.
Ambient Air Quality Standards and PSD Increments	OAR 340-202	Yes	No	No	Establish concentrations, exposure time, and frequency of occurrence of an air contaminant or multiple contaminants in the ambient air that must not be exceeded. Applicable to PM10 ambient air quality during removal activities.
Oregon Emission Standards for Hazardous Air Pollutants	OAR 340-244	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are part of this removal action.
Oregon Air Pollution Laws	ORS 468A.005-085	No	Yes	No	Provides laws governing air pollution control, abatement and prevention. Relevant and appropriate to removal action construction activities. However, BLM may invoke CERCLA authority.
Identification and Listing of Hazardous Waste	OAR 340-101	Yes	No	No	Identifies those residues which are subject to regulation as hazardous wastes. Solid waste from the extraction, beneficiation, and processing of ores and minerals are exempt under 40 CFR Part 261.4(b)(7). However, treatment sludge and discharge are not exempt.
Oregon Standards for Mining Operations	ORS 517.952-989	No	No	No	Regulations governing design, construction, operation and closure of mining operations. Not applicable to abandoned mines.

Shading – Most Applicable ARAR

LOCATION-SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
Protection of Wetlands Executive Order 11990	33 USC § 131440 CFR Part 6.302(a) and Appendix A	No	No	No	Minimizes impacts to wetlands. Requires Federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. No wetlands have been identified at this site.
Floodplain Management Executive Order 11988	33 USC § 1314 40 CFR Part, 6.302(b) and Appendix A	Yes	No	No	Regulates construction in floodplains. Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible. Relevant, if all or part of a treatment system or mine waste containment embankment is constructed in a floodplain.
Clean Water Act Section 404, Dredge and Fill Regulations	33 USC § 1314 33 CFR Parts 320-323 33 CFR Part 330	Yes	No	No	Regulates discharge of dredge or fill materials into waters of the U.S. Must take practicable steps to minimize and mitigate adverse impacts. Permits are not required for this action however the substantive portions of the regulation may be applicable.
Fish and Wildlife Coordination Act	16 USC §§ 661, et seq, 40 CFR 6.302(g)	No	No	No	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources.
Fish and Wildlife Conservation Act	16 USC §§ 2901-2912	No	Yes	No	Federal departments and agencies are encouraged to utilize their authority to conserve nongame fish and wildlife and their habitats and assist States in the development of their conservation plans, including during remedial activities.
Wild and Scenic Rivers Act	40 CFR Part, 6.302(e) 36 CFR Part 297 16 USC § 12,71-12,87	Yes	No	No	Establishes requirements to protect wild, scenic, or recreational rivers.
National Historic Preservation Act	16 USC § 470 et seq. 36 CFR Part 800 40 CFR Part 6.301(b) 36 CFR Part 63	No	Yes	No	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places. Regulates inventory, assessment and consultation on project effects and protection measures for cultural properties on federal lands.
The Historic and Archeological Preservation Act of 1974	16 USC § 469 40 CFR Part 6.301(c)	Yes	No	No	Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Native American Graves Protection and Repatriation Act	25 USC §§ 3001-3013 43 CFR Part 10	Yes	No	No	Regulations that pertain to the identification, protection and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony. None known at Site.
Historic Sites Act of 1935	16 USC §§ 461-467 40 CFR Part 6.301(a)	No	No	No	Preserves for public use historic sites, buildings, and objects of natural significance. There are no historic sites, buildings or objects of natural significance as defined in the Historic Sites Act of 193 at the Site.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	16 USC § 470	Yes	No	No	Requires Federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on them. None known at Site.
The Archaeological Resources Protection Act of 1979	43 CFR Part 7	No	Yes	No	Regulates requirements for authorized removal of archeological resources from public or tribal lane. May be relevant and appropriate if archeological resources are encountered during removal action activity.
Endangered Species Act	16 USC §§ 1531(h)-1543 40 CFR Part 6.302 (b) 50 CFR Parts 17 & 402	Yes	No	No	Regulates the protection of threatened or endangered species and critical habitat. Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. Northern spotted owls are listed as a threatened species in the vicinity of the Site.
Bald Eagle Protection Act	16 USC § 668 et seq.	Yes	No	No	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.
Migratory Bird Treaty Act	16 USC § 703 et seq.	Yes	No	No	Establishes federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.
Federal Land Policy and Management Act of 1976	43 USC § 1701	No	Yes	No	Provides for multiple use and inventory, protection, and planning for cultural resources on public lands. No cultural resources known at Site.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
STATE OF OREGON					
ODNR's Plant Conservation Biology Program Plants: Wildflowers and Endangered, Threatened, and Candidate Species	OAR 603-73	Yes	No	No	Provides for protection of certain plants, wildflowers, and shrubs; guidelines on the listing, reclassification, and delisting of plant species as threatened or endangered. There is one known threatened plant, Kincaid's Lupine, in the vicinity of the site.
Oregon's Endangered Species Rule, Wildlife Diversity Program	OAR 635-100	Yes	No	Yes	Provides rules for maintaining Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges.
Oregon State Police Wildlife Enforcement and Penalties		No	No	Yes	Protects wildlife from detrimental actions.
Oregon Historical and Archaeological Resources Rules and Regulations	ORS 358 & 390 OAR 736-50 & 51	No	No	No	Regulations for historic and archaeological resources on State lands. No state lands at Site.
Oregon Register of Historic Places		Yes	No	No	Review of potential impacts to historic places and structures.

Shading – Most Applicable ARAR

ACTION SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Pollutant Discharge Elimination System	33 USC § 1314 40 CFR Parts 122 - 125, 131	No	Yes	No	Regulates the discharge of treated effluent and storm water runoff to waters of the U.S. Defer to ORS 468B. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Effluent Limitations	33 USC § 1311 40 CFR Part 440	No	Yes	No	Sets standards for discharge of treated effluent to waters of the U.S.
Toxic Pollutant Effluent Standards	33 USC § 1317 40 CFR Part 129	No	Yes	No	Establishes standards or sets prohibitions for certain hazardous constituents.
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328 30 CFR Part 816	No	No	No	Performance standards for surface mining activities.
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 40 49 CFR Parts 107, 171-177	No	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous material offsite to a hazardous waste landfill.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	No	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous waste offsite to a hazardous waste landfill.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260 - 270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Establishes requirements for hazardous waste treatment, storage, and disposal of hazardous wastes. Excludes certain solid waste resulting from mining operations from the definition of hazardous wastes and Subtitle C requirements (Bevill Exemption).
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258 & 261.2	No	Yes	No	Establishes definitions of solid wastes and establishes requirements for municipal solid waste landfills. Requirements may be relevant or appropriate for onsite repository design.
Off-site Disposal	40 CFR Part 300.440	No	No	No	Establishes criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA wastes from response actions authorized or funded under CERCLA.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	42 USC §§ 6924 & 6925 40 CFR Part 264.13.14 264	No	No	No	Requirements for proper handling, treatment, storage, and disposal of hazardous wastes. General regulations for the design, operation, and maintenance of hazardous waste treatment, storage, and disposal (TSD) facilities.
Closure Requirements	40 CFR Part 264, Subpart G	No	No	No	Closure of hazardous waste repositories must meet protective standards. Regulations to minimize contaminant migration, provide leachate collection and prevent contaminant exposure will be met.
Landfill Design and Construction	40 CFR Part 264, Subpart N	No	No	No	Hazardous waste landfills must meet minimum design standards.
Groundwater Monitoring	40 CFR Part 264, Subparts F & X	No	No	No	Establishes standards for detection and compliance monitoring.
Criteria for Municipal Solid Waste Landfills	40 CFR Part 258 40 CFR Part 257.3-1 through 257.3-4	No	Yes	No	Establishes criteria for municipal solid waste landfills. Criteria may be relevant or appropriate for repository design, if used. Defer to OAR 340-95.
Standards Applicable to Generation of Hazardous Waste	40 CFR Part 262	No	No	No	Establishes standards for the generation of hazardous waste. Exempt through 40 CFR Part 261.4(b)(7).
Land Disposal Restrictions (LDR)	40 CFR Part 268	No	Yes	No	LDRs place specific restrictions (conc. or trmt) on RCRA hazardous wastes prior to their placement in a land disposal unit. Relevant and appropriate LDR requirements will be met if any material accumulations are treated ex situ.
Disposal of Solid Waste Criteria for Classification of Solid Waste Disposal Facilities and Practices	42 USC §§ 6901 et seq. 40 CFR 257	No	Yes	No	Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste. Establishes criteria for determining which solid waste disposal practices pose threats to human health and the environment. May be considered relevant and appropriate for any repository.
Occupational Safety and Health Act	29 USC §§ 651-678	Yes	No	No	Regulates worker health and safety.
Federal Mine Safety and Health Act	30 USC §§ 801-962	No	No	Yes	Regulates worker safety at active mine sites.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
STATE OF OREGON					
Oregon Mined Land Reclamation Rules	OAR 632-30	No	No	Yes	Regulates permitting of surface mining activities and specifies reclamation plan requirements as part of the permitting process. Though this is applicable to permitting of surface mining activities, minimum standards for reclamation will be considered.
Solid Waste: Land Disposal Sites other than MSW Landfills	OAR 340-95	No	Yes	No	Regulates the siting, operation and maintenance of any non-municipal land disposal site. Criteria may be relevant or appropriate for the siting of a repository.
Oregon Statutes on Solid Waste Disposal and Recycling	ORS 459-459A	No	No	No	Regulates the storage and handling of solid waste.
Oregon Hazardous Waste Regulations	OAR 340-100 to 340-135	No	No	No	Regulates the storage and handling of hazardous waste.
Storage, Treatment and Disposal of Hazardous Waste	ORS 466	No	No	No	Regulates the transportation and disposal of hazardous waste.
Standards for Owner and Operators of Hazardous Waste TSDF	OAR 340-104	No	No	No	Establishes minimum State standards which define the acceptable management of hazardous waste.
Oil and Hazardous Materials Spills and Releases	OAR 340-108	No	Yes	No	Specifies the reporting requirements, cleanup standards and liability that attaches to a spill or release or threatened spill or release involving oil or hazardous material. Specified cleanup standards of hazardous substances apply to removal actions. May be relevant and appropriate for or site spills of petroleum products related to construction activities.
Oregon Soil Cleanup Standards	OAR 340-122 ORS 465.200 through 465.455 and 465.900	No	Yes	No	Establish the standards and procedures to be used under Oregon's Environmental Cleanup Law (ORS 465.200 through 465.455 and 465.900) for the determination of removal and remedial actions necessary to assure protection of the present and future public health, safety and welfare, and the environment in the event of a release or threat of a release of a hazardous substance. Criteria may be relevant or appropriate for this site. However, BLM retains its CERCLA authority for work on this site.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Regulations Pertaining to NPDES and WPCF Permits	OAR 340-45	No	Yes	No	Prescribe limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the ODEQ. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Well Construction Standards	OAR 690-200 & 210	No	No	No	Provides well construction and maintenance and construction standards applicable to water wells. No site monitoring wells.
Water Control Regulations	OAR 340-045	No	Yes	No	Regulations and statutes governing water pollution control permits, and general storm water permits. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.

Shading – Most Applicable ARAR

APPENDIX 7

Detailed Cost Summary of Proposed Alternatives

Item	Cost	Alternative 1 No Action		Alternative 2 Inst. Contols		Alternative 3 On-Site Disposal		Alternative 4 Off-Site Disposal		Alternative 4a Off-Site Disposal		Alternative 5 On- & Off-Site Recycle	
		Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
Mob-Demobilizations:													
Excavator Mob	$3,000 Fixed	0	$0	0	$0	1	$3,000	1	$3,000	1	$3,000	1	$3,000
Mini-Exc. Mob*	$2,000 Fixed	0	$0	1	$2,000	1	$2,000	1	$2,000	1	$2,000	1	$2,000
Large Truck Mob	$1,000 Fixed	0	$0	0	$0	1	$1,000	3	$3,000	5	$5,000	2	$2,000
Light Truck Mob*	$750 Fixed	0	$0	1	$750	2	$1,500	2	$1,500	2	$1,500	2	$1,500
Tank & Soil Disp.*	$10,000 Fixed	0	$0	0	$0	1	$10,000	1	$10,000	1	$10,000	1	$10,000
Fencing	$30 /ft	0	$0	560	$16,800	0	$0	0	$0	0	$0	0	$0
Signage*	$1,000 Fixed	0	$0	1	$1,000	1	$1,000	1	$1,000	1	$1,000	1	$1,000
Metal Removal & Sorting:													
Excavators	$250 /hr	0	$0	0	$0	16	$4,000	16	$4,000	16	$4,000	16	$4,000
Decon & disposal	$2,000 Fixed	0	$0	0	$0	1	$2,000	1	$2,000	1	$2,000	1	$2,000
Metal Testing	$35 /hr	0	$0	0	$0	0	$0	0	$0	0	$0	16	$560
Metal Off-Site Disposal:													
Cutting	$50 /hr	0	$0	0	$0	0	$0	16	$800	16	$800	16	$800
Crushing	$150 /hr	0	$0	0	$0	8	$1,200	16	$2,400	16	$2,400	16	$2,400
Loading	$150 /hr	0	$0	0	$0	0	$0	40	$6,000	48	$7,200	16	$2,400
Transporting (Local Recycling)	$480 /RT	0	$0	0	$0	0	$0	0	$0	0	$0	7	$3,360
Transporting (RCRA-C)	$1,700 /RT	0	$0	0	$0	0	$0	0	$0	30	$51,000	0	$0
Transporting (Local RCRA-D)	$480 /RT	0	$0	0	$0	0	$0	30	$14,400	0	$0	0	$0
Disposal RCRA-C	$155 /ton	0	$0	0	$0	0	$0	0	$0	750	$116,250	0	$0
Disposal RCRA-D	$55 /ton	0	$0	0	$0	0	$0	750	$41,250	0	$0	0	$0
Repository Construction:													
Excavators	$250 /hr	0	$0	0	$0	24	$6,000	0	$0	0	$0	24	$6,000
Trucks	$110 /hr	0	$0	0	$0	24	$2,640	0	$0	0	$0	24	$2,640
Drain Tile w/Inst.	$30 /ft	0	$0	0	$0	150	$4,500	0	$0	0	$0	150	$4,500
Internal Cap:													
Material Cost	$2 /sf	0	$0	0	$0	1300	$2,600	0	$0	0	$0	1300	$2,600
Installation Labor	$70 /hr	0	$0	0	$0	8	$560	0	$0	0	$0	8	$560
Soil Cover & backfilling:													
Excavators	$250 /hr	0	$0	0	$0	32	$8,000	8	$2,000	8	$2,000	24	$6,000
Truck	$110 /hr	0	$0	0	$0	32	$3,520	8	$880	8	$880	24	$2,640
Growth Media:													
Excavators	$250 /hr	0	$0	0	$0	8	$2,000	8	$2,000	8	$2,000	8	$2,000
Truck	$110 /hr	0	$0	0	$0	8	$880	8	$880	8	$880	8	$880
Reclamation:													
Excavators	$250 /hr	0	$0	0	$0	8	$2,000	8	$2,000	8	$2,000	8	$2,000
Truck	$110 /hr	0	$0	0	$0	8	$880	8	$880	8	$880	8	$880
Seeding:													
Seeding	$30 /lb	0	$0	0	$0	50	$1,500	50	$1,500	50	$1,500	50	$1,500
Labor	$70 /hr	0	$0	0	$0	8	$560	8	$560	8	$560	8	$560
Field Expenses:													
Contractor Mileage	$1 /mi	0	$0	280	$168	3,080	$1,848	2,860	$1,716	3,080	$1,848	3,740	$2,244
Oversite Mileage	$1 /mi	0	$0	280	$168	1,540	$924	1,430	$858	1,540	$924	1,870	$1,122
Oversite Per Diem	$150 /day	0	$0	2	$300	14	$2,100	13	$1,950	14	$2,100	17	$2,550
Oversite Hours	$140 /hr	0	$0	16	$2,240	112	$15,680	104	$14,560	110	$15,400	136	$19,040
XRF	$1,500 /wk	0	$0	0	$0	2	$3,000	2	$3,000	2	$3,000	2	$3,000
Verification Sampling	$5,000 Fixed	0	$0	0	$0	1	$5,000	1	$5,000	1	$5,000	1	$5,000
Report	$15,000 Fixed	0	$0	0.3	$4,500	1	$15,000	1	$15,000	1	$15,000	1	$15,000
Standby Time:													
Excavators	$125	0	$0	0		16	$2,000	8	$1,000	8	$1,000	40	$5,000
Trucks	$55	0	$0	0		40	$2,200	0	$0	0	$0	19	$1,045
Subtotal:			**$0**		**$27,926**		**$109,092**		**$145,134**		**$261,122**		**$121,781**
Contingency:			$0		$5,585		$21,818		$29,027		$52,224		$24,356
Total:			**$0**		**$33,511**		**$130,910**		**$174,161**		**$313,346**		**$146,137**
Monitoring w/ Report*	$5,000 /yr	0	$0	3	$15,000	3	$15,000	3	$15,000	3	$15,000	3	$15,000
Site Maintenance	$2,000 /yr	0	$0	0	$12,000	3	$6,000	0	$0	0	$0	3	$6,000
Site Maintenance (Off-Site Disposal)	$1,000 /yr	0	$0	0	$0	0	$0	3	$3,000	3	$3,000	0	$0
Total Monitoring + O&M:			**$0**		**$27,000**		**$21,000**		**$18,000**		**$18,000**		**$21,000**
PROJECT 3-YEAR TOTALS:			**$0**		**$60,511**		**$151,910**		**$192,161**		**$331,346**		**$167,137**

NOTES:

* Indicates costs common to all alternatives

Contractor costs assume Grants Pass source

Disposal location is assumed as Roseburg

Alternative 2 requires **2 days** on-site

Alternative 3 requires **14 days** (2 days debris relocation+3 days rep. construction+1 day tile installation+4 days filling&backfilling+1 day cap install. + 1 day growth media + 1 day reclamation + 1 day contingency)

Alternative 4 requires **13 days** (2 days debris relocation+1 day rep. backfilling + 1 day growth media + 1 day reclamation + 2 days cutting + 5 days & 3 trucks loading and hauling+ 1 day contingency)

Alternative 4a requires **14 days** (2 days debris relocation+1 day rep. backfilling + 1 day growth media + 1 day reclamation + 2 days cutting + 6 days & 5 trucks loading and hauling+ 1 day contingency)

Alternative 5 requires **17 days** (2 day debris relocation+3 days rep. construction+1 day tile installation+3 days filling&backfilling+1 day cap install. + 1 day growth media + 2 days cutting & testing + 2 days & 2 trucks loading & hauling+ 1 day reclamation + 1 day contingency)

Alternative 4 = Local RCRA Subpart D disposal

Alternative 4a = RCRA Subpart C disposal