ecology and
environment, inc.
Member of WSP

333 SW Fifth Avenue, Suite 600
Portland, OR 97204
Tel: (503) 248-5600 Fax: (503) 345-6821

February 28, 2020

Randy Nattis, Federal On-Scene Coordinator
United States Environmental Protection Agency
805 SW Broadway,
Suite 500
Portland, Oregon 97205

Re: Removal Action Report
Black Butte Mine / Furnace Creek Non-Time Critical Removal Action
Contract Number EP-S7-13-07, Task Order Number 25

Dear Mr. Nattis:

Enclosed please find the Removal Action Report for the non-time critical removal action (NTCRA) of the Furnace Creek area at the Black Butte Mine Site located near Cottage Grove in Lane County, Oregon.

This version of the Final Report has been updated to include comments from CDM Smith on the Draft Report.

If you have any questions regarding this submittal, please call me at (206) 624-9537.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.,
Member of WSP

Steven Hall

Steven G. Hall
START-IV Removal Team Leader

cc: Maren Fulton, START-IV Project Manager, E & E, Portland

REMOVAL ACTION REPORT

Black Butte Mine Site / Furnace Creek Removal Action
Cottage Grove, Lane County, Oregon
Task Order Number: TO-25

START IV
Region 10

Prepared for:

U.S. Environmental Protection Agency, Region 10
805 SW Broadway, Suite 500
Portland, Oregon 97205

Prepared by:

Ecology and Environment, Inc.
Member of WSP
333 SW 5th Avenue, Suite 600
Portland, Oregon 97204

February 2020

This page intentionally left blank.

Table of Contents

Table of Contents (cont.)

Section **Page**

Table of Contents (cont.)

Section **Page**

Appendices

Table of Contents (cont.)

Section **Page**

List of Tables

This page intentionally left blank.

List of Figures

This page intentionally left blank.

List of Acronyms and Abbreviations

Abbreviation	Definition
%	Percent
%R	percent recovery
$\mu g/m^3$	micrograms per cubic meter
AAR	Applied Archaeological Research, Inc.
BBM	Black Butte Mine
bgs	below ground surface
BMPs	Best Management Practices
BS	Blank Spike
CDM Smith	CDM Federal Programs Corporation
CFWR	Coast Fork Willamette River
Comms	Communications
CY	cubic yards
DQOs	Data Quality Objectives
DU	Decision Unit
EA	EA Engineering, Science, and Technology, Inc., PBC
EE/CA	Engineering Evaluation/Cost Analysis
E & E	Ecology and Environment, Inc.
ERRS	Emergency and Rapid Response Services
EPA	U. S. Environmental Protection Agency
EQM	Environmental Quality Management, Inc.
ft^2	square feet
gpm	gallons per minute
HRS	Hazard Ranking System
LCV	log cross vane
mg/kg	milligrams per kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MVA	Mercury Vapor Analyzer
ng/L	nanograms per liter
NTCRA	Non-Time-Critical Removal Action
ODEQ	Oregon Department of Environmental Quality

OPWA	Ore Processing Waste Area
OU	Operable Unit
QA	Quality Assurance
QC	Quality Control
RCV	rock cross vane
RI	Remedial Investigation
RPD	Relative Percent Difference
Site	Black Butte Mine Superfund Site
SPAF	Sample Plan Alteration Form
SPLP	Synthetic Precipitate Leaching Procedure
SSSP	Site-Specific Sampling Plan
START	Superfund Technical Assessment and Response Team
TCLP	Toxicity characteristic leaching procedure
TCRA	Time-Critical Removal Action
XRF	X-Ray Fluorescence

Executive Summary

The United States Environmental Protection Agency (EPA) completed a non-time-critical removal action (NTCRA) at the Furnace Creek area in Operable Unit (OU) 1 of the Black Butte Mine (BBM) Site (Site) near Cottage Grove, Oregon. The removal action was conducted in multiple phases. The Furnace Creek area removal action occurred from May through August 2018, and the residential removal action occurred in September and October 2018. In July 2019, EPA returned to the site to perform additional removal activities at the Former Ore Processing Waste Area (OPWA) in OU1 and to make some enhancements and repairs to portions of the Furnace Creek removal action.

The BBM is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River (CFWR) basin, approximately 10 miles south of Cottage Grove, Oregon. Cinnabar was discovered at what would become the Black Butte Mine circa 1890. Mining operations at the BBM began circa 1897 and continued intermittently through 1968. The Old Furnace was located near the right bank of Furnace Creek, and tailings from furnace operations were presumably disposed of downgradient of the furnace along the right bank and within the channel of Furnace Creek. It is presumed that the mercury-laden tailings within Furnace Creek were generated prior to 1919. The BBM property is currently owned by The Land and Timber Company, which has used the property surrounding the site for logging.

In 2007, EPA completed a time-critical removal action (TCRA) at the site to address uncontrolled sources of mercury migrating to Dennis Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings removed during the 2007 TCRA were consolidated on top of the Main Tailings Pile located on site to form a repository. Additionally, tailings and soil with elevated mercury concentrations located at the Old Furnace and New Furnace were capped with soil/tailings that were determined to have low mercury concentrations.

After the 2007 TCRA, continued monitoring of surface water and sediment performed by the Oregon Department of Environmental Quality (ODEQ) and EPA Remedial program indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Source areas located within the Furnace Creek catchment, consisting of tailings and co-mingled contaminated soils and sediment, were determined to be the dominant sources of mercury migrating to Garoutte Creek (CDM Smith 2018d).

Furnace Creek was not included in the scope of the 2007 TCRA. EPA's Remedial Program completed an engineering evaluation / cost analysis (EE/CA) for the Furnace Creek area of OU1, and the recommended removal alternative was the excavation of mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel (CDM Smith 2016).

EPA conducted a remedial investigation (RI) at the site from 2012 through 2017 (CDM Smith 2018e). The Draft RI report was completed in 2018. To reduce the release of mercury to surface water, EPA decided to perform a NTCRA within the Furnace Creek area of the site. The principal goals of the Furnace Creek NTCRA were to stabilize, remove, and/or contain tailings, bank soil, and sediment within the Furnace Creek catchment in order to reduce the high

concentrations of mercury in surface water and sediment discharging from Furnace Creek to the CFWR watershed.

In 2014, EPA's Remedial Program investigated mine tailings discovered at the residence located at the base of the BBM property. The residential investigation concluded that arsenic and mercury concentrations on the property exceeded the site-specific action levels. Based on these results, EPA included cleanup activities at the residence under the Furnace Creek NTCRA.

EPA and its contractors mobilized to the site in May 2018 to begin preparations for the Furnace Creek NTCRA. The 2018 removal activities included three primary activities: excavation of mine-related wastes from the Furnace Creek area of OU1; restoration of Furnace Creek and areas of OU1 disturbed during the removal; and the residential removal. Field work for the Furnace Creek removal action was performed from May through August 2018. The Furnace Creek work area was cleared and grubbed, and topographic surveys of Furnace Creek were conducted to aid and direct restoration of the creek channel gradient following excavation. Benchmarks for the survey stations were established along the length of the removal area of Furnace Creek. An on-site borrow source was characterized as a suitable source for clean fill, and the source area was cleared and developed as a soil borrow source.

Excavated mine-related waste from the Furnace Creek area was loaded into haul trucks and transported to the repository area which was created during the 2007 TCRA. Excavation and removal were guided by visual observations of tailings and the use of x-ray fluorescence (XRF) and mercury vapor analyzer field instruments. During initial excavation activities, contaminated material was determined to be present within the Furnace Creek channel at a much greater depth than originally characterized. Based on this discovery, excavation of the floor of the channel was conducted to a depth of 6 feet throughout the length of the removal area. The left bank was excavated until native material and/or soil met the NTCRA clean-up criteria, where feasible. The right bank was excavated to uncontaminated clean material, where feasible; otherwise, it was excavated down to a stable slope, leaving contaminated material in place. Additionally, contaminated waste material containing microbeads of elemental mercury and waste with large amounts of building materials (e.g., bricks and dimensional lumber) with very high reported concentrations of mercury vapor (>100 micrograms per cubic meter), were discovered on both banks of Furnace Creek in the vicinity of the Old Furnace. Approximately 50 cubic yards (CY) of material containing microbeads and elevated mercury levels was excavated from this location. The excavated material was segregated and temporarily staged on a lined stockpile area located at the repository. This material was then analyzed for Synthetic Precipitation Leaching Procedure metals and subsequently characterized as appropriate for on-site disposal.

By the end of the excavation phase, approximately 13,117 loose CY of material had been hauled and placed in the on-site repository, including the 50 CY of material containing elevated mercury concentrations, which was segregated and contained in polyethylene sheeting prior to placement in the repository. The repository was then capped with overburden material excavated from the Furnace Creek channel and fill material from the on-site borrow source. The material from both sources was analyzed using XRF (with a subset of samples sent for laboratory analysis as confirmation) to verify that concentrations of mercury and arsenic were below the NTCRA clean-up criteria action levels.

Following the removal of contaminated sediment and tailings in the Furnace Creek channel, EPA restored the creek channel. The grade of the channel before excavation was determined based on benchmarks and elevations recorded during the pre-removal surveys, and clean clay material from the on-site borrow source was placed within the channel and compacted to original grade. A 1-foot-wide by 1-foot-deep center channel, with a 3:1 (horizontal:vertical) slope on either side of the center channel running up to the floodplain, was excavated to create a channel with a total width of approximately 7 feet. Stream cobble was then placed to a depth of 1 foot in sections of the channel not exceeding a 20 percent (%) grade, and rock cross vanes were installed in series through sections of the channel that exceeded a 20% grade. Contaminated material left in-place along the banks and slopes was capped with clean fill from the on-site borrow source. Bank slopes graded to a slope greater than 3:1 received rock armor, and banks at a slope of 3:1 or less received topsoil and a hydroseed mix. Approximately 9,400 CY of clay backfill and approximately 2,700 CY of topsoil were hauled from the borrow source and placed in the Furnace Creek channel and on the slopes. The expanded repository was capped during the restoration phase with clean soil obtained from the on-site borrow source. All disturbed areas were hydroseeded in August 2018. EPA demobilized from the site in August 2018, leaving stockpiles of imported rock material and clean borrow material from the on-site borrow source. The materials were left in anticipation of the residential cleanup, and for future potential repair work.

EPA returned to the site in September 2018 to investigate the extent of contamination at the residence, and in October 2018, EPA and its contractors excavated and removed contaminated surface soil in the yard at the residence. The excavated material was temporarily placed in a separate stockpile near the primary repository. The excavated areas of the residence were backfilled with clean borrow material from an off-site source. Two mercury flasks declared by the property owner were also shipped off site for disposal.

Post-construction site investigations conducted by the EPA Remedial Cleanup Program identified the Former OPWA as an additional area recommended for removal within the Furnace Creek OU1. Several areas observed during the post-construction site investigations were also determined to require site enhancements. Additionally, during the 2019 removal activities, EPA discovered a section of the Furnace Creek channel removal that required repair.

EPA and its contractors returned to the site in July 2019 to conduct the removal activities at the OPWA area and to make the enhancements to the Furnace Creek removal area. The OPWA removal activities included excavation and removal of contaminated soil in the OPWA area, followed by restoration of the removal areas. The excavated material was placed in the existing repository, which was expanded to accommodate the additional material excavated from the OPWA removal area. Restoration activities included grading the excavated areas to a stable slope, construction of a center channel for drainage, and placement of clean backfill material sourced from both the Furnace Creek borrow source area and an off-site source. Rock armor was placed along the constructed drainage channel, as well as areas where contamination was left in place, to prevent erosion and off-site migration of contaminated material. The expanded repository was capped during the restoration phase with material from the residential removal temporary stockpile.

During the 2019 removal activities, EPA also performed enhancements and repairs to the 2018 Furnace Creek removal area. EPA addressed conveyance issues along the Adit Creek drainage channel near the southeast edge of the repository and runoff and erosion issues along the main access road leading from the residence to the repository. EPA also repaired a slope failure on the right bank of the Furnace Creek channel, located below the Old Furnace section of the Furnace Creek removal area, as well as erosion and mass wasting due to excess drainage from the Adit Creek seep at the borrow source area.

Currently, EPA and ODEQ are conducting ongoing monitoring and sampling of Garoutte Creek and the CFWR.

1 Introduction

The United States Environmental Protection Agency (EPA) has completed a non-time-critical removal action (NTCRA) at the Black Butte Mine (BBM) Superfund Site (Site) near Cottage Grove, Oregon.

The BBM is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River (CFWR) basin, approximately ten miles south of Cottage Grove, Oregon (Figure 1-1). The BBM is located on the northwest flank of Black Butte on property owned by The Land and Timber Company, which has used the property surrounding the site for logging (Figure 1-1). BBM is on the National Priorities List, and EPA has recently completed a remedial investigation (RI) at the site. The Draft RI report was completed in 2018.

In 2007, EPA completed a time-critical removal action (TCRA) at the site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings that were removed were consolidated with the Main Tailings Pile on site to form a repository. The repository cover was constructed with tailings/waste material which analytical results showed to be below the 2007 action level of 23 milligrams per kilogram (mg/kg) for mercury. Additionally, mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil/tailings that were determined to have low mercury concentrations.

Recent surface water and sediment sampling by the Oregon Department of Environmental Quality (ODEQ) and EPA indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment are the dominant sources of mercury migrating to Garoutte Creek (CDM Smith 2018d). Erosion of tailings and mercury-impacted soil into Furnace Creek and re-suspension of mercury impacted channel bottom sediments into the water column are the two primary mechanisms for transport of particulate mercury from source areas within the Furnace Creek catchment to Garoutte Creek. Furnace Creek was not included in the scope of the 2007 TCRA.

To address the migration of mercury contaminated particulates, EPA's Remedial Program completed an engineering evaluation / cost analysis (EE/CA) for the Furnace Creek area of Operable Unit (OU) 1. The removal alternative selected was RA3, which entailed excavation and on-site disposal of mercury source material from the Furnace Creek channel (CDM Smith 2016).

EPA decided to perform a NTCRA within the Furnace Creek area of the site. The Action Memorandum was signed approving the execution of the NTCRA (EPA 2017). The primary goal of the Furnace Creek NTCRA was to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFWR watershed. Additionally, as part of the Furnace Creek NTCRA, EPA addressed contaminated material located at the on-site residence in October 2018 and also in the Former Ore Processing Waste Area (OPWA) in July 2019.

1.1 Purpose and Objectives

The primary purpose of the NTCRA was to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate the release of high concentrations of particulate mercury in surface water and high concentrations of mercury in sediment (CDM Smith 2018d).

The Preliminary Removal Action Objectives of the NTCRA, summarized in the Implementation Plan (CDM Smith 2018d), were to:

- Reduce the availability and/or mobility of mercury in soil and sediment within the Furnace Creek catchment area to migrate in particulate form to surface water; and,
- Reduce the migration of mercury from Furnace Creek into Garoutte Creek.

1.2 NTCRA Overview

Field work for the Furnace Creek NTCRA was performed from May through August 2018. During the 2018 NTCRA, EPA excavated a total of 13,117 cubic yards (CY) of contaminated material from the Furnace Creek channel. The excavated material was added to the on-site repository created during the 2007 TCRA, and then the expanded repository was covered with a new cap composed of clean borrow soil from an on-site borrow source. Following the removal of contaminated sediment and tailings in the creek channel, EPA restored the Furnace Creek channel. In September and October 2018, EPA returned to the site and removed a total of 1,625 CY of contaminated surface soil from the yard at the on-site residence.

In July 2019, EPA returned to the site and removed 1,525 CY of contaminated material from the OPWA. Additionally, EPA conducted enhancements and repairs to the features installed in 2018 in the Furnace Creek removal area.

The excavation and construction portions of the removal activities were performed by Environmental Quality Management, Inc. (EQM), as the EPA Region 10 Emergency and Rapid Response Services (ERRS) contractor. EPA tasked Ecology and Environment, Inc. (E & E), under Superfund Technical Assessment and Response Team (START) contract number EP-S7-13-07, Task Order Number 25, to provide technical support and document site conditions and activities through logbook entries and photographs. START also provided on-site sampling, air monitoring, field analytical, and engineering support during the removal activities.

1.3 Report Organization

This report provides a summary of the 2018 and 2019 removal activities and results. Representative photographs taken throughout the removal activities are included in Appendix A. The report is organized into the following sections:

- Section 1: Introduction
- Section 2: Site Background
- Section 3: Project Organization and Schedule
- Section 4: Furnace Creek Area NTCRA Planning and Logistics Phase, 2018
- Section 5: Furnace Creek Area Excavation and Waste Removal Phase, 2018
- Section 6: Furnace Creek Area Restoration Phase, 2018
- Section 7: Residential Removal, 2018
- Section 8: 2019 NTCRA Site Activities

- Section 9: Quality Assurance/Quality Control
- Section 10: Summary
- Section 11: References, and
- Appendices:
    - A – Photographs
    - B – Cultural Resources Reports
    - C – Site-Specific Sampling Plans/Sample Plan Alteration Form/Site-Specific Data Management Plan
    - D – Correlation Study
    - E – Stream Profile Surveys
    - F – Well Abandonment Logs
    - G – Borrow Source Area and Old Furnace Area Repair Recommendations (CDM Smith)
    - H – Final Record Drawings Survey
    - I – Validation Memoranda

This page intentionally left blank.

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure1-1_Site_Location.mxd

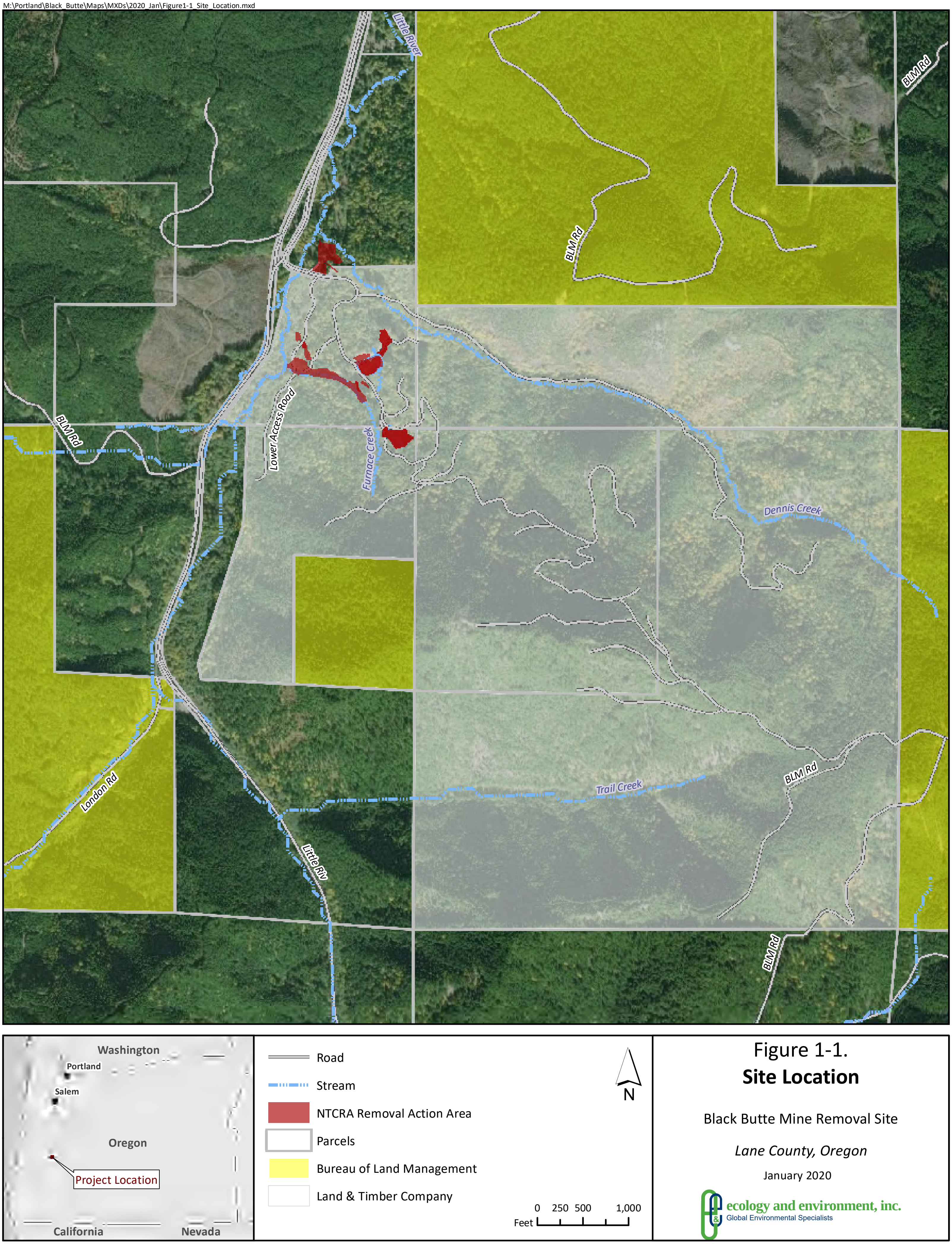


Figure 1-1.

Site Location

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

This page intentionally left blank.

2 Site Background

2.1 Site Location

The site is located in a rural area in southern Lane County, approximately 10 miles south of the city of Cottage Grove, Oregon (Figure 1-1). Access to the site is via London Road.

The BBM is located on the northwest flank of Black Butte at latitude 43 degrees 34 minutes 42 seconds north, longitude 123 degrees 3 minutes 58 seconds west in Section 6, Township 23 South, Range 3 West of the Willamette Baseline and Meridian (Figure 1-1). The site is bordered to the northeast by Dennis Creek, to the southwest by Furnace Creek, to the southeast by Black Butte mountain, and to the northwest by Garoutte Creek and a private residence. Motor vehicle access to the site is restricted by locked gates. The road leading to one of the gates crosses the private residential property. Both Dennis Creek and Furnace Creek flow west–northwest to Garoutte Creek which flows northward approximately six miles to the CFWR. The CFWR empties into Cottage Grove Lake, which is used extensively for recreational activities including contact recreation (i.e. swimming, canoeing, and scuba diving) and fishing (EPA 2017).

2.2 Site Layout and Land Use

The Black Butte Mine site is located on private property owned by the Land and Timber Company, which has used the property surrounding the mine for logging.

The 2018 Draft RI report (CDM Smith 2018e) divides the site into three OUs as follows:

- OU1 – Consists of the abandoned underground mine and associated waste rock dumps, tailings piles and ore processing areas. OU1 also includes the OPWA, located east of Garoutte Creek and north of the Furnace Creek catchment, as well as a residential parcel near the mine access road, adjacent to Garoutte Creek and Dennis Creek.
- OU2 – Consists of Garoutte Creek (downstream of OU1) extending to the CFWR and Cottage Grove Lake.
- OU3 – Encompasses Cottage Grove Lake and a wetland area where the CFWR enters.

All activities pertaining to the NTCRA were performed within OU1[1].

The primary features of OU1 include waste rock piles, mill tailings, a soil/tailings repository, the remnants of two furnaces, and several dilapidated buildings. The New Furnace Area is located upgradient of the area impacted by removal activities. It consists of a rotary furnace, mercury condenser, and ore storage/crushing equipment. The Old Furnace Area is located adjacent to Furnace Creek and is presumed to be the source of the mercury-laden tailings deposited throughout Furnace Creek. Prior to the 2007 TCRA, the only structural remains of the Old Furnace consisted of a concrete structure with a grid of approximately 12-inch-diameter vertical ceramic pipes extending from the top surface of the concrete to the interior of the structure. This structure is believed to be part of the condenser system of the Old Furnace. Sheet metal and ceramic pipe debris were also present surrounding the Old Furnace structure.

The OPWA is located east of Garoutte Creek and north of the Furnace Creek catchment. The OPWA is believed to have functioned as a settling pond area for process water associated with

[1] Water used for dust suppression during the removal action was sourced from Cottage Grove Lake, OU3.

the mercury ore furnaces. The OPWA removal area is divided into two units, the Upper/South OPWA unit, and the Lower/North OPWA unit. The Upper/South OPWA unit topography includes a steep draw extending downhill from the western edge of the Old Furnace area tailings. The Lower/North OPWA unit consists of a low-lying area on the Garoutte Creek floodplain, and includes a potential historic water course where ore processing wastewater from the Old Furnace mining process water was assumed to be discharged. No distinct streams or channels are present within the OPWA (CDM Smith 2019).

Additionally, a private residence is located adjacent to Garoutte Creek near a locked gate which blocks access to the site. The residence includes a single-family dwelling and several outbuildings.

2.3 Site History

Cinnabar was discovered at what would become the Black Butte Mine circa 1890. Mining operations at the BBM began circa 1897 and continued intermittently through 1968. The BBM became one of the largest mercury producers in Oregon. The mine experienced five periods of commercial operation: circa 1898-1908, 1916-1919, 1927-1943, 1955-1957, and 1964-1968. The Old Furnace was originally constructed sometime during the first period, and subsequently modified and improved through the second period. It is presumed that the mercury-laden tailings within furnace creek were generated prior to 1919. During the third period, the New Furnace was constructed, and the Old Furnace was dismantled. The third period marked the longest single operation period of the mine, as well as the largest production period during the mine’s history. Appendix B presents the Cultural Resources Report which presents the known history of the mine.

2.4 Previous Investigations and Removal Actions

BBM is on the National Priorities List, and EPA has conducted a RI at the site. The Draft RI report was completed in January 2018 (CDM Smith 2018e).

EPA's first involvement at BBM was a Site Inspection conducted in 1998. The Site Inspection concluded that “…elevated concentrations of mercury are present in creek sediments up to several hundred feet downstream of the mine tailings located at the site” (E & E 1998).

Several other agencies and organizations, including Oregon State University, the United States Fish and Wildlife Service, and ODEQ, have performed investigations at the site. For a more thorough summary of these investigations, refer to the Draft RI report (CDM Smith 2018e).

In 2006, after receiving a request from ODEQ, EPA returned to BBM to perform a Removal Assessment (E & E 2006). The Removal Assessment recommended that removal actions were warranted for the Main Tailings Pile, the Old Furnace Area, the New Furnace Area, and Furnace Creek.

In 2007, EPA completed a TCRA at the site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings that were removed were consolidated with the Main Tailings Pile on site to form a repository. The repository cover was constructed with tailings/waste material which analytical results showed to be below the 2007 action level of 23 mg/kg for mercury. Additionally, mercury-impacted tailings and soil at the Old Furnace Area and New Furnace Area were capped with soil/tailings that were determined to have low mercury concentrations (EPA 2008).

In 2008, EPA completed a Hazard Ranking System (HRS) evaluation of the site (E & E 2008). Sites which score greater than 28.5 are proposed for placement on the National Priorities List. BBM received an HRS score of 56.51, and on March 5, 2010, was added to the National Priorities List.

In 2012 EPA completed a site optimization review (EPA 2012). The purpose of the report was to evaluate site conditions and identify optimal approaches for conducting an RI at the site. The review made the following recommendations for sampling and testing at the site:

- Baseflow and storm event surface water samples from the creeks in the immediate vicinity of the site (Dennis, Furnace, and Garoutte);
- Groundwater samples from saturated unconsolidated material underlying on-site tailings (sampling concurrent with storm event surface water sampling);
- Precipitation (rate and concentration);
- Sediment samples from these creeks;
- Native soils potentially contaminated by site operations, and;
- Tailings from the Furnace Creek Tailings Area and the Main Tailings Pile.

In January of 2016, a Request to Conduct an EE/CA for the Proposed NTCRA at the Black Butte Mine Superfund Site was approved. The Request stated "…Furnace Creek contributes 48 percent (%) of the total annual mercury load to the downstream watershed, representing the largest single contribution of mercury." And that "…conditions at the Furnace Creek Area within OU1 of the Black Butte Mine Superfund Site meet the criteria in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR part 300.415, for a non-time critical removal action." (EPA 2016c)

EPA's Remedial Program completed the EE/CA (CDM Smith 2016) and recommended the removal alternative of excavating mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel, with the excavated material to be added to the existing on-site repository from the 2007 TCRA.

The 2018 Draft RI report also identified the residential parcel near the mine access road, as well as the OPWA, as containing surface soil contamination containing elevated concentrations of several metals, including mercury and arsenic, exceeding action levels within OU1. EPA's Remedial Program determined that removal actions were necessary at the residential parcel, as well as at the OPWA (CDM Smith 2018e), with the excavated material to be added to the existing on-site repository from the 2007 TCRA and the 2018 NTCRA.

This page intentionally left blank.

3 Project Organization and Schedule

3.1 Key Organization Roles

The NTCRA was performed by the EPA Region 10 Emergency Management Branch and its contractors, on behalf of the EPA Region 10 Remedial Cleanup Program. The key participants of the Emergency Management Branch are described below:

> **On-Scene Coordinator (OSC):** The removal action was performed under the supervision of EPA OSC Randy Nattis.
>
> **ERRS:** Removal action cleanup work was performed by EQM under the EPA Region 10 ERRS contract.
>
> **Superfund Technical Assessment and Response Team (START):** E & E, under the EPA Region 10 START contract, provided on-site technical and engineering support.

Throughout the NTCRA, representatives and contractors for the Remedial Cleanup Program and the remedial contractor CDM Smith provided guidance and design details and periodically visited the site. Additional stakeholder agencies that periodically visited the site during the 2018 NTCR included ODEQ and the United States Army Corps of Engineers.

3.2 Final Project Schedule

Table 3-1 summarizes the project schedule during the NTCRA.

Table 3-1 Project Schedule

Activity	Date
Pre-NTCRA Site Visits	January 26, 2018 and April 26, 2018
Cultural Resources Survey	April 3, 2018
ERRS Mobilization	May 14, 2018
START Mobilization	May 21, 2018
NTCRA Field Activities Begin	May 24, 2018
Furnace Creek Restoration Begins	July 11, 2018
Furnace Creek Restoration Completed	August 21, 2018
Residential Sampling Event	August 24-27, 2018
Residential Removal Begins	October 8, 2018
Residential Removal Complete	October 17, 2018
Ore Processing Waste Area (OPWA) Removal Begins	July 8, 2019
Furnace Creek Area Site Enhancement and Repair Activities Begin	July 19, 2019
Ore Processing Waste Area Removal Complete	July 24, 2019
Furnace Creek Area Site Enhancement and Repair Activities Complete	July 25, 2019
2019 NTCRA Site Activities Complete	July 26, 2019

This page intentionally left blank.

4 Furnace Creek Area NTCRA Planning and Logistics Phase, 2018

Implementation of the Furnace Creek area NTCRA required coordination between EPA, START, ERRS, and CDM Smith. The following sections describe the planning and initial phases of work that occurred before excavation in Furnace Creek occurred.

4.1 Site Visits

Two site visits were conducted during the planning stages of the Furnace Creek area NTCRA; one on January 26, 2018, and the second on April 26, 2018. The objectives of the January site visit were to determine site access and equipment required. The April site visit was conducted to determine site logistics for the NTCRA. Each site visit was completed in one day.

The January site walk was conducted by EPA, CDM Smith, ERRS, and START. An attorney representing the landowner also accompanied the site walk team. The team walked the lower access road, Furnace Creek, and the existing repository area. The team also observed Dennis Creek, and searched for and discovered where the Adit Creek drainage seep resurfaces from below the repository area. The team discussed site preparation, potential health and safety needs, environmental monitoring, and mobilization strategies. Clearing and grubbing area extents, potential staging area locations for equipment and site materials, potential borrow source areas, as well as project scheduling were also discussed. At the end of the site visit, the team observed the bridge across Garoutte Creek to determine the bridge weight limit and discussed placement of alternative crossing structures if the weight limit for the bridge were to be exceeded by equipment and material delivery vehicles. Follow-up with the Oregon Department of Transportation and Lane County determined that the bridge weight limits were adequate for anticipated needs, with no restrictions on the bridge that would affect loads up to 105,000 pounds.

The April 2018 site visit was conducted by EPA (including a representative from EPA's Emergency Response Team), ERRS, and START. The focus of the site visit was to determine project logistics and layout for staging of equipment and office trailers.

4.2 Cultural Resources Survey and Report

E & E subcontracted with Applied Archaeological Research, Inc. (AAR), of Portland, Oregon, to conduct a cultural resources survey and produce a findings report prior to any earth-disturbing work. AAR conducted the field survey on April 3, 2018. The survey focused on areas of the site that would be impacted by the Furnace Creek area NTCRA. AAR concluded that the portion of the site that would be affected by the NTCRA does not contribute to the potential significance and eligibility of the site to be listed on the National Register of Historic Places. Appendix B contains the 2018 Cultural Resources Report prepared by AAR. The report contains a State of Oregon Archaeological Site Record form, which was submitted to the State Historic Preservation Office by AAR.

4.3 Site-Specific Sampling Plan and Site-Specific Data Management Plan

Site-Specific Sampling Plans (SSSPs) for air monitoring and soil excavation sampling were produced for the site, as well as a Site-Specific Data Management Plan. These documents are included in Appendix C. The air monitoring SSSP describes action levels for mercury vapor and dust particulates of 10 micrograms per cubic meter ($\mu g/m^3$) and 300 $\mu g/m^3$, respectively. These values are for a sustained 10-minute exposure. The dust action level was based on site-specific mercury and arsenic concentrations, while the mercury vapor action level was based on the Agency for Toxic Substances and Disease Registry level for a residential setting. Personal air sampling methodology and implementation was also provided in the air monitoring SSSP.

A memorandum from the Remedial Program (Appendix B of CDM Smith 2018d) provided the Field Decision Criteria for mercury and arsenic concentrations to be used during the NTCRA, including the target removal criteria, on-site borrow material criteria, and off-site borrow material criteria (Table 4-1). Based on this memorandum and the Implementation Plan (CDM Smith 2018d), START prepared an SSSP for soil excavation during the NTCRA.

Table 4-1 Field Decision Criteria for Mercury and Arsenic

Criteria Type	Mercury (mg/kg)	Arsenic (mg/kg)
Target Removal Criteria	20	100
Criteria for On-site Borrow Material	7	30
Criteria for Off-site Borrow Material	2	20

The values in Table 4-1 were provided by CDM Smith (CDM Smith 2018d).

The soil SSSP provided direction for sampling, as well as in situ and ex situ x-ray fluorescence (XRF) method requirements. The soil excavation sampling SSSP defined the main sampling areas: The Furnace Creek Removal Action Area; the borrow source area(s); and the repository area. The SSSP was updated to include a discussion of the results of the field screening and off-site analytical laboratory Correlation Study (see Section 5.7) and additional guidance on the use of field screening tools.

4.4 Mobilization and Site Layout

EPA and ERRS mobilized to the site on Monday, May 14, 2018. Heavy equipment was received and ERRS commenced grading and clearing of the support zone to prepare the site for the work trailers. Prior to conducting clearing and grading activities, ERRS identified and protected the residence's water supply line, located along the south side of the main access road. A circular drive in the support zone was constructed using compacted gravel, and parking was provided for site personnel and visitors. Four START personnel with equipment mobilized to the site on Monday May 21, 2018. Equipment mobilized included the EPA Region 10 Communications (Comms) Rig, the Club Car and trailer, and field analytical equipment including a Lumex mercury vapor analyzer (MVA) with soils attachment, two field portable XRF instruments, and a Jerome 505 MVA. The Comms Rig was stationed next to the work trailers, and a satellite connection was acquired, providing internet and telephone access in the support zone.

The support zone included two work trailers, a CONEX box used for auxiliary storage, the Comms Rig, and the START equipment trailer. Bathroom facilities and hand wash stations were made available for the duration of the removal action. The support zone area is depicted in Figure 4-1.

4.5 Clearing and Grubbing

Site preparation began the week of May 14, 2018, with clearing and grubbing of the repository and support zone areas. Clearing and grubbing of the site included removal of unwanted surface material, such as trees, brush, grass, weeds, downed trees, and other items. The repository area, support zone and laydown areas, and the Furnace Creek Removal Action Area required clearing and grubbing. Felled trees and root wads were retained for future use as woody debris for ravine and stream restoration. The woody debris was temporarily staged in the North Laydown Area. Surface debris encountered during clearing and grubbing, such as metal and tires, were segregated for later recycling/disposal off site. Small trees were hauled to an on-site chipper for use as mulch later. Larger trees were stockpiled and retained for restoration purposes.

During the week of May 21, 2018, START worked with ERRS to mark the boundaries of the Furnace Creek Removal Area. ERRS then spent approximately 3.5 days to complete clearing and grubbing of the Furnace Creek Removal Area. ERRS also cleared a small, existing road to facilitate access for the Club Car and site personnel from the main access road to the lower section of Furnace Creek near STA 6+50. See Figure 4-1 for the locations of the work zones.

4.5.1 Repository Grading

After the Furnace Creek Removal Area was cleared and grubbed, ERRS graded and prepared the repository area to receive additional material to be excavated from Furnace Creek during removal activities. ERRS cleared and graded an area to the east and southeast of the 2007 TCRA repository to increase the available footprint of the repository. Increasing the repository size was necessary to accommodate the staging and placement of the additional material anticipated to be created during excavation activities for the Furnace Creek NTCRA.

4.6 Correlation Study

As per the SSSP, START implemented a correlation study in order to guide the selection and use of field analytical tools to support the NTCRA objectives. START collected soil samples from three site features; the borrow sources, the existing repository area cap material (i.e., from the 2007 TCRA), and the Furnace Creek Removal Action Area, representing expected low, moderate, and high-level mercury concentrations, respectively. Samples were analyzed in the field using XRF and Lumex instruments. Additionally, a subset of those samples was sent to a fixed analytical laboratory for analysis of mercury and arsenic. Using these results, START created a correlation curve between XRF and Lumex results, and between Lumex and fixed laboratory results.

The results of the Correlation Study performed on samples collected from May 21 through May 25, 2018 indicated that the XRF instrument could potentially provide definitive level data for arsenic. For mercury, the results indicated that the XRF instrument could potentially provide definitive level data for mercury at concentrations greater than 20 mg/kg, and the Lumex could potentially provide definitive level data for mercury at concentrations less than 20 mg/kg. START produced a memorandum summarizing these results and revised and finalized the soil excavation SSSP to include the results of the Correlation Study, along with other changes to the sampling approach. A memorandum summarizing the results of the Correlation Study is included as Appendix D, and includes details on the number of samples collected from each sampling area, the type of analyses performed, and analytical results.

4.7 Borrow Source Assessment

A significant volume of clean backfill material was determined necessary to complete the restoration phase subsequent to the completion of removal activities in Furnace Creek. Due to the large volume of required backfill material, an on-site borrow source was preferable as the most cost-effective source for clean backfill. To determine whether a suitable borrow source for backfill material was present on the site, START conducted an initial desktop study to review existing analytical data on the site as well as accessibility of the potential borrow site(s). Prior to the mobilization, START identified one area as potentially suitable for a borrow source (Borrow Source 1, BS01), located upgradient of the repository area and southeast of the New Furnace access road (Figure 4-1). During field activities, BS01 was visited and sampled as part of the Correlation Study (see Section 4.6). Samples were also collected for characterization of BS01 to determine suitability for use as clean backfill material.

During the Correlation Study, two additional potential borrow sources were identified: one located along the lower access road (Borrow Source 2, BS02); and one south of Furnace Creek (Borrow Source 3, BS03). BS02 was also sampled as part of the Correlation Study. BS02 analytical results indicated that the source met the clean backfill requirements; however, the BS02 source was determined to not be a suitable backfill material due to heavy presence of invasive scotch broom and blackberry vines. BS03, the potential borrow source south of Furnace Creek was sampled and analyzed on June 9, 2018 and was determined to have elevated concentrations of arsenic and mercury. BS03 was not sampled as part of the Correlation Study.

Table 4-2 presents the field and laboratory analytical results from all three borrow sources. Appendix D contains all field and analytical results collected as part of the Correlation Study. BS01 was determined to meet the site's characterization and volume requirements for backfill and restoration, and it was the only borrow source used during the 2018 and 2019 removal activities.

4.8 Pre-Removal Survey and Stream Profile

Prior to the start of excavation activities in Furnace Creek, START conducted a pre-removal survey of the cross-sectional and longitudinal profiles of the Furnace Creek channel. START laid out the cross-sectional profile stations at 50-foot intervals along the channel and placed marked stakes to denote the left bank and right bank benchmarks for each station. Station 0+00 represented the upgradient end of the removal, and Station 9+00 represented the downgradient end of the removal. START surveyed pre-removal stream profiles at each cross-sectional profile, and also conducted a pre-removal longitudinal profile survey of the removal area from the upstream extent of the removal at Station 0+00 to Garoutte Creek. Surveys were conducted using a rod and level, and reel tape.

See Figure 4-2 for an overview of the locations of each transect and Appendix E for a compilation of the pre-removal, post-removal, and post-restoration survey profiles.

4.9 Site Security

ERRS subcontracted with a private company to provide security and a continuous presence on site during periods when work was suspended, such as nights, Sundays, and holidays. During non-working hours, gates were closed across the mine access road. Signs were posted at the road entrances identifying the site and the cleanup action. The signs indicated that only authorized personnel were permitted on the site and contained EPA contact information for the site.

4.10 Communications

The EPA Comms Rig was used to obtain a satellite connection, providing Wi-Fi and VoIP capabilities in the support zone. No cell reception was available within the work areas of the project. Two-way radios were used to maintain on-site communications, to ensure site safety during site operations, and to maintain awareness of personnel movements about the site.

4.11 Health and Safety Air Sampling/Monitoring

START conducted health and safety air sampling and monitoring during the duration of site activities. Air sampling and monitoring activities are detailed herein.

4.11.1 Personnel Air Sampling

START collected 18 air samples from four site workers (including ERRS and START staff) conducting site activities within the active site clearing and grubbing, excavation, and repository working areas. Samples were collected on June 6, June 7, June 8 and June 11, 2018. Six samples were analyzed for mercury vapor, six for mercury in particulates, and six for arsenic in particulates. Samples were sent to the laboratory for analysis with a 48-hour turnaround time. Analytical results are presented in Table 4-3. Results of these samples showed that personnel exposure to airborne mercury and arsenic did not exceed allowable exposure limits. One mercury vapor sample indicated an exposure greater than the site action level of 10 $\mu g/m^3$ for mercury. The single mercury exposure was associated with excavator operations occurring within Furnace Creek around the Old Furnace Area. See Section 5.1 for a discussion of excavation activities and sampling results within the Furnace Creek Removal Area.

4.11.2 Air Monitoring Stations

START conducted particulate monitoring utilizing DustTrak instrumentation. DustTraks were deployed at the command post (air station AS01), repository (air station AS02), and excavation zones (air stations AS03 through AS13). The DustTraks at AS01 and AS02 were connected and logged with VIPER (a wireless network-based communications system designed to enable real time transmission of data from field sensors), and data from the other stations were downloaded at the end of each day. While airborne particulate concentrations tended to increase during periods of warmer and dryer weather conditions, the daily time-weighted averages remained lower than the site action level of 300 $\mu g/m^3$. See Figure 4-1 for the locations of the air monitoring stations.

START regularly monitored for mercury vapors in the excavation area using the Jerome J505 MVA. The results indicated occasional detections of measurable mercury vapors associated with tailings and other waste materials, but sustained readings were lower than site action level of 10 $\mu g/m^3$.

START also used the Jerome J505 MVA to periodically monitor the command post and support zone areas for mercury vapor. The results were well below the site action level.

Table 4-2 **Borrow Source Sample Results**

Sample ID	Location ID	Location Description	Depth Samples (ft bgs)	Sample Event	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
Borrow Source 01										
18050021	BS02SB02	Borrow Source 1	0.5 to 2.0	Correlation Study	5/22/2018	3.4 U	**0.6**	**0.143**	**44.3**	**14.4 JL**
18050022	BS03SB04	Borrow Source 1	2.0 to 4.0	Correlation Study	5/22/2018	3.4 U	**0.3**	**0.122**	**30.6**	**13.7**
18050023	BS04SB06	Borrow Source 1	4.0 to 6.0	Correlation Study	5/22/2018	3.4 U	--	--	**35.9**	--
18050024	BS01SS	Borrow Source 1	0 to 0.5	Correlation Study	5/22/2018	3.4 U	--	--	**28**	--
18050025	BS05SS	Borrow Source 1	0 to 0.5	Correlation Study	5/22/2018	**22.1**	**16**	**15.9**	**21**	**8.9**
18050026	BS06SB02	Borrow Source 1	0.5 to 2.0	Correlation Study	5/22/2018	3.4 U	--	--	**27.2**	--
18050027	BS07SB04	Borrow Source 1	2.0 to 4.0	Correlation Study	5/22/2018	3.4 U	--	--	**29.1**	--
18050028	BS08SB06	Borrow Source 1	4.0 to 6.0	Correlation Study	5/22/2018	3.4 U	--	--	**24.8**	--
18050029	BS09SS	Borrow Source 1	0 to 0.5	Correlation Study	5/22/2018	**4.3**	--	--	**16.8**	--
18050030	BS10SB02	Borrow Source 1	0.5 to 2.0	Correlation Study	5/22/2018	3.4 U	--	--	**21.3**	--
18050031	BS11SB04	Borrow Source 1	2.0 to 4.0	Correlation Study	5/22/2018	3.4 U	--	--	**18.9**	--
18050032	BS12SB06	Borrow Source 1	4.0 to 6.0	Correlation Study	5/22/2018	3.4 U	--	--	**20.3**	--
18050073	BS13SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	3.6 U	**2.8**	5.25 U	**32.1**	**12 JL**
18050074	BS14SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**8.6**	--	--	**23.4**	--
18050075	BS15SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	3.6 U	--	--	**20.3**	--
18050076	BS16SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**20.3**	**17.5**	**32.9**	**19.1**	**17.3 JL**
18050077	BS17SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**8.8**	**9.2**	**11.1**	**20.6**	**13.4 JL**
18050078	BS18SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**7.2**	**15.8**	**6.72 JQ**	**22.1**	**12.4 JL**
18050079	BS19SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**6.7**	--	--	**23.7**	--
18050080	BS20SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**11.9**	**8.3**	**14**	**22.4**	**10.3 JL**
18050081	BS21SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**6.4**	**6**	**6.82 JQ**	**16.5**	**4.35 JL**
18050082	BS22SS	Borrow Source 1	0 to 0.5	Correlation Study	5/23/2018	**13.6**	**9.9**	**10.2**	**16.4**	**9.16 JL**
18060123	BS63SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	**8.55 J**	**6.945**	--	**21.9 J**	--
18060124	BS6402	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**21.15 J**	--
18060125	BS6504	Borrow Source 1	2.0 to 4.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**22.5 J**	--
18060126	BS6606	Borrow Source 1	4.0 to 6.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	0.44 U	--	**23.65 J**	--
18060127	BS67SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	2.6 U	--	--	**25.65 J**	--
18060128	BS6802	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	2.05 U	0.44 U	--	**18.3 J**	--
18060129	BS6904	Borrow Source 1	2.0 to 4.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**18.45 J**	--
18060130	BS7006	Borrow Source 1	4.0 to 6.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**23.5 J**	--
18060131	BS71SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**25.3 J**	--
18060132	BS7202	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**37.75 J**	--
18060133	BS7304	Borrow Source 1	2.0 to 4.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	0.44 U	--	**39.75 J**	--
18060134	BS7406	Borrow Source 1	4.0 to 6.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**42.2 J**	--
18060135	BS75SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	**7.85 J**	**6.82**	--	**23.35 J**	--
18060136	BS7602	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	1.95 U	--	**0.121**	**25.1 J**	**2.69**

Table 4-2 Borrow Source Sample Results

Sample ID	Location ID	Location Description	Depth Samples (ft bgs)	Sample Event	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18060137	BS7704	Borrow Source 1	2.0 to 4.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**22.75 J**	--
18060138	BS7806	Borrow Source 1	4.0 to 6.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**32.05 J**	--
18060139	BS79SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	**8.6 J**	**1.8**	**5.6**	**26.7 J**	**6.06**
18060140	BS8002	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**27.45 J**	--
18060141	BS8104	Borrow Source 1	2.0 to 4.0	Ongoing Borrow Source Evaluation	6/21/2018	2.6 U	--	--	**26.4 J**	--
18060142	BS8206	Borrow Source 1	4.0 to 6.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	--	--	**35.15 J**	--
18060143	BS67SS	Borrow Source 1	0 to 0.5	Ongoing Borrow Source Evaluation	6/21/2018	**6.55 J**	**6.49**	--	**26.55 J**	--
18060144	BS7602	Borrow Source 1	0.5 to 2.0	Ongoing Borrow Source Evaluation	6/21/2018	0 U	0.44 U	**0.173**	**23.65 J**	**1.76**
18060145	BS8303	Borrow Source 1	3.0 to 3.5	Ongoing Borrow Source Evaluation	6/21/2018	**4 J**	--	--	**31.5 J**	--
18070101	BS84CL	Borrow Source 1	4.0 to 8.0	Ongoing Borrow Source Evaluation	7/12/2018	**4.05 J**	--	--	**30.9 J**	--
18070102	BS85CL	Borrow Source 1	4.0 to 8.0	Ongoing Borrow Source Evaluation	7/12/2018	**3.85 J**	--	--	**30.1 J**	--
18070103	BS86CL	Borrow Source 1	4.0 to 8.0	Ongoing Borrow Source Evaluation	7/12/2018	**4 J**	--	--	**28.05 J**	--
18070104	BS87TS	Borrow Source 1	0 to 2.0	Ongoing Borrow Source Evaluation	7/12/2018	**5.7 J**	--	--	**27.35 J**	--
18070105	BS88TS	Borrow Source 1	0 to 2.0	Ongoing Borrow Source Evaluation	7/12/2018	**7.05 J**	--	**5.73 JQ**	**29.55 J**	**7.79 JL**
18070106	BS88TS	Borrow Source 1	0 to 2.0	Ongoing Borrow Source Evaluation	7/12/2018	**6.5 J**	--	4.34 U	**29.3 J**	**5.42 JL**
Borrow Source 02										
18050083	BS23SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**23.6**	**23.6**	--	**34.9**	--
18050084	BS24SB02	Borrow Source 2	0.5 to 2.0	Correlation Study	5/23/2018	**7.7**	**11.5**	--	**25.7**	--
18050085	BS25SB04	Borrow Source 2	2.0 to 4.0	Correlation Study	5/23/2018	3.6 U	--	--	**24.4**	--
18050086	BS26SB06	Borrow Source 2	4.0 to 6.0	Correlation Study	5/23/2018	3.8 U	--	--	**25.9**	--
18050087	BS27SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	3.6 U	--	--	**18.7**	--
18050088	BS28SB02	Borrow Source 2	0.5 to 2.0	Correlation Study	5/23/2018	3.4 U	1.14	--	**16.6**	--
18050089	BS29SB04	Borrow Source 2	2.0 to 4.0	Correlation Study	5/23/2018	3.3 U	0.873	--	**19.1**	--
18050090	BS30SB06	Borrow Source 2	4.0 to 6.0	Correlation Study	5/23/2018	3.6 U	--	--	**19.3**	--
18050091	BS31SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	3.7 U	--	--	**22.8**	--
18050092	BS32SB02	Borrow Source 2	0.5 to 2.0	Correlation Study	5/23/2018	3.6 U	--	--	**22.4**	--
18050093	BS33SB04	Borrow Source 2	2.0 to 4.0	Correlation Study	5/23/2018	3.2 U	**0.774**	--	**17.6**	--
18050094	BS34SB06	Borrow Source 2	4.0 to 6.0	Correlation Study	5/23/2018	3 U	**1.03**	--	**17.3**	--
18050095	BS35SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**4.1**	--	--	**23.1**	--
18050096	BS36SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	3.6 U	--	--	**21.3**	--
18050097	BS37SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**3.8**	**4.37**	--	**22.3**	--
18050098	BS38SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**7.3**	**11.5**	--	**29.1**	--
18050099	BS39SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**20**	**25.6**	--	**39.6**	--
18050100	BS40SS	Borrow Source 2	0 to 0.5	Correlation Study	5/23/2018	**6.4**	**6.87**	--	**17.2**	--
Borrow Source 03										
18060101	BS41SB06	Borrow Source 3	4.0 to 6.0	Borrow Source Characterization	6/9/2018	**12.3**	**14.8**	--	**55.55**	--
18060102	BS42SB06	Borrow Source 3	4.0 to 6.0	Borrow Source Characterization	6/9/2018	**9.35 J**	**5.75**	--	**39.1 J**	--

Table 4-2 **Borrow Source Sample Results**

Sample ID	Location ID	Location Description	Depth Samples (ft bgs)	Sample Event	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18060103	BS43SB06	Borrow Source 3	4.0 to 6.0	Borrow Source Characterization	6/9/2018	**4 J**	**2.43**	--	**39.9 J**	--
18060104	BS44SB06	Borrow Source 3	4.0 to 6.0	Borrow Source Characterization	6/9/2018	**10.2 J**	**13.7**	--	**62.55**	--
18060105	BS45SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**48.05**	**34.7**	--	**44.2**	--
18060106	BS46SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**80.55**	**49.6**	--	**40.6 J**	--
18060107	BS47SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**42.3**	--	--	**71.05**	--
18060108	BS48SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**1185**	--	--	**47.1**	--
18060109	BS49SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**19.95**	**24.4**	--	**30.25 J**	--
18060110	BS50SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**16.5**	**35.3**	--	**22.95 J**	--
18060111	BS51SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**30.95**	--	--	**27.6 J**	--
18060112	BS52SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**18.5**	--	--	**32.75 J**	--
18060113	BS53SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**15.95**	**31**	--	**32.35 J**	--
18060114	BS54SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**68.75**	--	--	**31 J**	--
18060115	BS55SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**51.8**	--	--	**27.6 J**	--
18060116	BS56SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**55.45**	--	--	**17.15 J**	--
18060117	BS57SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**16.7**	--	--	**25.05 J**	--
18060118	BS58SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**32.95**	**29.4**	--	**41.15 J**	--
18060119	BS59SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**42.45**	--	--	**37.2 J**	--
18060120	BS60SS	Borrow Source 3	0 to 0.5	Borrow Source Characterization	6/9/2018	**32.05**	--	--	**44.85**	--

Detected results are bolded.

KEY:

-- - Not applicable
bgs - below ground surface
EPA - United States Environmental Protection Agency
ft - feet
ID - Identification
J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample
L - The sample result is biased low
mg/kg - milligrams per kilogram
Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit
U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit
XRF - X-Ray flourescence

Table 4-3 Personnel Air Sampling

Sample ID	Location ID	Sub Location	Sample Date	Compound Specific Action Level (mg/m^3)	Result (mg/m^3)	Volume (L)
Arsenic as Particulates						
18060404	FC03P_As	START	6/6/2018	0.002	0.000158 U	474.99
18060401	FC01P_As	Haul Truck	6/6/2018		0.000167 U	450.213
18060410	FC04P_As	Excavator	6/7/2018		0.000173 U	433.466
18060413	FC06P_As	Dozer	6/7/2018		0.000176 U	425.8
18060428	BS01P_As	Haul Truck	6/11/2018		0.000198 U	379.407
18060431	BS03P_As	Excavator	6/11/2018		0.000206 U	363.893
18060419	FC07P_As	Haul Truck	6/8/2019		0.000214 U	349.8825
18060422	FC09P_As	START	6/8/2019		0.000241 U	310.176
18060407	QC01P_As	Blank	6/6/2018		0.000075 U	--
18060416	QC03P_As	Blank	6/7/2018		0.000075 U	--
18060425	QC05P_As	Blank	6/8/2019		0.000075 U	--
18060434	QC07P_As	Blank	6/11/2018		0.000075 U	--
Mercury as Particulates						
18060411	FC05P_Hg	Haul Truck	6/7/2018	0.005	0.0000175 U	57.06
18060420	FC08P_Hg	Excavator	6/8/2019		0.0000204 U	49.0364
18060414	RC02P_Hg	START	6/7/2018		0.0000213 U	46.9365
18060429	BS02P_Hg	Excavator	6/11/2018		0.000022 U	45.428
18060432	BS04P_Hg	Excavator-Chipper	6/11/2018		0.0000228 U	43.9089
18060423	RC03P_Hg	Dozer	6/8/2019		0.0000256 U	39.13105
18060402	FC02P_Hg	Excavator	6/6/2018		**0.0000877**	64.0458
18060408	QC02P_Hg	Blank	6/6/2018		0.0000175 U	--
18060417	QC04P_Hg	Blank	6/7/2018		0.0000175 U	--
18060426	QC06P_Hg	Blank	6/8/2019		0.0000175 U	--
18060435	QC08P_Hg	Blank	6/11/2018		0.0000175 U	--
Mercury Vapor						
18060415	RC02V_Hg	START	6/7/2018	0.01	**0.000913**	46.9365
18060412	FC05V_Hg	Haul Truck	6/7/2018		**0.00292**	57.06
18060433	BS04V_Hg	Excavator-Chipper	6/11/2018		0.000518 U	43.9089
18060403	FC02V_Hg	Excavator	6/6/2018		0.0148	64.0458
18060430	BS02V_Hg	Excavator	6/11/2018		**0.00056**	45.428
18060421	FC08V_Hg	Excavator	6/8/2019		**0.00173**	49.0364
18060424	RC03V_Hg	Dozer	6/8/2019		**0.00691**	39.13105
18060409	QC02V_Hg	Blank	6/6/2018		**0.00081**	--
18060418	QC04V_Hg	Blank	6/7/2018		0.0000227 U	--
18060436	QC08V_Hg	Blank	6/11/2018		0.0000227 U	--
18060427	QC06V_Hg	Blank	6/8/2019		0.0000227 U	--

Key:

Bold - Indicates the analyte was detected above the method reporting limit
-- - Not applicable
ID - Identification
L - Liter
mg/m^3 - milligrams per cubic meter
U - The analyte was not detected at or above the method reporting limit
Inverse shading - Exceeds action level

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure4-1_Site_Layout.mxd

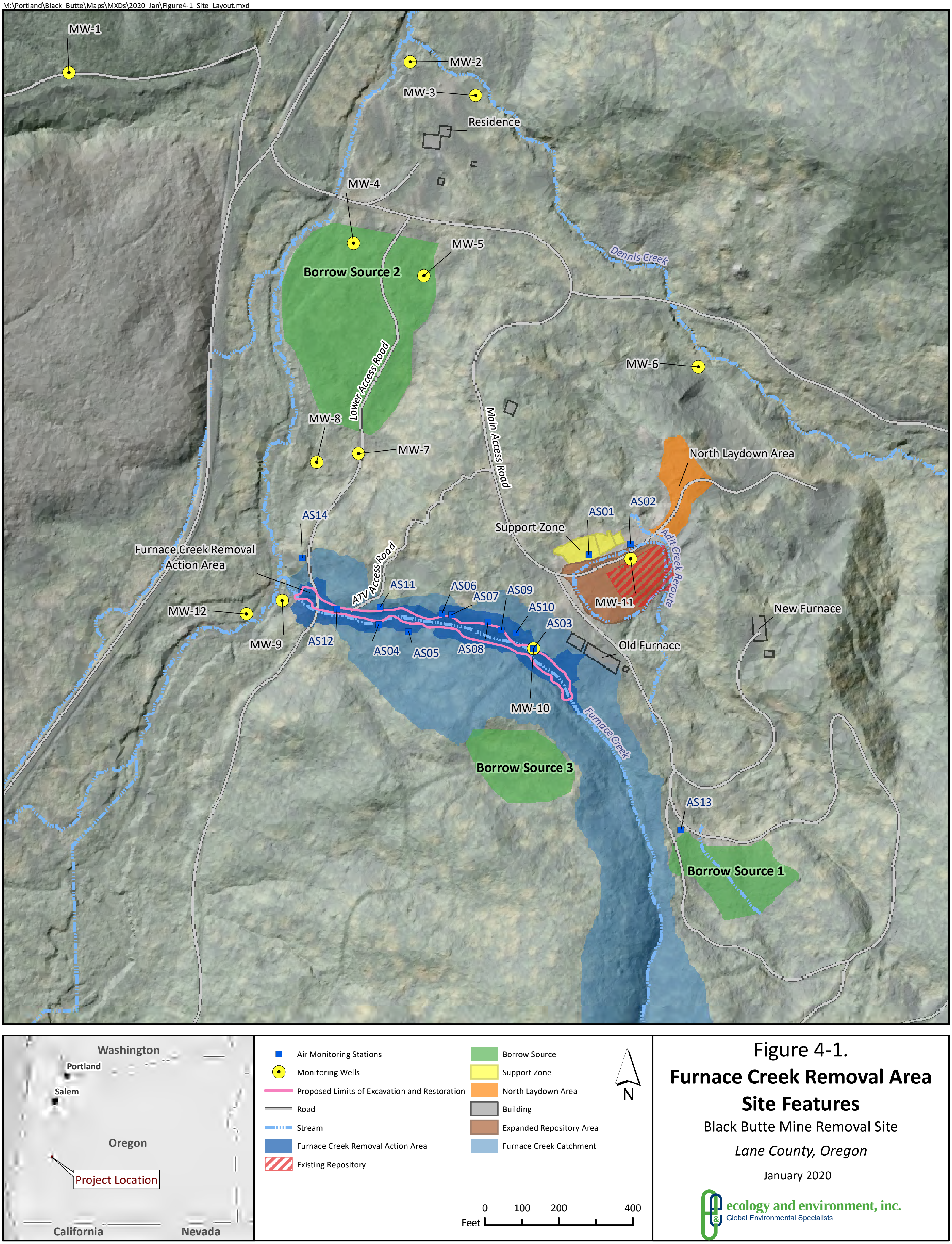


Figure 4-1.
Furnace Creek Removal Area Site Features

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure4-2_Furnace_Creek_Survey.mxd

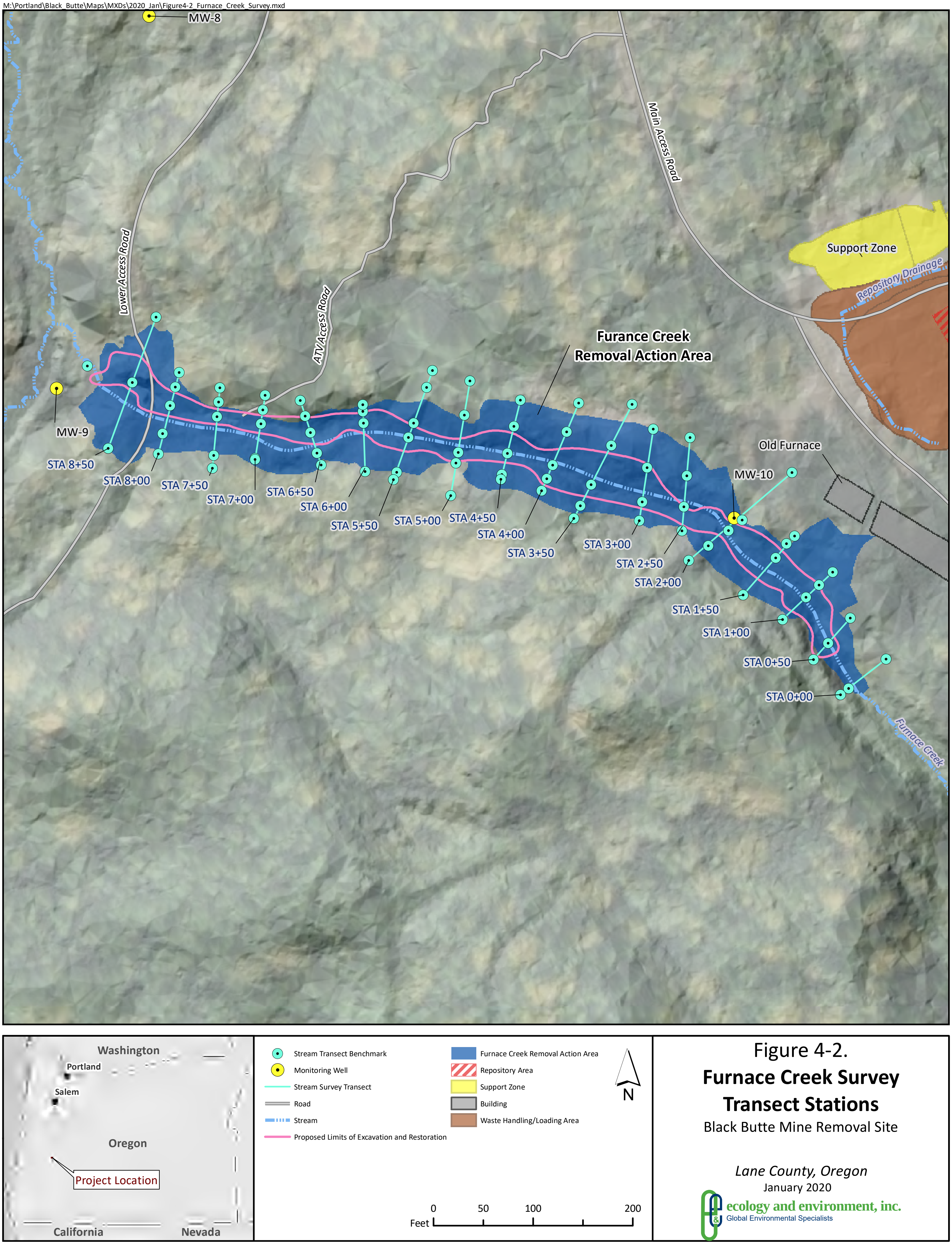


Figure 4-2.
Furnace Creek Survey Transect Stations
Black Butte Mine Removal Site

Lane County, Oregon
January 2020

ecology and environment, inc.
Global Environmental Specialists

This page intentionally left blank.

5 Furnace Creek Area Excavation and Waste Removal Phase, 2018

5.1 Furnace Creek

ERRS began removal activities in Furnace Creek on May 24, 2018. Excavators were utilized to remove contaminated material which was direct-loaded into a haul trucks and transported to the on-site repository (Figure 4-1). As material was placed on the repository, a bulldozer was used to shape and grade the material to allow continued placement of excavated material while maintaining a stable slope. ERRS used a water truck to spray water along the access and haul roads, the repository and support areas, and active excavation locations, for dust control for the site. As described in Section 4.11, START conducted air sampling and monitoring during daily removal activities. The water truck was refilled at the Cottage Grove Lake in coordination with the United States Army Corps of Engineers.

The excavation and removal of contaminated materials was primarily based on visual observations of the mine-related waste. START assisted ERRS with visual observations and START also monitored concentrations of mercury and arsenic with XRF and Jerome J505 MVA field instruments. Sections 5.1.1 through 5.1.1.4 provide further discussion on field screening of contaminated materials and removal decisions.

The Furnace Creek removal area was divided into Decision Units (DUs) based on the 50-foot survey transects. The area between two 50-foot survey transects was considered as one DU. Upon completion of excavation within each DU, START collected composite samples to document the condition of materials left in place. Three of these post-removal composite samples were collected from each DU; one from each sidewall (left bank and right bank), and one from the excavation floor. All samples were analyzed for mercury and arsenic via ex situ XRF. A sub-selection of samples was also analyzed for mercury via Lumex, and a sub-selection of those samples (approximately 20%) were sent for laboratory analysis for arsenic and mercury. Post-removal samples collected after June 23, 2018, were not field analyzed by the Lumex, as the mercury concentration of materials left in place were exceeded the maximum concentrations for accurate Lumex results (as determined by the Correlation Study) (Section 4.7). Table 5-1 presents field and laboratory analytical results for the Furnace Creek Removal Area.

Excavation removal activities commenced at the upgradient extent of the removal area, starting at Station 0+00, and proceeded downgradient to approximately Station 2+00. No tailings or mine waste were observed for the first 25 feet, and excavation was conducted to an average 1-foot depth. Tailings and mine waste were first observed in the Furnace Creek channel at approximately Station 0+25, and excavation depths increased to as much as ten feet below the original channel grade to remove contaminated material and reach uncontaminated soil. During field screening of the excavated channel between Station 0+25 and Station 2+00, START noted that elevated levels of mercury and arsenic were still detected in areas where visible tailings deposits had already been excavated. A black layer of fine silt/clay material was also encountered in sections beneath the excavated tailings, with reported in situ XRF results of mercury concentrations ranging from 13 mg/kg to over 400 mg/kg. Additionally, elemental mercury microbeads were discovered on the left bank and right bank of Furnace Creek between Stations 0+50 and 1+00, near the location of the Old Furnace. Excavation and disposal of the elemental mercury-contaminated soil is discussed further in Section 5.1.2 and Section 5.4.1.

During excavation activities between Station 0+25 and Station 2+00, some tailings and contaminated material were left in-place along sections of the channel floor and the right bank. Due to the depth of tailings located within the channel and compounded by the inflow of groundwater contributing to slope instability, leaving tailings in-place was determined as necessary to maintain stable slopes during excavation. In order to remove additional tailings, further excavation of the right bank would have required layback of the slope and the removal of large trees to avoid undercutting the bank below the location of the Old Furnace. Based on the discovery of deep deposits of tailings located throughout the Furnace Creek channel and banks, EPA and START discussed next steps for excavation and contaminant removal methodology. EPA directed ERRS to excavate the channel to a depth of six feet, or until the floor of the channel meets the recommended field screening decision criteria (CDM Smith 2018d), whichever occurred first. Restoration activities would then proceed to place clean backfill within the channel to bring it back to original grade, prior to placement of the stream channel rock or flow-control structures. This methodology was chosen to be protective of any potential erosion that would contribute to off-site migration of contaminated sediment within the Furnace Creek channel and would achieve the NTCRA objectives as described in the Implementation Plan (CDM Smith 2018d). Additionally, excavation activities were able to remove a majority of the contaminated material located along the left bank and achieve recommended field screening decision criteria. The right bank in most locations was composed of intermixed tailings and uncontaminated soil. The extensive tailings composition of the right bank was assumed to have occurred during active furnace operations, with tailings being disposed below the Old Furnace along the length of the right bank, and then spilling down into the Furnace Creek channel. In areas where the removal did not achieve recommended field screening decision criteria along the banks, the tailings and waste material were laid back to a stable slope prior to restoration. Slope stability is discussed further in Section 5.1.3.

Significant rainfall began the evening of Friday, June 8, 2018, and continued throughout the weekend. Due to the resultant muddy and unsafe conditions on site, excavation activities were temporarily halted at the end of the day on June 8, 2018. ERRS did not conduct site work on Saturday, June 9, 2018, and no excavation activities were conducted on Monday, June 11, 2018. Prior to the temporary demobilization, ERRS installed stormwater best management practices (BMPs) including straw wattles at several points within the removal area and covering the repository. Additionally, ERRS constructed sediment ponds within the removal area to contain any surface water or groundwater seeps within the channel and prevent off-site migration of the runoff and any associated contaminants. As removal activities proceeded, ERRS continued to place several ponds along the length of the channel to control groundwater inflow into the removal area until the seasonal water table dropped below the excavated channel grade. ERRS used a portable pump to dewater the ponds before resuming excavation, as needed. Dewatering liquid was discharged into adjacent vegetated slopes, away from the Furnace Creek channel. Discharged dewatering liquid was observed to infiltrate quickly into the vegetated and forested slopes.

Removal activities resumed on Tuesday, June 12, 2018 at Station 6+50 and proceeded upgradient towards Station 2+00. A thick clay deposit was observed to exist within the Furnace Creek channel from approximately Station 6+35 to Station 8+00. The clay deposit was present as a five-foot-thick layer above tailings located deeper within the Furnace Creek channel. The clay deposit was assumed to be the result of a 1996 upstream reservoir breach which buried tailings beneath the deposition of clay material. In situ XRF results for arsenic and mercury concentrations within the clay deposit were below recommended field screening decision criteria. This clay deposit of "*clean*" overburden was temporarily staged in a stockpile that was isolated from the rest of the contaminated material in the repository so that it could be placed on top of the completed repository prior to the final clean fill soil cap.

Between Stations 8+00 and 8+75, the Furnace Creek channel crossed the collapsed lower access road at the location of a failed culvert and continued down a very steep slope to the Garoutte Creek flood plain. The left and right bank were laid back to achieve stable slopes, while removing as much contaminated material as feasible. A layer of pale ashy mine waste was encountered along the right bank between approximately Station 8+25 down to the terminus of the bank at approximately Station 8+75. In situ XRF screening revealed that this material contained mercury concentrations ranging up to approximately 1,000 mg/kg. The pale ashy mine waste could not be removed down to clean material, so the right bank was excavated down to a stable slope (see Section 5.1.3). Excavation of the Furnace Creek channel terminated at approximately Station 8+90.

By the end of the excavation phase, a total of 676 loads containing 13,117 loose CY of material had been hauled and placed in the on-site repository, including 50 CY of material containing elevated mercury concentrations, which was segregated and contained in polyethylene sheeting prior to placement within the top of the repository. Based on the pre-removal and post-removal surveys, an estimated 9,500 bank CY were excavated and placed in the on-site repository.

5.1.1 Removal Criteria

As ERRS excavated tailings and contaminated materials, START monitored the progress through visual observations and measurement with XRF and Jerome MVA field instruments. The floor of the Furnace Creek channel was excavated to a depth of 6 feet, except between Stations 0+25-2+00, as described in Section 5.1 above. The left bank was excavated until native material and/or soil met the recommended field screening decision criteria, where feasible. The right bank was excavated to uncontaminated clean material where feasible, or to a stable slope, leaving contaminated material in place. START collected three composite samples (two sidewall samples and one floor sample) from each of the DUs as they were completed to document the concentrations of mercury and arsenic left in place. Due to steep slopes prohibiting safe entry for personnel, post-removal composite samples were collected from DUs 0+00–0+50, 0+50–1+00, and 1+00–1+50 during backfill restoration activities, via excavator bucket.

5.1.1.1 Visual Screening

Visual screening was used to guide removal of tailings and contaminated material along the banks and channel of Furnace Creek. Visual screening was effective for identifying many of the varieties of tailings and contaminated material found within the Furnace Creek channel, including the pale red and gravelly-type of tailings material (Appendix A, photograph 10, removal phase), the pale ashy-type of mine waste material (Appendix A, photograph 10, pre-removal), and material from the Old Furnace structure such as broken pieces of pipes and brick.

5.1.1.2 In Situ XRF Screening

A field XRF was used in situ to guide removal of tailings and contaminated material along the banks and channel of Furnace Creek and to supplement the visual screening field method. During in situ field screening of the excavated channel, it was noted that tailings were visually apparent in sections of the excavation; however, based on in situ XRF analysis, elevated levels of mercury and arsenic were also determined to be present in areas that lacked visible tailings deposits.

5.1.1.3 Mercury Vapor Screening

START used the Jerome J505 MVA field instrument to screen the excavation work area for the presence of mercury vapor and to detect potential mercury exposure and maintain worker safety. Additionally, START used the Jerome MVA to guide the removal of tailings and detect the presence of elemental mercury. Mercury vapor screening was periodically conducted within the command post work areas, site equipment cabs and workspaces, and off-site vehicle interior cab spaces. Additionally, worker personal items including work boots and safety vests were periodically screened for mercury vapors.

5.1.1.4 Removal Decisions

As discussed in Section 5.1, some areas the Furnace Creek channel and banks could not be excavated to meet the recommended field screening decision criteria. To achieve the Preliminary Removal Action Objectives to reduce the off-site migration of mercury and mercury-contaminated sediment, EPA directed ERRS to excavate the channel to a depth of six feet, or until the floor of the channel met the recommended field screening decision criteria, whichever occurred first.

5.1.2 Microbeads and "Hot Tailings"

On Monday, June 4, 2018, START observed elemental mercury on the left bank of Furnace Creek between Stations 0+50 and 1+00, near the location of the Old Furnace. ERRS created a temporary staging area lined with polyethylene sheeting next to the repository for stockpiling of the excavated materials containing elemental mercury. Throughout the week, START identified several other areas in the same vicinity, including the right bank, containing elemental mercury. Additionally, START identified an area near Station 1+50 that contained large amounts of building materials (e.g., bricks and dimensional lumber). Jerome MVA monitoring in this area reported very high concentrations of mercury vapor (>100 $\mu g/m^3$). Although no elemental mercury was observed, the presence of high mercury vapor concentrations are indicative of elemental mercury, and the building materials were excavated and placed in the lined stockpile area located at the repository. Approximately 50 CY of material containing microbeads and elevated mercury levels were excavated from Furnace Creek in the vicinity immediately downgradient of the Old Furnace. The segregated stockpile of material with elevated mercury concentrations was later characterized and disposed of during the restoration phase. See Section 5.4.1 regarding discussion on sampling and disposal of the microbead-contaminated waste.

5.1.3 Slope Stability

To maintain site safety during excavation activities, the following protocols were followed, based on the Occupational Safety and Health Administration Standard 1926, Subpart P. Oversight of excavation activities was conducted by a designated Competent Person (START engineer, or other approved START personnel with knowledge of site conditions), who inspected and evaluated the excavation areas. Starting at the upper limits of the left and right banks, ERRS excavated the channel from the top down, proceeding in shallow (2- to 3-foot deep) benches, until reaching the limit of the base of each slope in the bottom of the creek channel.

Once excavation or trenching was conducted at the base of the slope, either in the creek bed or along the face of the slope, the slope was considered to be unsafe, and access was prohibited. No personnel were allowed to enter into an unsafe trenched area, nor access any slopes above an open trench. Any further sampling or monitoring/characterization of soil material from the inaccessible area was conducted via soil material offered via excavator bucket from ERRS. Personnel were allowed access to the side slopes, benching, and floor of the excavation, provided the side slope met the approved gradient based on soil type.

5.1.4 Post Removal Survey

START surveyed the creek channel before excavation activities using a rod and level and reel tape, with the rod personnel entering and crossing the channel to conduct the survey for each section. However, due to steep and unsafe trench conditions after excavation, personnel were not allowed entry onto the side slopes or into the excavation. In order to conduct the post-removal surveys, START designed and constructed a survey method that did not require personnel to enter the removal area, while allowing the station transect surveys to be safely conducted. This method was implemented beginning on June 14, 2018. Photographs 22, 23, & 24 of Appendix A, Removal Phase, show the equipment in use. Figure 4-2 shows the locations of the survey transect stations. Appendix E contains a compilation of the pre-removal, post-removal, and post-restoration survey profiles.

5.1.5 Well Abandonment

During the Furnace Creek excavation phase, two monitoring wells (MW-10 and MW-11) were located in the way of removal activities, and EPA decided to remove the wells to facilitate removal activities. Monitoring well MW-10, located on the right bank near Station 2+00, and monitoring well MW-11, located at the base of the repository, were removed under the oversight of a driller licensed in the state of Oregon. Monitoring well MW-11 was removed on June 21, 2018, via the subcontracted driller.

Monitoring well MW-10 was removed on July 13, 2018 via excavator, under oversight of the state-licensed driller. ERRS over-excavated and removed well MW-10, as the well was installed to a depth of 15 feet below ground surface, or approximately to the depth of the creek channel excavation elevation, and the entire well and surrounding material was removed to depth of completion to allow the right bank to be laid back to a stable slope. EPA had communicated with the State of Oregon Water Resources Department, and they indicated that the excavation of MW-10 could proceed, provided the work was overseen by a licensed driller. The driller also completed the appropriate documentation with the State of Oregon Water Resources Department. Copies of the monitoring well abandonment records are included as Appendix F.

On June 27, 2018, the stick-up monument for monitoring well MW-9, which is located downstream of the lower Furnace Creek channel near Garoutte Creek, appeared to be leaning slightly; it may have been hit by a falling tree from the excavation area earlier in the day. This was reported through the OSC to the Remedial Project Manager.

5.2 Adit Creek

Adit Creek is a small intermittent drainage which begins upgradient of the repository and eventually flows into Dennis Creek. The 2007 repository was unknowingly constructed in the flow path of Adit Creek and forced the drainage subsurface into the tailings pile on which the repository was constructed. In order to keep Adit Creek from impacting the repository, the creek was rerouted around the repository. Once the repository was completed, Adit Creek was routed around the east side of the repository and redirected to the drainage located to the north of the repository. Details of this work are presented in Section 6.3 below. START collected surface soil samples from the proposed route for the redirection of Adit Creek around the repository footprint. All samples were analyzed for mercury and arsenic via ex situ XRF and also analyzed for mercury via Lumex. See Table 5-2 for the analytical results.

5.3 Borrow Source Preparation

As describe in Section 4.8, START assessed three potential borrow areas; based on field and laboratory results for total metal, BS01 was determined to be the most suitable borrow source. ERRS began clearing and grubbing of BS01 the week of June 18, 2018. Topsoil in BS01 was encountered at an average thickness of 4 feet across the borrow source area. Felled trees and root wads were retained during clearing for future use as woody debris for ravine and stream restoration. The woody debris was temporarily staged in the northern end of the laydown area. An on-site wood chipper was also staged in the northern end of the laydown area and used to convert small diameter trees and small woody debris into mulch to be used during the restoration phase. Surface debris encountered during clearing and grubbing, such as metal and tires, were segregated for later recycling and disposal off site.

ERRS scraped and staged the topsoil in two piles on the BS01 borrow source site. Calculations were conducted for the Furnace Creek backfill volumes, based on the pre-removal and post-excavation surveys. The survey calculations estimated that the borrow source area needed to be expanded in order to meet fill volume requirements. The clay layer exposed beneath the excavated topsoil was determined to be a suitable backfill material and was slated to be used for backfilling the channel floor. The topsoil was reserved for the Furnace Creek slope and bank restoration activities.

Additionally, START collected samples for agronomic analysis of the borrow sources. Samples from BS01 and BS02 were sent off site for laboratory agronomic analysis. Both BS01 and BS02 were determined to meet the agronomic requirements from the Implementation Plan (CDM Smith 2018d). After BS01 was designated as the borrow source for the site, the clay layer was also sampled (Sample ID BS83C) and sent for agronomic analysis and determined to also meet agronomic requirements. See Table 5-3 for the agronomic results for BS01 and BS02.

During excavation and soil stockpiling activities of the BS01 borrow source area, a seep assumed to be the headwaters of Adit Creek was identified. The Adit Creek seep originated at southern and upper extent of the disturbed area and ran north/northwest down the center of the disturbed borrow source area towards the repository. See Section 7.3 for further discussion on restoration of the Adit Creek channel. See Figure 4-1 for the location and extent of BS01 and the Adit Creek flow path.

5.4 Repository

As discussed in Section 5.1, an estimated 9,500 bank CY (estimated as 13,117 loose CY with an assumed expansion factor) of excavated material was hauled and placed in the on-site repository, including 50 CY of material containing elevated mercury concentrations (discussed below in section 5.4.1). During excavation and removal operations, ERRS staged the cleaner overburden material excavated from the lower reach of the Furnace Creek channel in a separate stockpile from the main waste repository. This cleaner overburden material was placed in the repository on top of the more contaminated tailings contained deeper within the repository, to further isolate the mercury contamination, prior to placing clean backfill as part of the repository cap. Additionally, START collected a daily sample of contaminated material placed in the repository. See Table 5-4 for analytical results of the daily repository samples.

5.4.1 Burial of Microbeads and "Hot Tailings"

START collected a composite sample of the approximately 50 CY of stockpiled waste material excavated from Furnace Creek. This material, described in Section 5.1.2, contained microbeads of elemental mercury and building material waste with very high concentrations of mercury vapor (>100 $\mu g/m^3$). START sent the sample for laboratory analysis including Synthetic Precipitation Leaching Procedure (SPLP), toxicity characteristic leaching procedure (TCLP), and total metals analysis for mercury. The SPLP extraction (SW-846 Method 1312) was selected to simulate potential leaching under in situ conditions, while TCLP was selected to evaluate offsite disposal options . SPLP results confirmed the waste material as viable for on-site disposal. Approximately 50 CY of material with either visual elemental mercury, or mercury vapor greater than 100 $\mu g/m^3$, were encapsulated in thick polyethylene plastic sheeting, then buried and capped in the top of the repository. See Table 5-5 for the analytical results for this composite sample.

5.4.2 Grading and Cover

After the excavation portion of the removal was completed in Furnace Creek, and all material was staged in the repository, ERRS graded the slopes of the repository to a stable 3:1 (H:V) slope. Next, ERRS placed approximately 1,640 CY of clean overburden material from Furnace Creek, which had been stockpiled for subsequent use, on top of the repository. Clean cover from BS01 was then placed as a cap over the repository, and track-walked and compacted in place via dozer. ERRS then placed large woody debris throughout the repository area to provide erosion control and to discourage and prevent off-road vehicle entry.

5.4.3 Drainage and Retention Pond

After repository grading was complete, ERRS constructed stormwater drainage channels around the perimeter of the repository. The drainage channels were routed around the repository to drain into a constructed stormwater pond located at the southwest corner of the repository. The pond was sized by CDM Smith to accommodate stormwater runoff from the repository without discharging. START and ERRS laid out the footprint of the repository stormwater pond based on volume calculations provided by CDM. ERRS began construction of the stormwater detention pond on August 15, 2018, and construction was completed on August 16, 2018, including the placement of logs around perimeter to prevent vehicle entry. START provided engineering oversight during the installation of the stormwater pond and surveyed for grade and elevation to ensure that the pond was constructed to contain the calculated volume of stormwater runoff.

Table 5-1 Furnace Creek Removal Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Sample Event	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18050033	FC01SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**8.4**	**2.1**	**1.92**	**14.7**	**2.22**
18050034	FC02SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**237**	--	--	**293**	--
18050035	FC03SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**356**	--	--	**247**	--
18050036	FC04SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**246**	--	--	**75.1**	--
18050037	FC05SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**1,420**	**42.6**	**1350**	**402**	**576**
18050038	FC06SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**1,313**	**61.1**	**1020**	**104.9**	**103**
18050039	FC07SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**261**	--	--	**99.6**	**--**
18050040	FC08SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**16.6**	**2.1**	**101**	**19.2**	**6.78**
18050041	FC09SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**55**	**24**	--	**53.5**	--
18050042	FC10SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**94**	**43.8**	--	**195**	--
18050043	FC11SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**315**	**12.1**	**237**	**216**	**239**
18050044	FC12SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**111**	**70.8**	--	**51.3**	--
18050045	FC13SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**279**	--	--	**228**	--
18050046	FC14SS	Furnace Creek	0 to 0.5	5/22/2018	Correlation Study	**662**	**32.3**	**841**	**475**	**304**
18050047	FC15SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**11**	**14.3**	**14.1**	**22.5**	**5.06**
18050048	FC16SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**3.7**	**5.2**	**8.1 JQ**	**7.9**	1.38 U
18050049	FC17SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**125**	**9.57**	**160**	**33.8**	**42.4**
18050050	FC18SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**43.2**	**10.1**	--	**22.6**	--
18050051	FC19SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**29.9**	**11.4**	--	**24.2**	--
18050052	FC20SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**100**	**11.1**	--	**36.5**	--
18050053	FC21SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**289**	**16.4**	**225**	**222**	**211**
18050054	FC22SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**74**	**8.4**	**85.6**	**21.2**	**4.19**
18050055	FC23SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**214**	**7.5**	--	**185**	--
18050056	FC24SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**270**	--	--	**52.4**	--
18050057	FC25SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**187**	**6.82**	**184**	**165**	**118**
18050058	FC26SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**479**	**14.8**	**260**	**242**	**243**
18050059	FC27SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**717**	**31.5**	**418 JQ**	**228**	**223**
18050060	FC28SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**94**	**7.01**	**116**	**86.5**	**118**
18050061	FC29SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**233**	--	--	**214**	--
18050062	FC30SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**627**	**22.3**	**561**	**312**	**336**
18050063	FC31SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**47.9**	**20.8**	--	**19.5**	--
18050064	FC32SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**51.9**	**14.8**	**42.6**	**1.8**	**6.36**
18050065	FC33SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**1,127**	**9.21**	**1,080**	**231**	**222**

Table 5-1 Furnace Creek Removal Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Sample Event	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18050066	FC34SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**216**	**13.4**	**186**	**178**	**139 JL**
18050067	FC35SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**164**	**12.4**	--	**96**	--
18050068	FC36SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**315**	--	--	**180**	--
18050069	FC37SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**705**	--	--	**304**	--
18050070	FC38SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**55.9**	**8.87**	**74.6**	**35.2**	**36.4 JL**
18050071	FC39SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**319**	--	--	**44**	--
18050072	FC40SS	Furnace Creek	0 to 0.5	5/23/2018	Correlation Study	**213**	**10.5**	--	**30**	--
18050101	FC41SS	Furnace Creek	0 to 0.5	5/24/2018	Correlation Study	**6.3**	--	--	**33.4**	--
18050102	FC42SS	Furnace Creek	0 to 0.5	5/24/2018	Correlation Study	**8.7**	--	--	**34.2**	--
18060201	RB150-200	Furnace Creek (Right Bank)	0 to 0.5	6/7/2018	Post Removal Composite	**84.5**	--	--	**24.8 J**	--
18060202	FL150-200	Furnace Creek (Floor)	0 to 0.5	6/7/2018	Post Removal Composite	**33.45**	**38.3**	--	**35.85 J**	--
18060203	LB150-200	Furnace Creek (Left Bank)	0 to 0.5	6/7/2018	Post Removal Composite	**217**	--	--	**41.2 J**	--
18060204	RB650-600	Furnace Creek (Right Bank)	0 to 0.5	6/12/2018	Post Removal Composite	**45.7**	**28**	--	**45.8**	--
18060205	FL650-600	Furnace Creek (Floor)	0 to 0.5	6/12/2018	Post Removal Composite	**291**	--	--	**123.2**	--
18060206	LB650-600	Furnace Creek (Left Bank)	0 to 0.5	6/12/2018	Post Removal Composite	**35.45**	**31.8**	--	**22.55 J**	--
18060207	RB600-550	Furnace Creek (Right Bank)	0 to 0.5	6/13/2018	Post Removal Composite	**158.5**	--	--	**74.1**	--
18060208	FL600-550	Furnace Creek (Floor)	0 to 0.5	6/13/2018	Post Removal Composite	**218**	--	--	**80.45**	--
18060209	LB600-550	Furnace Creek (Left Bank)	0 to 0.5	6/13/2018	Post Removal Composite	**53.1**	**30.9**	--	**23.2 J**	--
18060210	RB550-500	Furnace Creek (Right Bank)	0 to 0.5	6/13/2018	Post Removal Composite	**182.5**	--	--	**89.85**	--
18060211	FL550-500	Furnace Creek (Floor)	0 to 0.5	6/13/2018	Post Removal Composite	**1,202**	--	--	**182**	--
18060212	LB550-500	Furnace Creek (Left Bank)	0 to 0.5	6/13/2018	Post Removal Composite	**84.9**	--	--	**26.15 J**	--
18060213	LB500-450	Furnace Creek (Left Bank)	0 to 0.5	6/14/2018	Post Removal Composite	**6.3 J**	**4.11**	--	**17.75 J**	--
18060214	FL500-450	Furnace Creek (Floor)	0 to 0.5	6/14/2018	Post Removal Composite	**65.4**	**47**	--	**63.85**	--
18060215	RB500-450	Furnace Creek (Right Bank)	0 to 0.5	6/14/2018	Post Removal Composite	**273**	--	--	**113**	--
18060216	LB400-450	Furnace Creek (Left Bank)	0 to 0.5	6/15/2018	Post Removal Composite	**37.8**	**37**	--	**23.45 J**	--
18060217	FL450-4100	Furnace Creek (Floor)	0 to 0.5	6/15/2018	Post Removal Composite	**507.5**	**71.3**	**517**	**119.55**	**106**
18060218	RB400-450	Furnace Creek (Right Bank)	0 to 0.5	6/15/2018	Post Removal Composite	**121.5**	--	--	**115.75**	--
18060221	LB350-400	Furnace Creek (Left Bank)	0 to 0.5	6/15/2018	Post Removal Composite	**56**	--	--	**42.7 J**	--
18060901	RB400-450	Furnace Creek (Right Bank)	0 to 0.5	6/15/2018	Post Removal Composite	**227**	**23.1**	--	**88.05**	--
18060902	RB350-400	Furnace Creek (Right Bank)	0 to 0.5	6/15/2018	Post Removal Composite	**213**	**49.7**	--	**296.5**	--
18060219	RB400-350	Furnace Creek (Right Bank)	0 to 0.5	6/16/2018	Post Removal Composite	**136**	--	--	**76.5**	--
18060220	FL350-400	Furnace Creek (Floor)	0 to 0.5	6/16/2018	Post Removal Composite	**522**	--	--	**155.65**	--
18060222	RB300-350	Furnace Creek (Right Bank)	0 to 0.5	6/18/2018	Post Removal Composite	**328.5**	--	--	**67.75**	--

Table 5-1 Furnace Creek Removal Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Sample Event	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18060223	FL300-350	Furnace Creek (Floor)	0 to 0.5	6/18/2018	Post Removal Composite	**728.5**	--	--	**201.7**	--
18060224	LB300-350	Furnace Creek (Left Bank)	0 to 0.5	6/18/2018	Post Removal Composite	**9.75 J**	--	**10.2**	**38.4 J**	**20.9**
18060225	RB250-300	Furnace Creek (Right Bank)	0 to 0.5	6/19/2018	Post Removal Composite	**520**	--	--	**127.4**	--
18060226	FL250-300	Furnace Creek (Floor)	0 to 0.5	6/19/2018	Post Removal Composite	**386.5**	--	--	**129.7**	--
18060227	LB250-300	Furnace Creek (Left Bank)	0 to 0.5	6/19/2018	Post Removal Composite	**33.15**	**16.1**	--	**39.8 J**	--
18060228	LB500-550	Furnace Creek (Left Bank)	0 to 0.5	6/22/2018	Post Removal Composite	**66.55**	--	**91.7**	**35.5 J**	**24**
18060229	LB550-600	Furnace Creek (Left Bank)	0 to 0.5	6/22/2018	Post Removal Composite	2.05 U	**0.933 J**	--	**22.2 J**	--
18060230	LB600-650	Furnace Creek (Left Bank)	0 to 0.5	6/22/2018	Post Removal Composite	**10.15 J**	**6.56**	--	**23.75 J**	--
18060231	LB500-550	Furnace Creek (Left Bank)	0 to 0.5	6/22/2018	Post Removal Composite	**70.25**	--	**92**	**34.45 J**	**24.8**
18060232	LB550-600	Furnace Creek (Left Bank)	0 to 0.5	6/22/2018	Post Removal Composite	0 U	0.44 U	**1.63**	**20.95 J**	**6.01**
18060233	RB650-700	Furnace Creek (Right Bank)	0 to 0.5	6/25/2018	Post Removal Composite	**27.05**	--	--	**25.95 J**	--
18060234	FL650-700	Furnace Creek (Floor)	0 to 0.5	6/25/2018	Post Removal Composite	**52.8**	--	--	**155.6**	--
18060235	LB650-700	Furnace Creek (Left Bank)	0 to 0.5	6/25/2018	Post Removal Composite	**20.9**	--	--	**36.95 J**	--
18060236	RB700-750	Furnace Creek (Right Bank)	0 to 0.5	6/26/2018	Post Removal Composite	**13.25**	--	--	**20.2 J**	--
18060237	FL700-750	Furnace Creek (Left Bank)	0 to 0.5	6/26/2018	Post Removal Composite	**45.2**	--	--	**46.45**	--
18060238	LB700-750	Furnace Creek (Left Bank)	0 to 0.5	6/26/2018	Post Removal Composite	**21.55**	--	--	**32.55 J**	--
18060242	RB700-750	Furnace Creek (Right Bank)	0 to 0.5	6/26/2018	Post Removal Composite	**15.35**	--	--	**17.9 J**	--
18060243	LB700-750	Furnace Creek (Left Bank)	0 to 0.5	6/26/2018	Post Removal Composite	**23**	--	--	**33.95 J**	--
18060239	RB750-800	Furnace Creek (Right Bank)	0 to 0.5	6/28/2018	Post Removal Composite	**63.45**	--	--	**59.85**	--
18060240	FL750-800	Furnace Creek (Left Bank)	0 to 0.5	6/28/2018	Post Removal Composite	**65.6**	--	--	**135.15**	--
18060241	LB750-800	Furnace Creek (Left Bank)	0 to 0.5	6/28/2018	Post Removal Composite	**12.5**	--	--	**38.6 J**	--
18070201	RB800-850	Furnace Creek (Right Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**247.5**	--	**121 JH**	**90.05**	**55.3 JL**
18070202	FL800-850	Furnace Creek (Left Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**7.45 J**	--	**4.84 JH**	**40.5 J**	**20.6 JL**
18070203	LB800-850	Furnace Creek (Left Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**22.15**	--	--	**65.8**	--
18070204	RB850-890	Furnace Creek (Right Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**98**	--	--	**65**	--
18070205	FL850-890	Furnace Creek (Left Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**31.4**	--	**41.5 JH**	**56**	**48.8 JL**
18070206	LB850-890	Furnace Creek (Left Bank)	0 to 0.5	7/10/2018	Post Removal Composite	**13.35**	--	--	**43.3 J**	--
18070207	RB200-250	Furnace Creek (Right Bank)	0 to 0.5	7/11/2018	Post Removal Composite	**182.5**	--	--	**76.8**	--
18070208	FL200-250	Furnace Creek (Left Bank)	0 to 0.5	7/11/2018	Post Removal Composite	**295.5**	--	**318 JH**	**57.15**	**32.7 JL**
18070211	FL100-150	Furnace Creek (Left Bank)	0 to 0.5	7/14/2018	Post Removal Composite	**20.55**	--	**21.6 JH**	**21.55 J**	**17.6 JL**
18070214	FL50-100	Furnace Creek (Left Bank)	0 to 0.5	7/14/2018	Post Removal Composite	**176**	--	**108 JH**	**64.2**	**29.6 JL**
18070217	FL0-50	Furnace Creek (Left Bank)	0 to 0.5	7/14/2018	Post Removal Composite	**4.25 J**	--	**4.53 JQ**	**29.2 J**	**15.6 JL**
18070209	LB200-250	Furnace Creek (Left Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**31.9**	--	--	**57.15**	--

Table 5-1 Furnace Creek Removal Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Sample Event	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18070210	RB100-150	Furnace Creek (Right Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**236**	--	--	**64.15**	--
18070212	LB100-150	Furnace Creek (Left Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**52.65**	--	--	**20.1 J**	--
18070213	RB50-100	Furnace Creek (Right Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**489**	--	**631 JH**	**93.15**	**63.2 JL**
18070215	LB50-100	Furnace Creek (Left Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**25.75**	--	--	**36.1 J**	**--**
18070216	RB0-50	Furnace Creek (Right Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**26.95**	--	--	**28.95 J**	**--**
18070218	LB0-50	Furnace Creek (Left Bank)	0 to 0.5	7/18/2018	Post Removal Composite	**19.35**	--	--	**37.55 J**	--

Detected results are bolded.

KEY:

-- - Not applicable
H - The sample result is biased high
bgs - below ground surface
EPA - United States Environmental Protection Agency
ft - feet
ID - Identification
J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample
L - The sample result is biased low
mg/kg - milligrams per kilogram
Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit
U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit
XRF - X-Ray flourescence

Table 5-2 Adit Creek Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
					XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18050103	AC01SS	Adit Creek	0 to 5.0	5/24/2018	**18.3**	**14.2**	--	**100.2**	--
18050104	AC02SS	Adit Creek	0 to 5.0	5/24/2018	**19.4**	**14**	--	**83.7**	--
18050105	AC03SS	Adit Creek	0 to 5.0	5/24/2018	**23.4**	**18.1**	--	**158.5**	--
18050106	AC04SS	Adit Creek	0 to 5.0	5/25/2018	**19.6**	**14.2**	--	**99.1**	--
18050107	AC05SS	Adit Creek	0 to 5.0	5/25/2018	**46.9**	**28.2**	--	**161.5**	--
18050108	AC06SS	Adit Creek	0 to 5.0	5/25/2018	**13.8**	**11.9**	--	**78.95**	--
18050109	AC07SS	Adit Creek	0 to 5.0	5/25/2018	**246**	**28**	--	**181**	--
18050110	AC08SS	Adit Creek	0 to 5.0	5/25/2018	**23.45**	**14.8**	--	**105.45**	--

Detected results are bolded.

KEY:

-- - Not applicable
bgs - below ground surface
EPA - United States Environmental Protection Agency
ft - feet
ID - Identification
mg/kg - milligrams per kilogram
XRF - X-Ray flourescence

Table 5-3 Borrow Source Agronomics Analytical Results

Sample ID	**18060146**	**18060147**	**18060148**
Sample Date	**6/13/2018**	**6/13/2018**	**7/2/2018**
Location	**Borrow Source 1**	**Borrow Source 2**	**Borrow Source 1**
Borrow Source Location	**BS01 - top soil**	**BS02**	**BS01 - clay layer**
Analyte		**Result**	
Estimated Water Holding Capacity (%)	**53.8**	**53**	**45.5**
Estimated Available Water	**1.6**	**1.6**	**1.4**
Sodium Adsorption Ratio	**0.1**	**0.2**	**0.4**
Exchangeable Sodium Percentage	<0.1	<0.1	<0.1
Sodium (meq/L)	**0.1**	**0.2**	**0.2**
Calcium (meq/L)	**1.1**	**0.8**	**0.2**
Magnesium (meq/L)	**0.5**	**0.3**	**0.2**
pH	**6**	**5.4**	**5.2**
Carbonate (meq/L)	0	0	0
Bicarbonate (meq/L)	**0.8**	**0.8**	**0.5**
Electric Conductivity (dS/m)	**0.3**	**0.2**	**0.1**
Chloride (meq/L)	**0.4**	**0.1**	**0.2**
Boron (ppm)	**0.1**	**0.1**	**0.1**
Saturation (%)	**57.5**	**54.8**	**48.5**
Organic Matter (% Rating)	**8.8 (Very High)**	**6.2 (Very High)**	**5.2 (High)**
Organic Matter (ENR lbs/A)	**207**	**159**	**133**
Sand (%)	**47**	**41**	**37**
Silt (%)	**34**	**34**	**34**
Clay (%)	**19**	**25**	**29**
Soil Texture	**Loam**	**Loam**	**Clay Loam**

Detected results are bolded.

KEY:

% - Percent
ds/m - decisiemens per meter
ENR - Estimated Nitrogen Release
ID - Identification
lbs/A - Pounds per acre
meq/L - milliequivalents per liter
ppm - parts per million

Table 5-4 Repository Screening Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sampling event	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18050001	RC01SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**12.7**	--	--	**75.8**	--
18050002	RC02SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**30.3**	--	--	**72.6**	--
18050003	RC03SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**15.4**	--	**8.31**	**82.6**	**52.9**
18050004	RC04SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**30.9**	--	--	**95.2**	--
18050005	RC05SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**9.8**	--	**1.68**	**110.4**	**98.7**
18050006	RC06SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**70**	--	**7.17**	**121.3**	**75.1**
18050007	RC07SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**15.1**	--	--	**110.9**	--
18050008	RC08SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**11.7**	--	--	**98.1**	--
18050009	RC09SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**13.4**	--	**2.6**	**176**	**161 JL**
18050010	RC10SS	Repository Cover	0 to 0.5	Correlation Study	5/21/2018	**14.7**	--	--	**167**	--
18050011	RC11SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**10.4**	--	--	**125.6**	--
18050012	RC12SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**31**	--	--	**80.2**	--
18050013	RC13SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**23.6**	--	**19.1**	**92.2**	**79.8 JL**
18050014	RC14SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**10.2**	--	**1.99**	**119.3**	**96.1 JL**
18050015	RC15SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**24.7**	--	**38.3**	**78.2**	**56.9 JL**
18050016	RC16SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**21.8**	--	**15**	**88.2**	**70.1 JL**
18050017	RC17SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**10**	--	**1.16**	**116.8**	**105 JL**
18050018	RC18SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**34.3**	--	--	**102.6**	--
18050019	RC19SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**6.7**	--	--	**109.3**	--
18050020	RC20SS	Repository Cover	0 to 0.5	Correlation Study	5/22/2018	**10.9**	--	**0.656**	**102.9**	**98.9 JL**
18060001	RS01SS	Repository	0 to 0.5	Daily Repository Sampling	6/6/2018	**1,503.50**	--	--	**153**	--
18060002	RS02SS	Repository	0 to 0.5	Daily Repository Sampling	6/7/2018	**553**	--	--	**74.8**	--
18060003	RS03SS	Repository	0 to 0.5	Daily Repository Sampling	6/8/2018	**196.5 J**	--	--	**79 J**	--
18060004	RS04SS	Repository	0 to 0.5	Daily Repository Sampling	6/11/2018	**143.5**	--	--	**25.1 J**	--
18060005	RS05SS	Repository	0 to 0.5	Daily Repository Sampling	6/13/2018	**668.5**	--	--	**187.5**	
18060006	RS06SS	Repository	0 to 0.5	Daily Repository Sampling	6/14/2018	**363**	--	--	**111.25**	
18060007	RS07SS	Repository	0 to 0.5	Daily Repository Sampling	6/15/2018	**476**	--	--	**117.2**	--
18060008	RS08SS	Repository	0 to 0.5	Daily Repository Sampling	6/16/2018	**778**	--	--	**225**	--
18060009	RS09SS	Repository	0 to 0.5	Daily Repository Sampling	6/18/2018	**252.5**	--	**302**	**141.7**	**153**
18060010	RS10SS	Repository	0 to 0.5	Daily Repository Sampling	6/19/2018	**488**	--	--	**157.8**	--
18060011	RS11SS	Repository	0 to 0.5	Daily Repository Sampling	6/20/2018	**297.5**	--	--	**73**	--
18060012	RS12CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	6/22/2018	**30.95**	--	--	**22.75 J**	--
18060013	RS13CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	6/23/2018	**44.95**	--	--	**32.1 J**	--
18060014	RS14SS	Repository	0 to 0.5	Daily Repository Sampling	6/23/2018	**137.5**	--	--	**66.05**	--
18060015	RS15SS	Repository	0 to 0.5	Daily Repository Sampling	6/25/2018	**178**	--	--	**89.25**	--
18060016	RS16SS	Repository	0 to 0.5	Daily Repository Sampling	6/26/2018	**67.5**	--	--	**61.75**	--

Table 5-4 Repository Screening Analytical Results

Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sampling event	Sample Date	Mercury (mg/kg)			Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Lumex (EPA Method 7473)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
18060017	RS17CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	6/26/2018	**37.3**	--	--	**33.3 J**	--
18060018	RS18SS	Repository	0 to 0.5	Daily Repository Sampling	6/27/2018	**142.5**	--	--	**140.95**	--
18060019	RS19CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	6/27/2018	**24.9**	--	--	**39.6 J**	--
18060020	RS16SS	Repository	0 to 0.5	Daily Repository Sampling	6/26/2018	**74.5**	--	--	**68.35**	--
18060021	RS20SS	Repository	0 to 0.5	Daily Repository Sampling	6/28/2018	**83**	--	--	**86**	--
18060022	RS21SS	Repository	0 to 0.5	Daily Repository Sampling	6/29/2018	0 U	--	--	0 U	--
18060023	RS22CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	6/29/2018	**43.75**	--	--	**54.2**	--
18070001	RS23SS	Repository	0 to 0.5	Daily Repository Sampling	7/9/2018	**51.55**	--	--	**58.6**	--
18070002	RS24CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	7/9/2018	**40**	--	--	**69.25**	--
18070003	RS25SS	Repository	0 to 0.5	Daily Repository Sampling	7/10/2018	**270.5**	--	--	**171**	--
18070004	RS26CC	"Clean" Overburden	0 to 0.5	Daily Repository Sampling	7/10/2018	**5.5 J**	--	--	**41.25 J**	--
18070005	RS27SS	Repository	0 to 0.5	Daily Repository Sampling	7/11/2018	**274**	--	**465 JH**	**110.35**	**109 JH**
18070006	RS28SS	Repository	0 to 0.5	Daily Repository Sampling	7/14/2018	**110.5**	--	--	**54.8**	--
18070007	RS27SS	Repository	0 to 0.5	Daily Repository Sampling	7/11/2018	**405.5**	--	**346 JH**	**113.45**	**88.8 JL**

Detected results are bolded.
KEY:
-- - Not applicable
bgs - below ground surface
EPA - United States Environmental Protection Agency
ft - feet
H - The sample result is biased high
ID - Identification
J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample
L - The sample result is biased low
mg/kg - milligrams per kilogram
Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit
U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit
XRF - X-Ray flourescence

Table 5-5 Micro-Bead Contaminated Material Analytical Results

Sample ID	Location	Sample Date	Mercury (mg/kg)		Mercury (mg/L)		Arsenic (mg/kg)
			XRF (Method 6200)	Fixed Lab (Method SW7471B)	Fixed Lab (Method SW7470A, 1311 TCLP)	Fixed Lab (Method SW7470A, 1312 SPLP)	XRF (Method 6200)
18070501	RS01HT	7/19/2018	**1,586**	**1,580 JH**	**0.0119 JK**	**0.00586**	**102.5**

Detected results are bolded.

KEY:

- H - The sample result is biased high
- EPA - United States Environmental Protection Agency
- ID - Identification
- J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample
- K - Bias of the sample is not known
- mg/kg - milligrams per kilogram
- SPLP - Synthetic Precipitation Leaching Procedure
- TCLP - Toxicity Characteristic Leaching Procedure

6 Furnace Creek Area Restoration Phase, 2018

Following the excavation and removal of mercury and arsenic laden tailings, bank soil, and sediment, EPA began to restore the Furnace Creek channel. ERRS conducted the restoration following a design provided by CDM Smith. START engineers participated to help implement the construction in accordance with this design. Details of the creek channel restoration as well as the restoration of other site features are provided below.

6.1 Backfill and Grading

On July 11, 2018, ERRS began to haul the clean clay backfill material from BS01 and place it into the Furnace Creek channel. START painted guide marks to indicate the backfill elevations along the excavated banks for ERRS. START used elevation data collected during the pre-removal surveys to lay out the backfill elevation guide marks and used a laser level to locate the station benchmarks. ERRS placed the clay material in 12- to 18-inch lifts and compacted it with a sheepsfoot roller. Material placed on slopes steeper than 3:1 was compacted by tracking with a bulldozer. ERRS completed backfill and grading of the channel on July 17, 2018, with the channel backfilled to original grade with clean fill or backfilled to grade appropriate for construction of the rock cross vane (RCV) and log cross vane (LCV) features.

Clay backfill material was also placed in over-excavated sections of the bank to bring the slopes back to grade. CDM Smith provided updated design drawings for the bank slope design, based on pre-removal and post-removal surveys conducted by START. The clay backfill was compacted and graded to slope as called out in the revised design drawings. Mass grading of channel banks with clay backfill material was completed on July 23, 2018. Approximately 9,400 CY of clay backfill material was hauled from BS01 and placed in the Furnace Creek channel and slopes. See Section 6.2.3 for further detail on slope restoration. See Table 6-1 below for the quantity of backfill materials placed in the Furnace Creek area.

Table 6-1 Furnace Creek Restoration Material Quantities

Material	Quantity	Units
Clay backfill[1]	9,380	CY
Topsoil backfill[1]	2,680	CY
6-inch open rock armor[2]	1,262	tons
Rip rap[3]	555	tons

Notes:

1. All clay and topsoil backfill was placed in the Furnace Creek restoration area.
2. The 6-inch rock armor was apportioned to the restoration areas as follows: 90% placed in the Furnace Creek restoration area; 7% placed along the Adit Creek reach in the BS01 borrow source area; and 3% placed in the Adit Creek reroute around the repository.
3. All rip rap was placed in Furnace Creek for use in construction of the RCVs.

Concurrent with channel construction activities, ERRS graded the repository slopes to less than 3:1, capped the graded slopes with clean overburden from Furnace Creek and fill material from BS01, then placed slash material on the finished slopes. See Section 5.4.2 for more detail on the repository construction and cover.

Figure 6-1 presents the locations and layout of the restored Furnace Creek channel features.

6.2 Furnace Creek Restoration

CDM Smith provided updated detail drawings for creek channel features based on pre-removal and post-removal surveys conducted by START. The surveys provided CDM Smith with information on existing channel gradient and streambank and slope angles, allowing them to design specifications on the allowable channel gradient and the locations of appropriate grade control features. Based on CDM Smith's updated detail drawings, sections of the channel not exceeding a 20% grade received stream cobble, placed to a depth of 1 foot. Sections of the channel that exceeded a 20% grade received RCVs installed in series, and a break in the grade received an LCV. The updated detail drawings also called out final streambank slopes and treatments. Slopes graded greater than 3:1 received rock armor, and slopes of 3:1 or less received top soil and hydroseed mix.

After backfilling and grading of the Furnace Creek removal area, ERRS began constructing the creek channel. A mini-excavator was used to prepare the channel to receive the placement of the stream cobble rock armor. The mini-excavator cut a 1-foot wide by 1-foot deep center channel, with a 3:1 slope on either side of the center channel running up to the floodplain, creating a channel with a total width of approximately 7 feet as designed in the Implementation Plan (CDM Smith 2018d).

6.2.1 Stream Cobble

ERRS prepared a staging area at the base of the main access road on July 18, 2018, to receive deliveries of 6-inch angular gravel (stream cobble and/or rock armor), and rip rap to be used for channel and bank construction and restoration. A total of 1,262 tons of 6-inch angular gravel was delivered to the site between July 19 and August 9, 2018, and a total of 555 tons of large rip rap was delivered to the site between July 23 and August 8, 2018. Table 6-1 includes the quantities of materials used during restoration activities.

On July 23, 2018, ERRS began placing stream cobble at a depth of 1 foot along the banks and stream channel in sections of the stream with a gradient at less than 20%. ERRS began the channel construction at Station 0+00 and working downgradient to approximately Station 1+90. Restoration activities then transitioned to Station 8+90, and restoration work proceeded upgradient to connect the channel at Station 1+90.

6.2.2 Cross Vanes

On July 24, 2018, ERRS began construction of the RCVs in sections of the Furnace Creek channel exceeding 20% grade. The RCV features were constructed using rip rap placed on gravel bedding. The stream channel bed within each RCV was then brought to grade with stream cobble. Construction of the RCV features was primarily conducted using a mini-excavator, with the aid of a large excavator to place gravel bedding and transport the large rip rap to the location of each RCV feature. START provided engineering support, including surveying for the layout and construction of the riprap RCVs. Three RCVs were installed between Stations 0+50 to 0+77. Once channel construction was completed to Station 1+90, ERRS mobilized to the lower extent of the Furnace Creek channel and began construction of the RCV features between Stations 8+22 and 8+87. Construction started at the most downgradient RCV pool key and ledge to tie the restored channel into the existing Furnace Creek channel across the Garoutte Creek floodplain. A total of thirteen RCVs were installed between Stations 8+22 and 8+87. Two additional series of thirteen RCVs were installed from Stations 4+25 to 5+33, and a series of eleven RCVs were installed from Stations 2+50 to 3+50.

One LCV was installed at Station 6+00. The LCV was placed in the Furnace Creek channel where the channel grade transitioned from a steeper grade down to a shallower grade to discourage head-cutting of the channel. See Figure 6-1 for the locations and layout of the restored Furnace Creek channel features.

6.2.3 Bank and Slope Restoration

CDM Smith engineers provided final updated section drawings and quantity estimates in Addendum 2 of the Implementation Plan (CDM Smith 2018b) and START surveyed and marked the extents of slope rock armor as detailed in the updated section drawings. START marked the banks with paint as a guide for ERRS to indicate which slope treatment was to be placed in each section. On July 21, 2018, ERRS began to place topsoil at the top of slopes along the left bank from station 3+25 to station 4+50. On July 23, 2018, ERRS began to place rock slope armoring with an excavator along the left and right banks, starting from stations 0+00 through 1+90. ERRS continued to place the slope and bank treatment prior to channel construction in each section, as work site conditions allowed. Due to narrow conditions within the certain channel areas, the channel and bank were constructed simultaneously. Approximately 2,700 CY of topsoil was hauled from BS01 and placed along the Furnace Creek slopes.

A mulch berm was placed along the top of the banks at the interface between the restored section of the slope and the undisturbed upland areas to deter stormwater run-on into the channel. See Figure 6-1 for the locations and layout of the restored Furnace Creek channel features.

6.3 Adit Creek

After construction of the repository and repository drainage channels, the new channel for Adit Creek around the repository was sited. The Adit Creek channel was routed east and north around the outer berm of the repository drainage channel and routed to drain into a vegetated ditch located north of the repository. The re-routed Adit Creek path and discharge area were armored with stream cobble. ERRS completed construction of the Adit Creek channel and the armored discharge area on August 14, 2018. See Figure 6-2 for the locations and layout of the restored site features.

As discussed in Section 5.3, the upgradient seep of Adit Creek was discovered during excavation and soil stockpiling activities conducted in the BS01 borrow source area. The Adit Creek seep originated at southern and upper extent of the disturbed area and ran north/northwest down the center of the disturbed borrow source area slope towards the repository. To prevent erosion along the seep drainage, EPA placed rock armor along the disturbed length of the drainage.

6.4 Borrow Source Restoration

ERRS began restoring the BS01 borrow source area on August 10, 2018. The cut faces of the borrow source area, located at the interface of the disturbed edges of the borrow source area and the undisturbed upland areas, were filled and graded to create a smooth transition. ERRS spread topsoil across the area, placed slash and wood chips along the slopes, and constructed an access road for the hydroseeder. As described in Section 6.3, ERRS constructed an armored drainage for Adit Creek down the face of borrow source slope and across the borrow source access road, with rock check dams installed every 20 linear feet down the channel. The Adit Creek drainage crossing for the borrow source access road was constructed shallow and wide to allow vehicular traffic across the armored drainage channel.

6.5 Capping Old Furnace

ERRS excavated and graded the slope located upgradient of the Old Furnace structure (along the right bank near Station 1+00) back to a stable 2:1 slope. Excavated contaminated material was placed into the Old Furnace structure, and the entire structure was capped in-place with clean backfill on August 15, 2018. ERRS hauled approximately 100 CY of clay fill from BS01 for grading and capping of the Old Furnace Area.

6.6 Hydroseeding

The BS01 borrow source area was hydroseeded on August 21, 2018. The capped areas of the Old Furnace Area and the Furnace Creek banks and slopes were hydroseeded on August 21 through 22, 2018. Hydroseeding within the Furnace Creek channel area was conducted using the revised Furnace Creek Revegetation Seed Mix as listed in Addendum 2 of the Implementation Plan (CDM Smith 2018b). Hydroseeding within the repository area, the borrow source area, the Old Furnace Area, and all other disturbed locations was conducted using the Furnace Creek Riparian Seed Mix as listed in the Implementation Plan (CDM Smith 2018d). The hydroseed mix for all areas included ProMatrix™ engineered fiber matrix, applied at 2,500 pounds per acre. To discourage growth of invasive plants, no fertilizer was utilized in the hydroseed mix. See Tables 6-2 and 6-3 below for descriptions of the seed mixes.

Table 6-2 Furnace Creek Revegetation Seed Mix

Common Name	Scientific Name	Requested %	PLS/square foot*
Regreen Hybrid	*Triticum aestivum x Elytrigia elongata*	40.5 %	16.53
Meadow Barley	*Hordeum brachyantherum*	8.9%	10.82
California Brome	*Bromus carinatus*	8.9%	6.06
Native Red Fescue	*Festuca rubra*	5.9%	12.12
Northwestern Mannagrass	*Glyceria occidentallis*	5.9%	2.44
Tufted Hairgrass	*Deschampsia cespitosa*	8.9%	15.15
Spike Bentgrass	*Agrostis exarata*	5.9%	9.60
Nootka Rose	*Rosa nutkana*	3.0%	0.45
Common Snowberry	*Symphoricarpos alba*	3.0%	0.38
Douglas Spirea	*Spiraea dougalsii*	3.0%	1.26
Red osier dogwood	*Cornus sericea*	3.0%	0.11
Vine maple	*Acer circinatum*	1.5%	0.24
Red alder	*Alnus rubra*	1.5%	0.42
Total		**100**	**75.6**

PLS = pure live seed

Table 6-3 Riparian Seed Mix

Common Name	Scientific Name	Requested %	PLS/square foot	PLS (lbs./acre)
Meadow Barley	*Hordeum brachyantherum*	15	5.42	6.6
California Brome	*Bromus carinatus*	15	3.03	6.6
Native Red Fescue	*Festuca rubra*	10	6.07	4.4
Northwestern Mannagrass	*Glyceria occidentallis*	10	1.22	4.4
Tufted Hairgrass	*Deschampsia cespitosa*	15	7.59	6.6
Spike Bentgrass	*Agrostis exarata*	10	4.80	4.4
Nootka Rose	*Rosa nutkana*	5	0.23	2.2
Common Snowberry	*Symphoricarpos alba*	5	0.19	2.2
Douglas Spirea	*Spiraea dougalsii*	5	0.63	2.2
Red osier dogwood	*Cornus sericea*	5	0.05	2.2
Vine maple	*Acer circinatum*	2.5	0.12	1.1
Red alder	*Alnus rubra*	2.5	0.21	1.1
Total		**100**	**62.05**	**44**

PLS = pure live seed   lbs./acre = pounds per acre

6.7 Post-Restoration Stream Profile Surveys

START and ERRS conducted post-restoration surveys of the Furnace Creek station cross-section profiles and longitudinal profile from August 14 through 17, 2018. The longitudinal profile survey captured the profile of the restored creek low-flow path, as well as the stationing and elevations of the RCVs and LCVs. ERRS supported START during the survey work by operating the survey rod and assisting with tape layout. START collected GPS coordinates of the main site features on August 22, 2018. See Figure 4-2 for the locations of the survey transect stations. See Appendix E for a compilation of the pre-removal, post-removal, and post-restoration survey profiles.

6.8 Demobilization

ERRS decontaminated and prepared equipment for demobilization on August 16 and 17, 2018. ERRS also removed solid waste from the site and transported surplus EPA supplies to the Portland EPA Logistics Center on August 16, 2018. START and ERRS demobilized from the site on August 22, 2018. All EPA and START equipment were removed from the site. ERRS left the two job trailers to be picked up by the rental company. Additionally, ERRS left several stockpiles of rock material to be used for repairs at a later date.

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure6-1_Restored_Site_Features_Layout.mxd

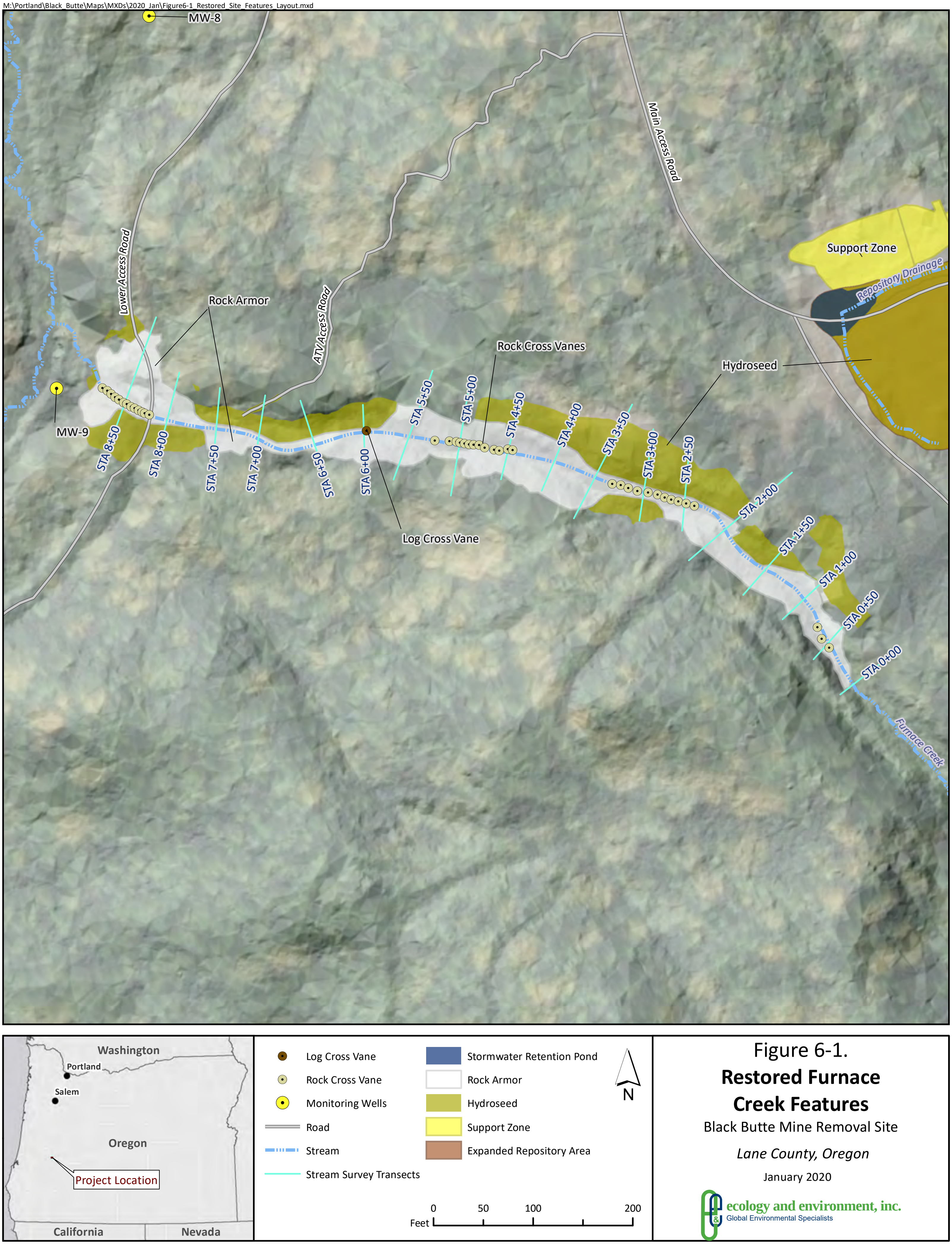
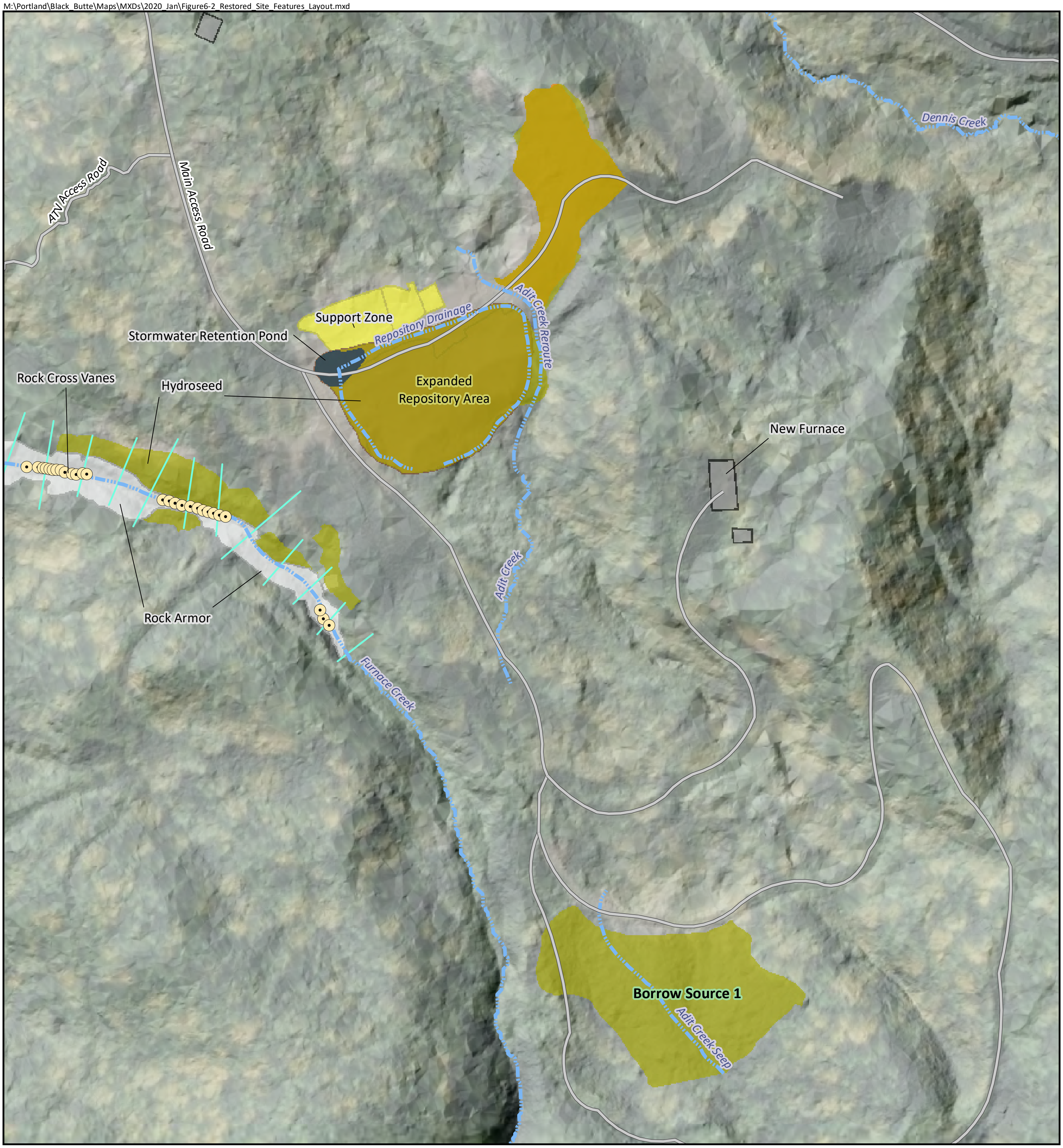


Figure 6-1.
Restored Furnace Creek Features
Black Butte Mine Removal Site
Lane County, Oregon
January 2020

ecology and environment, inc.
Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure6-2_Restored_Site_Features_Layout.mxd



Rock Cross Vane	Hydroseed
Road	Support Zone
Stream	North Laydown Area
Stream Survey Transects	Building
Stormwater Retention Pond	Expanded Repository Area
Rock Armor	

N

0 25 50 100
Feet

Figure 6-2.
Restored Site Features

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

This page intentionally left blank.

7 Residential Removal, 2018

As a part of the 2018 NTCRA, EPA also performed cleanup activities at the occupied site residence located at 70835 London Road. The Draft RI report prepared for the EPA Remedial Program (CDM Smith 2018e) indicated that surface soil at the occupied residence contained elevated concentrations of several metals, including mercury and arsenic, compared with background concentrations. In particular, the RI report stated that "mercury concentrations exceed background concentrations by a factor of more than 20, with a 95% upper confidence limit of 35.58 mg/kg." Field data collection during RI sampling activities included surface soil sampling (0-4 inches below ground surface [bgs]), sent for laboratory analysis, and XRF screening throughout the residence. Laboratory results and XRF screening results indicated concentrations of mercury and arsenic exceeded site-specific background levels and the site-specific action levels of 23 mg/kg for mercury and 29 mg/kg for arsenic. Laboratory and XRF screening results for arsenic indicated concentrations between 29 and 150 mg/kg throughout most of the property. Laboratory and XRF screening results for mercury indicated concentrations of 23 to 115 mg/kg near the center of the southern portion of the property. Elevated levels of mercury in concentrations of 230 to 1,330 mg/kg were discovered in soil samples collected near the shed area located near the southern portion of the property. Based on these results EPA decided that a removal action was necessary at the residence (CDM Smith 2018e).

To prepare for the residential removal activities, EPA performed a pre-removal sampling event, primarily to determine the depth of soils contamination. Details pertaining to the pre-removal sampling event and subsequent removal action are contained in the following subsections. The location of the residence and other site features during the residential removal are shown on Figure 7-1.

7.1 Pre-Removal Sampling Event

EPA and START conducted a pre-removal sampling event at the residence from September 24 through 26, 2018. The purpose of the event was to investigate soil contamination discovered at the residence by EPA's Remedial Program. START prepared a Site-Specific Sample Plan Alternation Form (SPAF), dated October 3, 2018 (Appendix C), which provided updated methods and procedures to be utilized during the pre-removal sampling event and subsequent removal action. EPA and START designated seventeen DUs for the pre-removal sampling event. Assessment of each DU included collection of a single 5-point composite surface soil (0-4 inches bgs) sample, and a single 5-point composite subsurface (12 inches bgs) soil sample. The site-specific action levels for the removal, as provided by the Remedial Program, were 23 mg/kg for mercury and 29 mg/kg for arsenic. All composite samples were sent for laboratory analysis of mercury and arsenic.

EPA and START mobilized to the site on September 24, 2018 and started the sampling event by marking out the seventeen proposed locations of the DUs. Based on field observations, the layout of several DUs were adjusted and some were removed entirely at the direction of EPA due to their distance from the residence. Ultimately, twelve DUs were selected for soil sampling. Figure 7-2 shows the locations of the DUs in relation to the residence.

DUs were marked with pin flags to indicate composite sub-sample locations. GPS coordinates were collected for each sub-sampling point. Surface soil sample points were excavated from 0-4 inches bgs, and samples were collected with dedicated plastic scoops. Hand tools were utilized to loosen soil, including rock hammers and picks. Subsurface soil samples were collected at 1-foot bgs using a hand auger; the samples were collected directly from the hand auger into dedicated plastic bags. Non-dedicated equipment used for soil sampling was decontaminated between sampling of each DU. START did not collect subsurface soil samples from the driveway areas (DU-12 through DU-15), as directed by EPA. Composite soil samples were submitted to the laboratory for analysis for mercury and arsenic with a 1-week turnaround time. Ex situ XRF screening was conducted by START on both individual soil sub-samples and composite soil samples.

Laboratory and XRF results indicated that both surface and sub-surface soil samples from all DUs had concentrations above the site-specific action level of 29 mg/kg for arsenic. Additionally, laboratory and XRF results for soil collected from DU-5 and DU-15 indicated concentrations above the site-specific action level of 23 mg/kg for mercury. Table 7-1 provides laboratory and XRF results for all samples. Based on the results of the pre-removal sampling event, arsenic and/or mercury contamination in each DU was present to a depth of at least 1 foot bgs, and EPA decided that removal of the top 1 foot of material within each DU was necessary to protect the health and safety of the occupants of the residence.

7.2 Removal Action and Restoration

START mobilized two field personnel and equipment to the residence on October 8, 2018. EPA equipment included the Portland Emergency Response Truck, Oregon Response Trailer, two DustTraks, one Lumex, one XRF, and equipment for soil sampling. ERRS also mobilized on October 8, 2018 to the residence with field personnel, two mini-excavators, one skid-steer, one dump truck, and one front loader. Removal and restoration activities were conducted from October 8 to 17, 2018.

7.2.1 Soil Excavation and Removal

As stated in Section 7.1, analytical results indicated that contamination at the residence was present to a depth of at least 1 foot bgs, which was the target depth for removal within each DU. To preserve existing trees and vegetation and avoid damaging tree root systems, ERRS only removed approximately 3 inches of material around areas with dense tree cover. ERRS utilized mini-excavators to excavate contaminated material into stockpiles. The stockpiled material was later loaded into a haul truck and transported to a temporary stockpile located in the North Laydown Area near the main repository (Figure 7-1). Excavation near structures was completed approximately 5 feet from the roofline of each structure while tapering the slope of the cavity away from the structures at an approximately 45-degree angle.

Following soil excavation and removal, START conducted the following sampling and analytical activities:

- START collected six-point composite soil samples for ex situ XRF screening from each DU as excavation was completed for that section. The XRF screening results indicated that mercury was detected at levels below the site-specific action level for all DUs, with the exception of DU-3 and DU-15. Arsenic was detected at all DUs above the site-specific action level. These post-excavation samples were not submitted for laboratory analysis. See Table 7-2 for XRF results.
- START performed additional XRF screening near sheds 1 & 2 (Figure 7-2), based on a report from the property owner of a possible mercury spill. START also utilized the Lumex to screen for mercury vapor to assist with the selection of points for in situ XRF

analysis. Lumex monitoring did not indicate presence of mercury, and in situ XRF results did not exceed the site-specific action level of 23 mg/kg for mercury.

- An approximately 1-foot by 1-foot deposit of gray-ashy material was discovered near the southeast corner of the residence in DU-6 and screened via in situ XRF. XRF results indicated concentrations of both arsenic and mercury above 200 mg/kg. ERRS removed the material with a shovel and placed it in the temporary stockpile at the North Laydown Area.
- An approximately 5-foot by 10-foot area of pale tailings was excavated in DU-5, and screened via in situ XRF. XRF results for arsenic were approximately 125 mg/kg, and mercury was approximately 25 mg/kg. ERRS over-excavated the area to approximately 2 feet bgs to remove the concentration of mine tailings.

ERRS completed excavation activities on October 14, 2018. Approximately 1,625 CY of material were removed from the residence and placed in the temporary stockpile.

START collected one 20-point composite soil sample from the temporary stockpile located in the North Laydown Area. The sample was sent for off-site laboratory analysis for total mercury and arsenic, and SPLP mercury. The residential stockpile sample was also analyzed via ex situ XRF screening. Both lab and XRF results from the sample indicated mercury concentrations less than the action level of 23 mg/kg for mercury, and greater than the action level of 29 mg/kg for arsenic. See Table 7-3 for complete lab and XRF sample results of the stockpile composite sample.

7.2.2 Restoration

ERRS conducted backfill and restoration activities from October 11 through 17, 2018. Prior to EPA selecting a source of topsoil backfill material, START collected samples of the material from two suppliers (Wildish and RiverBend Materials, both located in Eugene, Oregon) and submitted them for laboratory analysis for pesticides and total metals. The materials from both vendors were determined to be within acceptable levels for use as fill material as recommended in the Implementation Plan (CDM Smith 2018d). See Table 7-4 for laboratory analytical results of residential backfill material.

At the request of the property owner, EPA agreed to replace the excavated soil areas within the vicinity of the house and driveways with gravel. ERRS backfilled these areas with gravel and the remaining areas to the north and south of the residence with topsoil. Figure 7-3 shows where the different types of fill were placed. Soil and gravel deliveries were received between October 8 and 17, 2018. A total of 833.06 tons of loam was supplied by RiverBend Materials. Gravel deliveries were staged in an area to the south of the residence and deliveries continued throughout restoration activities as-needed until backfill and restoration was complete. All backfill was placed and compacted to grade using the skid-steer and front-loader. ERRS broadcast seed by hand and raked it into the soil in the restored areas that received topsoil in the residential property area, as well as the temporary stockpile at the North Laydown Area.

Upon completion of field activities, ERRS decontaminated excavation and hauling equipment. ERRS and START demobilized from the residence on October 17, 2018.

7.2.3 Best Management Practices

ERRS and START followed BMPs during site activities. The former residents vacated the property prior to the start of site activities. START performed air monitoring for particulates with handheld DustTraks whenever dust was visible. DustTrak results did not exceed the action levels of 300 $\mu g/m^3$ during field activities. ERRS controlled dust whenever necessary by spraying water onto dry materials and stockpiles during excavation activities. START performed monitoring for mercury vapor with the Lumex in and around equipment used by field crews. Mercury vapor did not exceed action levels during field activities.

7.2.4 Mercury Waste Disposal

In addition to the residential soil sampling and removal activities described above, EPA also encountered and disposed of elemental mercury waste at the residence. Upon arriving at the residence on October 8, 2018, the property owner relinquished two sealed flasks of mercury to EPA. The property owner indicated that he had found the flasks while rummaging through an outbuilding at the residence. Stericycle was contacted by ERRS to remove the flasks on October 16, 2018. Stericycle placed the flasks in lined 55-gallon drums and packed them with vermiculite for off-site transport to Burlington Environmental, LLC. in Tacoma, Washington.

Table 7-1 **Residential Pre-Removal Sampling Analytical Results**

Sample ID	Location	Sample Date	Mercury (mg/kg)		Arsenic (mg/kg)	
			XRF (EPA Method 6200)	Fixed Lab (EPA Method 7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method 6010C)
18091001	DU03SB	9/26/2018	**18.5**	**11.7**	**71.95**	**68.5 JK**
18091002	DU03SS	9/25/2018	**19.8**	**13.7**	**43.85**	**50.6 JK**
18091003	DU04SB	9/25/2018	**7.85 J**	**4.86**	**30.2 J**	**29.8 JK**
18091004	DU04SS	9/25/2018	**17.15**	**5.46 JQ**	**47.1**	**37.3 JK**
18091005	DU05SB	9/25/2018	**21.95**	**13.7**	**107.5**	**109 JK**
18091006	DU05SS	9/25/2018	**44.8**	**26.8**	**117.15**	**121 JK**
18091007	DU06SB	9/25/2018	**20**	**14.6**	**73.2**	**70.2**
18091008	DU06SS	9/25/2018	**18.7**	**9.04**	**106.95**	**97.3 JK**
18091009	DU08SB	9/26/2018	**11.3**	**6.32 JQ**	**87.05**	**79.9 JK**
18091010	DU08SS	9/25/2018	**11.6**	**4.91 JQ**	**64.25**	**58.8 JK**
18091011	DU09SB	9/26/2018	**38**	**8.49**	**10.85 U**	**33.1 JK**
18091012	DU09SS	9/25/2018	**20.1**	**19.1**	**41.65 J**	**37.7 JK**
18091013	DU10SB	9/25/2018	**7.35 J**	**4.31 JQ**	**64**	**58.8 JK**
18091014	DU10SS	9/25/2018	**8.3 J**	**6.11 JQ**	**66.75**	**60.3 JK**
18091015	DU11SB	9/25/2018	**10.65 J**	**3.33**	**93.35**	**80.1 JK**
18091016	DU11SS	9/25/2018	**16.85**	**6.83**	**132.8**	**97.7 JK**
18091017	DU12SS	9/26/2018	**10.65 J**	**4.95**	**76.5**	**72.8 JK**
18091018	DU13SS	9/26/2018	**13.5**	**5.01 JQ**	**68.5**	**58.8 JL**
18091019	DU14SS	9/26/2018	**25.2**	**13.8**	**84.95**	**67.7 JL**
18091026	DU15SS	9/26/2018	**35.5**	**125**	**122.1**	**98.6 JK**

Detected results are bolded.

KEY:

EPA - United States Environmental Protection Agency

ID - Identification

J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample

K - The bias of the sample is not known

mg/kg - milligrams per kilogram

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit

Table 7-2 Residential Removal Analytical Results

Sample ID	Location	Sample Date	Mercury (mg/kg)		Arsenic (mg/kg)	
			XRF (EPA Method 6200)	Fixed Lab (EPA Method 7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method 6010C)
18100004	DU11	10/8/2018	**25**	--	**131**	--
18100005	DU11	10/8/2018	**14.1**	--	**109**	--
18100006	DU11	10/8/2018	**13.4**	--	**98**	--
18100007	DU11	10/8/2018	**9.5 J**	--	**112.9**	--
18100008	DU11	10/8/2018	**13.4**	--	**109**	--
18100009	DU10	10/8/2018	**3.9 J**	--	**45.15**	--
18100010	DU11	10/8/2018	**4.1 J**	--	**70.6**	--
18100011	DU11	10/8/2018	0 U	--	**63.5**	--
18100012	DU11	10/8/2018	0 U	--	**54.3**	--
18100013	Box-1-comp	10/9/2018	**3.6 J**	--	**34.4 J**	--
18100014	Box-2-comp	10/9/2018	**3.8 J**	--	**43.35 J**	--
18100015	Box-3-comp	10/9/2018	0 U	--	**41.65 J**	--
18100016	DU06	10/9/2018	**13.15**	--	**22.8**	--
18100017	Fill 1	10/9/2018	0 U	--	**4.35**	--
18100018	Fill 2	10/9/2018	0 U	--	**5.4**	--
18100019	DU06	10/9/2018	**20.75**	--	**77.55**	--
18100019	DU06	10/9/2018	**20.75**	--	**77.55**	--
18100020	DU08	10/9/2018	**27.8**	--	**99.4**	--
18100021	DU09	10/9/2018	**20.75**	--	**41**	--
18100022	DU03	10/11/2018	**29.05**	--	**59.5**	--
18100023	DU12	10/11/2018	**9.85 J**	--	**60.5**	--
18100024	DU13	10/11/2018	**11.85**	--	**88.05**	--
18100025	DU04	10/12/2018	**7.7 J**	--	**40.8**	--
18100026	DU05	10/12/2018	**18.5**	--	**110.9**	--
18100028	DU14	10/13/2018	**18.15**	--	**77.6**	--
18100029	DU15	10/13/2018	**54.9**	--	**140.05**	--

Positive results are bolded.

KEY:

-- - Not applicable

EPA - United States Environmental Protection Agency

ID - Identification

J - The result is an estimated quantity The associated numerical value is the approximate concentration of the analyte in the sample

mg/kg - milligrams per kilogram

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit

Table 7-3 Residential Removal Stockpile Results

Sample ID	**18100003**
Sample Date	10/12/2018
Location	Residential Stockpile
Mercury	
Ex-Situ XRF(EPA Method 6200, mg/kg)	**20.1**
Total Mercury (EPA Method SW7471B, mg/kg)	**16.1**
SPLP (EPA Method SW7470A, SW1312, mg/L)	**0.00093**
Arsenic	
ExSitu XRF (EPA Method 6200, mg/kg)	**51.4**
Total Arsenic (EPA Method SW6010C, mg/kg)	**57.6**

Detected results are bolded.

KEY:

EPA - United States Environmental Protection Agency
ID - Identification
mg/kg - milligrams per kilogram
mg/L - milligrams per liter
SPLP - Synthetic Precipitate Leaching Procedure
XRF - X-Ray Fluorescence

Table 7-4 **Residential Removal Backfill Source Results**

Sample ID	**18100001**	**18100002**
Sample Date	10/9/2018	10/10/2018
Location	Soil Vendor 1	Soil Vendor 2
Organochlorine Pesticides (EPA Method 8081B)	**Fixed Lab (mg/kg)**	
4,4'-DDD	0.0038 U	0.0037 U
4,4'-DDE	0.0038 U	0.0037 U
4,4'-DDT	0.0038 U	0.0037 U
Aldrin	0.0038 U	0.0037 U
alpha-BHC	0.0038 U	0.0037 U
beta-BHC	0.0038 U	0.0037 U
delta-BHC	0.0038 U	0.0037 U
Chlordane (technical)	0.11 U	0.11 U
cis-Chlordane	0.0038 U	0.0037 U
Dieldrin	0.0038 U	0.0037 U
Endosulfan I	0.0038 U	0.0037 U
Endosulfan II	0.0038 U	0.0037 U
Endosulfan sulfate	0.0038 U	0.0037 U
Endrin	0.0038 U	0.0037 U
Endrin aldehyde	0.0038 U	0.0037 U
Endrin ketone	0.0038 U	0.0037 U
gamma-BHC (Lindane)	0.0038 U	0.0037 U
Heptachlor	0.0038 U	0.0037 U
Heptachlor epoxide	0.0038 U	0.0037 U
Methoxychlor	0.0075 U	0.0072 U
Toxaphene	0.15 U	0.15 U
trans-Chlordane	0.0038 U	0.0037 U

Table 7-4 Residential Removal Backfill Source Results

Sample ID	**18100001**	**18100002**
Sample Date	10/9/2018	10/10/2018
Location	Soil Vendor 1	Soil Vendor 2
Metals (EPA Method 6010C)	**Fixed Lab (mg/kg)**	
Aluminum	13,000 U	**20,000 JL**
Antimony	2.3 U	2.6 UJL
Arsenic	**2.4**	**3**
Barium	**69**	**100 JL**
Beryllium	**0.23 JQ**	**0.28 JQ**
Cadmium	0.94 U	1 U
Calcium	**4,700**	**5,800 JL**
Chromium	**18**	**18 JL**
Cobalt	**13**	**13**
Copper	**23**	**26**
Iron	**23,000**	**24,000**
Lead	**2 JQ**	**2.5 JQ**
Magnesium	**4,900**	**5,100 JL**
Manganese	**530**	**570 JL**
Nickel	**26**	**22 JL**
Potassium	**520**	**640 JL**
Selenium	4.7 U	5.1 UJL
Silver	0.13 JQ	1.3 U
Sodium	**600**	**920 JL**
Thallium	2.3 U	2.6 UJL
Vanadium	**72**	**81 JL**
Zinc	**41**	**41**
Mercury (EPA Method SW7471B)	**Fixed Lab (mg/kg)**	
Mercury	26 U	**16 JQ**

Detected results are bolded.

KEY:

EPA - United States Environmental Protection Agency

ID - Identification

J - The result is an estimated quantity - the associated numerical value is the approximate concentration of the analyte in the sample

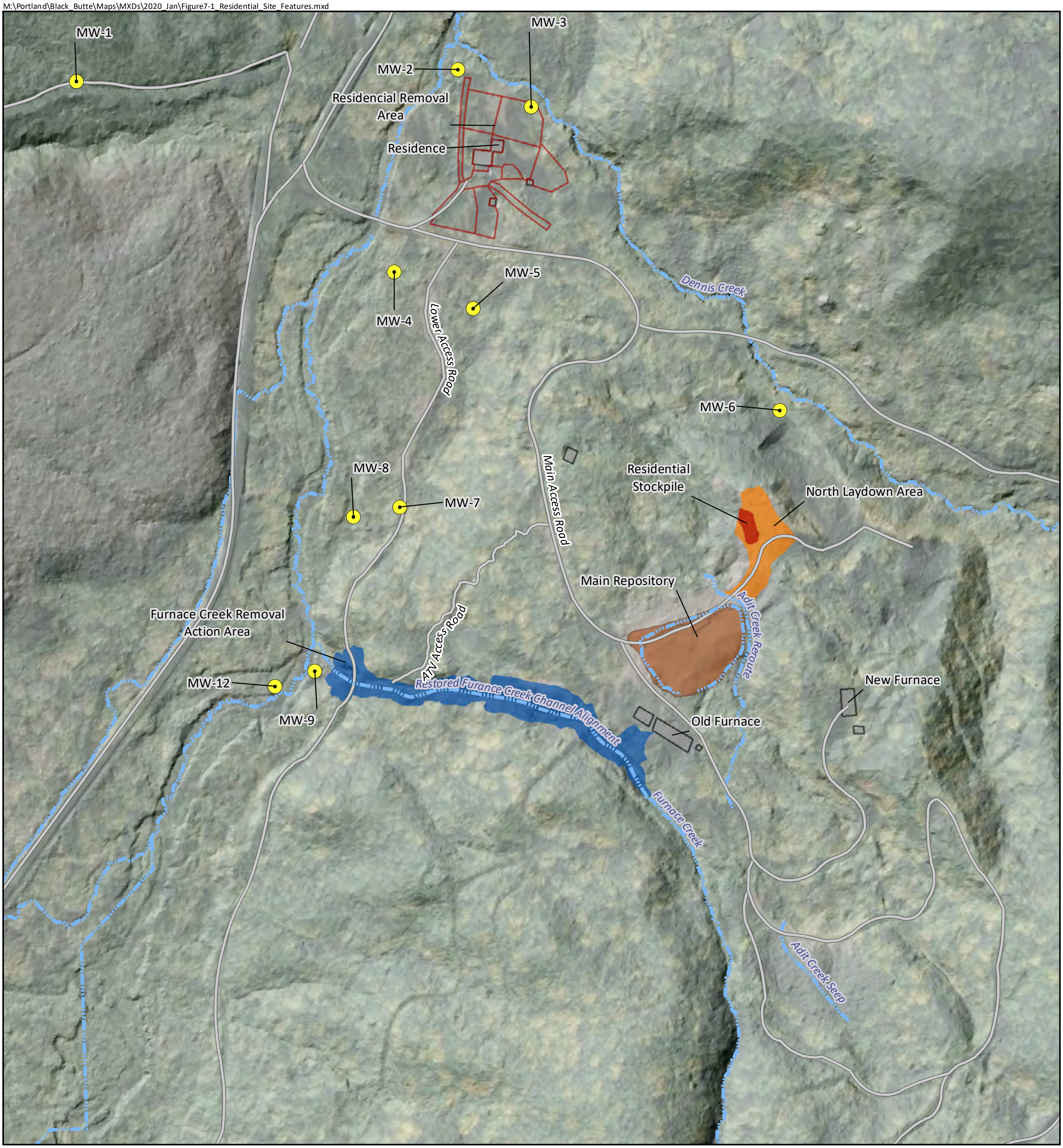
L - The sample result is biased low

mg/kg - milligrams per kilogram

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure7-1_Residential_Site_Features.mxd



Monitoring Wells

Road

Stream

Furnace Creek Removal Action Area

Residential Removal Area

Residential Stockpile

North Laydown Area

Building

Main Repository

N

0 100 200 400

Feet

Figure 7-1.

Residential Site Features and Layout

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.

Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure7-2_Residential_DU_Areas.mxd

Monitoring Wells

Building

Road

Stream

Decision Unit

N

0 25 50 100
Feet

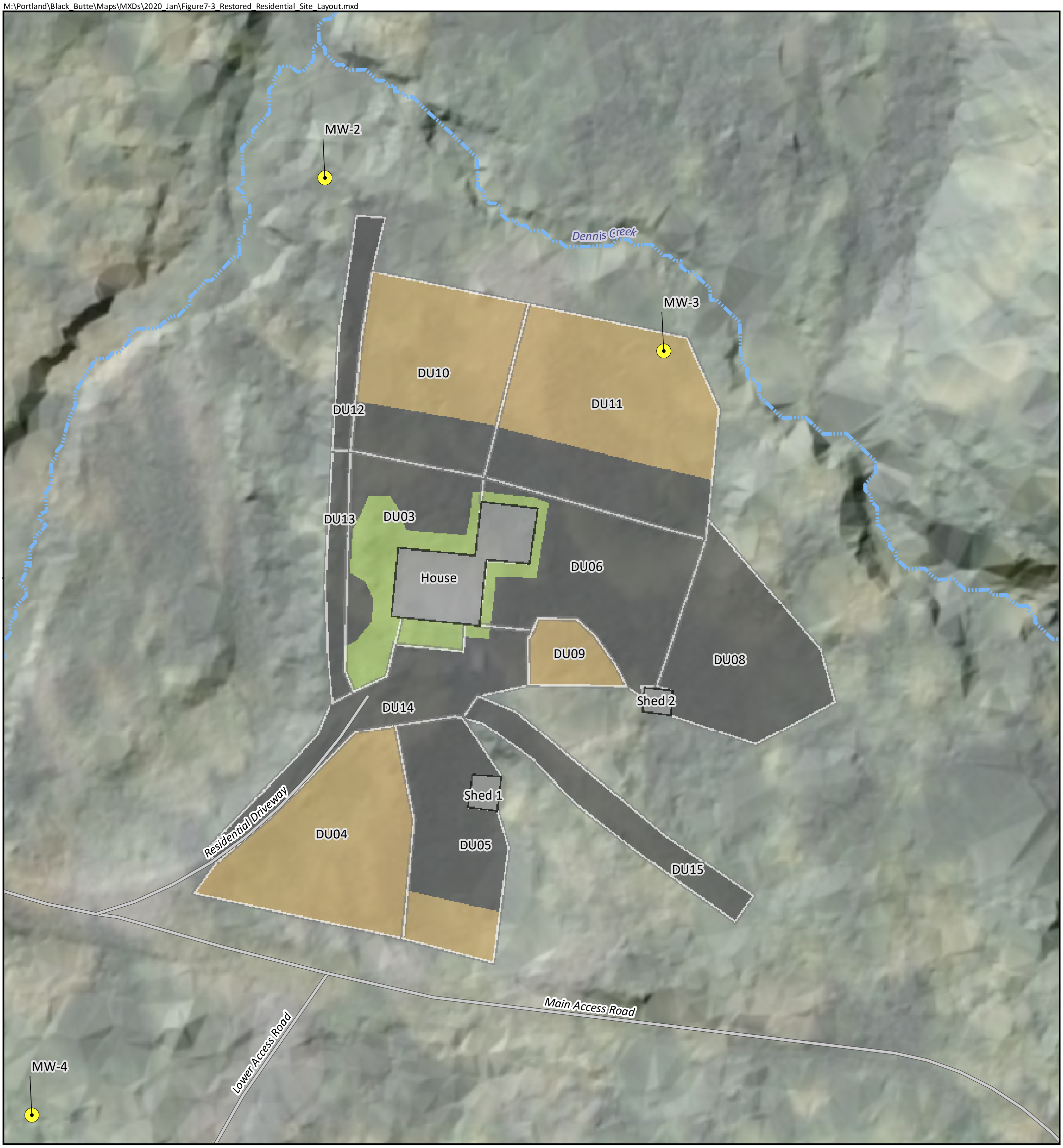
Figure 7-2.
Residential Layout and Decision Units
Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure7-3_Restored_Residential_Site_Layout.mxd



Restoration Treatment Type

- Gravel
- Soil
- Undisturbed Vegetation
- Monitoring Wells

- Road
- Stream
- Decision Unit
- Building

N

Feet 0 25 50 100

Figure 7-3.

Restored Residential Features

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

8 2019 NTCRA Site Activities

The following sections describe the Furnace Creek OU1 area site work conducted in 2019 as part of the NTCRA. Site work conducted in 2019 included removal activities to address contamination at the OPWA and enhancements and repairs of site features located within the Furnace Creek removal area. Implementation of the 2019 removal activities required coordination between EPA, START, ERRS, and the remedial contractor CDM Smith.

8.1 OPWA Removal Activities

8.1.1 OPWA Site Background and Previous Site Investigations

The OPWA is located east of Garoutte Creek and north of the Furnace Creek catchment. The OPWA is believed to have functioned as a settling pond area process water associated with the mercury ore furnaces. The OPWA removal area was divided into two units, the Upper/South OPWA unit, and the Lower/North OPWA unit. The topography of the Upper/South OPWA unit includes a steep draw extending downhill from the western edge of the Old Furnace area tailings, and is bounded by the lower access road on the north/downhill end. The Lower/North OPWA unit consists of a low-lying area on the Garoutte Creek floodplain, located between monitoring wells MW-7 and MW-8, and includes a potential historic water course where ore processing wastewater from the Old Furnace mining process water was assumed to be discharged. MW-8 is a shallow drive point well installed within an abandoned channel of Garoutte Creek immediately northwest of the Lower/North OPWA unit and at the base of a possible historic water course which may have received ore processing wastewater from the Old Furnace. Higher mercury concentrations in groundwater occur within the Garoutte Creek alluvial groundwater, which has a complete pathway to Garoutte Creek. No distinct streams or channels are present within the OPWA, as precipitation either infiltrates or flows as sheet flow or shallow concentrated flow, eventually pooling in the Garoutte Creek floodplain or discharging to Garoutte Creek (CDM Smith 2019). The OPWA removal area is depicted in Figure 8-1 and Figure 8-2.

Contamination in the OPWA primarily consists of a gray, silty, ash-like material that was produced by mining activities and that contains high concentrations of mercury. This material was usually found intermixed with brown native soil and was identified in distinct layers in the Furnace Creek area and within the OPWA during multiple site investigation activities. The OPWA was initially identified in 2013 during drilling, soil sampling, and installation of monitoring well MW-7, located at the northern margin of the OPWA (CDM Smith 2019). Analytical results indicated an elevated mercury concentration in subsurface soil in a sample collected during the 2013 MW-7 monitoring well installation. Mercury concentrations at MW-7 dropped to background levels in samples collected deeper than 2.5 feet, suggesting that soil impacts at this location were of limited vertical extent. The lateral extent of the OPWA was further investigated during a site-wide tailings delineation conducted in August 2016. The affected area was delineated using field observations of the characteristic gray, silty, ash-like material and through in situ XRF surface soil field screening (CDM Smith 2018e). The 2016 site-wide tailings delineation also identified the OPWA as containing the highest in situ XRF field screening results for mercury and arsenic concentrations in surface soil within the Furnace Creek area (CDM Smith 2018e). Data gaps related to the extent of contaminated soil at the OPWA were addressed during a focused soil investigation conducted in September 2018 (CDM Smith 2018a). The additional in situ XRF field screening conducted during the September 2018 site investigation revealed surface soil concentrations of mercury up to 5,095 mg/kg and arsenic concentrations of up to 1,724 mg/kg. The methods and results of the investigations of the OPWA were presented in a technical memorandum to EPA on November 20, 2018 (CDM Smith 2018a).

The OPWA location also contained the highest total mercury concentration reported within the Garoutte Creek alluvial groundwater system, observed at MW-8. Groundwater analytical results for MW-8 were 117 nanograms per liter (ng/L) for total mercury, approximately 30 times higher than the background groundwater concentration, and results for dissolved mercury were 180 ng/L, exceeding the background concentration by approximately 150 times. Low levels of methylmercury were also detected at MW-8 (CDM Smith 2018e).

Based on the areas within the OPWA identified during the site investigations as containing high mercury and arsenic concentrations, EPA determined that a removal action was necessary at the OPWA. The 2019 site work was performed as designed by the OPWA implementation plan provided by the EPA Remedial Program (CDM Smith 2019).

8.1.2 Cultural Resources Survey and Report

E & E subcontracted with AAR of Portland, Oregon, to conduct a cultural resources survey of the OPWA removal area and produce a findings report prior to any earth-disturbing work. AAR conducted the field survey on June 17, 2019. The survey supplemented the 2018 Cultural Resources Report and focused on areas of the site that were not previously included in the 2018 survey area that would be impacted by the 2019 OPWA removal activities. AAR concluded that the OPWA portion of the site affected by the 2019 removal activities does not contribute to the potential significance and eligibility of the site to be listed on the National Register of Historic Places. Appendix B contains the 2019 Cultural Resources Report prepared by AAR. The report contains a State of Oregon Archaeological Site Record form, which was submitted to the State Historic Preservation Office by AAR.

8.1.3 Site-Specific Sampling Plan

SSSPs for air monitoring and soil excavation were produced for the 2019 OPWA removal activities. These documents are included in Appendix C. The air monitoring SSSP described action levels for mercury vapor and dust particulates of 10 $\mu g/m^3$ and 400 $\mu g/m^3$, respectively. These values are for a sustained 10-minute exposure. The dust action level was based on site-specific mercury and arsenic concentrations from the OPWA, while the mercury vapor action level was based on the Agency for Toxic Substances and Disease Registry level for a residential setting. Personal air sampling followed methodology and implementation provided in the 2018 air monitoring SSSP.

The 2019 removal activities followed the same Field Decision Criteria for mercury and arsenic concentrations used during the 2018 NTCRA, including the target removal criteria, on-site borrow material criteria, and off-site borrow material criteria (see Table 4-1). Based on these criteria and the OPWA Implementation Plan (CDM Smith 2019), START prepared an SSSP for soil excavation during the 2019 removal activities. The soil SSSP provided direction for sampling, as well as in situ and ex situ XRF method requirements. The soil excavation sampling SSSP defined the main sampling areas as the OPWA Removal Action Area and the repository area. The SSSP contained additional guidance on the use of field screening tools and visual identification and field analysis of target removal soil to guide excavation. See Section 8.1.7 for further description of the removal criteria.

8.1.4 Mobilization and Site Layout

EPA, START, and ERRS mobilized to the site on Monday, July 8, 2019. Heavy equipment was received and ERRS commenced grading and clearing of the support zone to prepare the site for the work trailer and equipment. Prior to conducting clearing and grading activities, ERRS identified and protected the residence's water supply line, located along the south side of the main access road. The support zone was constructed using compacted gravel, and parking was provided for site personnel and visitors. Two START personnel mobilized with equipment, including the EPA Region 10 Comms Rig, a 20-foot cargo trailer, and field analytical equipment including a Lumex MVA, two field portable XRF instruments, and a Jerome 505 MVA. The Comms Rig was stationed next to the work trailer, and a satellite connection was acquired, providing internet and telephone access in the support zone. Additional ERRS personnel mobilized to the site on Tuesday, July 9, 2019.

The support zone included one work trailer, a CONEX box used for auxiliary storage, the Comms Rig, and the START equipment trailer. Bathroom facilities and hand wash stations were made available for the duration of the removal action. The support zone area is depicted in Figure 8-1.

From July 9–13, 2019, ERRS received delivery of 1.5-inch minus gravel for road and staging area protection. ERRS also received delivery of loam topsoil and 6-inch riprap July 15–20, 2019, with an additional delivery on July 25 of additional 6-inch rock armor for the Old Furnace area repair and restoration activities in Furnace Creek.

8.1.5 Health and Safety Air Sampling/Monitoring

START conducted health and safety air sampling and monitoring during the duration of site activities. Air sampling and monitoring activities are detailed herein.

8.1.5.1 Personnel Air Sampling

START collected nine air samples from two ERRS equipment operators conducting site activities within the active site clearing and grubbing, excavation, and repository working areas. Samples were collected on July 9, 10, and 11, 2019. Three samples were analyzed for mercury vapor, three for mercury in particulates, and three for arsenic in particulates. Samples were sent to the off-site subcontract laboratory for analysis with a 48-hour turnaround time. Personnel air sampling analytical results are presented in Table 8-1. Results of these samples showed that personnel exposure to airborne mercury particulates, mercury vapor, and arsenic did not exceed allowable exposure limits. Most sample results were reported as non-detections, and mercury vapor was only detected in one sample below the site action limit on July 11, 2019. The single mercury vapor detection was associated with excavator operations occurring within the Upper/South section of the OPWA. See Section 8.1.7 for a discussion of excavation activities and soil sampling results within the OPWA Removal Area.

8.1.5.2 Air Monitoring Stations

START conducted particulate monitoring utilizing DustTrak instrumentation. DustTraks were deployed at the command post (air station CP), repository (air station RP), and excavation zones (air stations MW7 and EXC). The DustTrak data from the air stations was downloaded at the end of each day. While airborne particulate concentrations tended to increase during periods of warmer and dryer weather conditions, the daily time-weighted averages remained lower than the site action level of 400 $\mu g/m^3$. See Figures 8-1, 8-2, and 8-3 for the locations of the air monitoring stations.

START regularly monitored for mercury vapors in the excavation area using the Jerome J505 MVA. The results indicated occasional detections of measurable mercury vapors associated with tailings and other waste materials, but sustained readings were lower than site action level of 10 $\mu g/m^3$. START also used the Jerome J505 MVA to periodically monitor the command post and support zone areas for mercury vapor. The results were well below the site action level.

8.1.6 Clearing and Grubbing

ERRS began to prepare the site during the week of July 8, 2019, by clearing and grubbing the support zone areas, haul roads, repository area, and the OPWA removal area. Clearing and grubbing of the site included removal of unwanted surface material, such as trees, brush, grass, weeds, and downed trees. Small trees were hauled to an on-site chipper for use as mulch later. Larger trees were stockpiled and retained for restoration purposes. The woody debris was temporarily staged along the lower access road near the wood chipper. ERRS prepared the existing repository on July 8 and 9 so that it could receive excavated material from the OPWA. START marked out the bounds for clearing and grubbing of the Lower and Upper areas of the OPWA removal area based on field flagging and figures from CDM Smith. ERRS conducted clearing and grubbing of the Upper/South OPWA area from July 9–10 and of the Lower/North OPWA area on July 13. See Figures 8-1 and 8-2 for the locations of the work zones.

ERRS used the water truck to provide dust control prior to clearing and grubbing, and continued to maintain dust control on the access roads as needed. START conducted air monitoring with DustTraks and collected personal air samples. START conducted mercury vapor monitoring at the breathing zone in the excavation workspace, stockpiled root wads, and around the wood chip workspace. Mercury vapor readings did not exceed the action level (10 $\mu g/m^3$) at the breathing zone, with average readings of 0.0 $\mu g/m^3$ to 0.01 $\mu g/m^3$, with un-sustained peak readings of 5 to 7 $\mu g/m^3$ in the cleared and grubbed area during clearing. Direct mercury vapor screening of the in situ ashy material located at the upper extent of the Upper/South OPWA area reported peak readings of 21 $\mu g/m^3$, when monitored approximately 1 inch above the ground surface. A high resolution (30 second) sample period was conducted at approximately waist level above the high-concentration ashy material, with a reported result of 1.82 $\mu g/m^3$, below the action level of 10 $\mu g/m^3$.

While monitoring the root wad material staged at the wood chip workspace, START recorded mercury vapor concentrations as high as 7 $\mu g/m^3$. The peak mercury vapor readings of 7 $\mu g/m^3$ were recorded when directly monitoring the root ball from a conifer tree with visible gray ash adhered to the root system. START also conducted XRF field screening of the ashy material on the root wad, with XRF results ranging between 1,000 to 2,500 mg/kg for mercury.

8.1.6.1 Repository Grading

During clearing and grubbing activities, ERRS also graded and prepared the repository area to receive additional material to be excavated from the OPWA removal area. ERRS cleared and graded an area to the east and southeast of the repository to increase the available footprint of the repository. Increasing the repository size was necessary to accommodate the staging and placement of the additional material anticipated to be created during excavation activities for the OPWA removal activities.

8.1.7 OPWA Excavation and Waste Removal

8.1.7.1 Removal Criteria

The principal goals of the 2019 removal activities were to stabilize, remove, and/or contain tailings and the ash-like material with high concentrations of contaminants within the OPWA to reduce potential off-site migration of mercury in surface water and sediment discharging to the CFWR watershed. The Field Decision Criteria for mercury and arsenic concentrations remained the same as in the 2018 NTCRA actions, including the target removal criteria, on-site borrow material criteria, and off-site borrow material criteria (see Table 4-1). The primary objective of the OPWA NTCRA was to remove contaminated material from the areas containing the highest concentrations of mercury, and not necessarily to fully achieve the removal criteria. The field monitoring removal criteria for excavation and removal of contaminated materials were based on the following performance metrics identified in the OPWA Implementation Plan (CDM Smith 2019):

- Visual confirmation: No visual evidence of the gray, silty, ash-like material associated with high mercury concentrations. Native soils and tailings have distinct color and texture differences when compared to this material.
- Analytical confirmation: Confirmation of contaminated soils removal to the recommended field screening decision criteria (see Table 4-1) using an in situ XRF analyzer or other reliable tool (e.g., Lumex MVA).

8.1.7.2 Excavation and Removal Activities

ERRS conducted excavation and removal activities at the Upper/South OPWA unit from July 11–12, 2019, and excavation and removal activities at the Lower/North OPWA unit were conducted and completed on July 13, 2019. A field engineer from CDM Smith was on site July 11, 2019 to provide additional guidance for the removal and design action. During the site July 11 site visit, a slope failure was observed at the upgradient extent of the Adit Creek seep in the BS01 borrow source area. Repairs conducted on the Adit Creek seep slope failure are discussed in Section 8.2.1.

The OPWA removal area boundaries were delineated based on results from the September 2018 focused soil investigation, including field observations of the characteristic gray, silty, ash-like soils, detected field screening concentrations, and comparison of contaminant concentrations to surrounding soils (CDM Smith 2018a). The total area of the Upper/South excavation area was approximately 9,750 square feet (ft^2), and the Lower/North excavation area was approximately 5,235 ft^2. ERRS utilized excavators to remove contaminated material based on in situ XRF readings and visual observations, and excavated material was direct-loaded into the haul truck and transported to the on-site repository (Figure 8-1). As material was placed on the repository, ERRS used a bulldozer to shape and grade the material to allow continued placement of excavated material while maintaining a stable slope. ERRS used a water truck for dust control for the site, including along the access and haul roads, the repository and support areas, and active excavation locations. The water truck was refilled at the Cottage Grove Lake in coordination with the United States Army Corps of Engineers. As described in Section 8.1.5, START conducted air sampling and monitoring during daily removal activities. START conducted air monitoring for particulates with DustTraks and mercury vapor monitoring with the Jerome J505 MVA field instrument. Mercury vapor in the breathing zone did not exceed the site action level.

After ERRS completed clearing and grubbing the OPWA areas, areas with visible gray ashy material intermixed with native soils were observed. START assisted ERRS with visual observations during excavation and removal activities, and START also monitored concentrations of mercury and arsenic with in situ XRF analysis. Based on in situ XRF readings and visual observations, ERRS excavated approximately 2 feet down to a native clay layer, where mercury readings were non-detect and arsenic levels were below the action level of 100 mg/kg. Discretion was used in the field during excavation to remove highly contaminated material to the extent practicable, under direction of the OSC, while still allowing for restoration of the area to a stable configuration. A shallow subsurface, low-flow (<1 gallon per minute (gpm)) seep was discovered during excavation activities on the north boundary of the Upper/South OPWA area.

In situ XRF concentrations of the contaminated material were well above action levels, with average soil concentrations ranging from 400 to 900 mg/kg for mercury and 200 to 500 mg/kg for arsenic. Peak in situ XRF results for the concentrated ash-like material were as high as 40,000 mg/kg for mercury and 8,000 mg/kg for arsenic. EPA directed ERRS to excavate and remove contaminated material to the extent practicable while maintaining stable slopes. A contaminated ashy material with in situ XRF readings ranging from 1,200 to 40,000 mg/kg mercury was encountered at the southern and upper extent of the Upper/South OPWA unit under a layer of red gravel tailings. This material was left in place to avoid removing additional gravel tailings and additional vegetation. Additional pockets of contaminated ashy material (in situ XRF = >6,000 mg/kg mercury) were exposed within the OPWA removal areas, including on the steep right bank of the Upper/South OPWA unit (looking downhill), as well as the swale area located on the south border of the Lower/North OPWA unit.

Excavation of the OPWA areas and placement of the excavated material in the repository was completed on July 13, 2019. The conifer tree root wad with visible gray ash (with mercury vapor readings of up to 7.0 μg/m^3 and XRF results ranging between 1,000 to 2,500 mg/kg mercury) was placed on the repository to contain the contamination. The following table summarizes the quantities of excavated material hauled and placed in the repository:

Excavation Area	**Haul Quantities (loose CY)**
Upper/South OPWA Unit	850
Lower/North OPWA Unit	675
Total	1,525

START collected a total of three 5-point composite samples from the repository area that received excavated OPWA waste material. One composite sample was collected each day to characterize the material placed in the repository. All samples were analyzed for mercury and arsenic via ex situ XRF. Upon completion of excavation within the OPWA removal area, START also collected a total of six 5-point composite samples from the final leave surface of the OPWA removal area, including one field duplicate sample. The OPWA removal area was divided into DU areas of 2,500 to 3,200 ft^2. Four samples (including one field duplicate) were collected from three DU areas of the Upper/South excavation area, and two samples were collected from two DU areas of the Lower/North excavation area. All of the OPWA removal area samples were analyzed on site for mercury and arsenic via ex situ XRF and were also sent off site for laboratory analysis. All of the leave surface samples collected from the OPWA removal area exceeded the target removal criteria for mercury (20 mg/kg; see Table 4-1). The target removal criteria for arsenic was not exceeded for any of the OPWA removal area sample results. Table 8-2 presents the ex situ XRF and laboratory analytical results for the OPWA removal area. Table 8-2 also presents the ex situ XRF results for the expanded repository area.

The expanded repository section that received the waste excavated from the OPWA was covered with material from the temporary residential stockpile in the North Laydown Area. This material from the Fall 2018 residential removal was deemed suitable as a repository cover material because the concentrations of mercury and arsenic were lower (see Section 7.2.1 and Table 7-3) than the more contaminated material from the OPWA that was placed in the repository. After the expanded section of the repository was covered, the remainder of the soil from the temporary stockpile was blended into the topography of the North Laydown Area.

On July 16, 2019, representatives from the EPA Remedial team, ODEQ, and United States Coast Guard visited the site to observe the progress of the 2019 removal activities. During the July 16 site walk, a slope failure was observed by EPA at STA 1+00 below the Old Furnace location, located along the right bank of the Furnace Creek removal area. Repairs conducted on the Old Furnace slope failure area are discussed in Section 8.2.2.

8.1.8 OPWA Restoration

ERRS conducted restoration activities at the Upper/South OPWA excavation area from July 17–19, 2019, and restoration activities were conducted at the Lower/North OPWA area on July 23–24, 2019. The CDM Smith field engineer was on site July 17 and 18 to observe and provide direction for the restoration of the OPWA excavation area. EPA, ERRS, START, and the CDM Smith field engineer conducted a site walk on July 17 and discussed site restoration action operations based on the Remedial program design plans. Additionally, restoration options were discussed during the site walk regarding options to address the known locations of contamination left in place in the OPWA removal areas, including the upper boundary of the Upper/South excavation area. To address the contamination that was left in place, rock armor was placed on top of the contaminated sections to reduce the potential for erosion and off-site migration.

On July 19, EPA, ERRS, and START conducted a site walk to observe and discuss the final site work, including restoration of the OPWA excavation areas, as well as the site enhancement and repair areas, the borrow source Adit Creek seep slope failure area, and the Furnace Creek Old Furnace area slope failure. START conducted a survey of the grade in the OPWA Lower/South area using a laser level and confirmed the existing grade would provide shallow drainage.

ERRS constructed rocked channels along the center of the OPWA areas and along the observed seep on the right bank (looking downstream) of the OPWA Upper/South area. Clean topsoil was hauled from the borrow source area and placed in the OPWA removal areas excavated to bare mineral clay to amend the soil for revegetation. Additional clean backfill was imported from an off-site source. A mulch berm was placed around the entire perimeter of the excavated boundary and also along the edge of the rocked channels. Slash and logs were also placed along the restored surface. ERRS placed rock armor in steep lower section of the Upper/South OPWA where slopes exceeded 3:1. The toe of the right bank slope (bordering the lower access road) was anchored with approximately 35 linear feet of boulders, placed in a keyed-in trench.

The Lower/North OPWA area received backfill at a minimum depth of 6 inches. Additional backfill material was placed at a minimum 1-foot depth in areas where contamination was left in place, including along the cut bank located at the base of the Furnace Creek access road and along the banks and floor of the swale located on the south border of the Lower/North OPWA area. ERRS graded the Lower/North OPWA area to generally pre-existing conditions, creating a shallow basin across the north half of the Lower/North OPWA area to direct any surface flow away from the swale and back to the center of the Lower/North OPWA area, with a low outfall at the northwest edge. Both the access road crossing the spillway down into the Lower/North OPWA area and the low outfall from the Lower/North OPWA area were protected with a layer of the 6-inch rock armor. A mulch berm was placed around the upgradient perimeter sections of the excavated boundary along the access road.

8.2 Furnace Creek Area Enhancements and Repairs

Following the completion of construction activities for the 2018 Furnace Creek area NTCRA, post-construction site visits and wet season surface water monitoring inspections were conducted. CDM Smith conducted two post-construction site visits in September and December 2018, and three wet season surface water monitoring events were conducted in February and April 2019. During these inspections, the following issues related to performance and implementation of the Furnace Creek area NTCRA were identified:

- Erosion damage caused by drainage was observed along the hydroseeder access road at the BS01 borrow source area.
- Insufficient grade along the constructed re-route of the Adit Creek drainage channel near the southeast edge of the repository was causing stormwater to back up and overtop the constructed banks, and subsequently flow into the repository stormwater channel and into the repository retention pond, overtopping the retention pond. The excessive surface water runoff from the repository area flowed downgradient along the main access road and onto the secondary driveway of the residence during heavy precipitation. Combined site runoff along the main access road most likely included overflow from the repository retention pond, as well as shallow subsurface flow from the hillslope located between the Black Butte Mine site and the residence.

In addition to these enhancements, EPA also repaired the following issues identified during the July 11 and 16, 2019 site visits:

- A slope failure at the upgradient extent of the Adit Creek seep in the BS01 borrow source area. Repairs conducted on the Adit Creek seep slope failure are discussed in Section 8.2.1.
- A slope failure at STA 1+00 below the Old Furnace location, located along the right bank of the Furnace Creek removal area. Repairs conducted on the Old Furnace slope failure area are discussed in Section 8.2.2.

The site enhancements and repair areas are depicted in Figure 8-1 and Figure 8-3.

8.2.1 Borrow Source Slope Failure Repair Activities

ERRS conducted repair activities at the BS01 borrow source Adit Creek seep slope failure area from July 19–22, 2019. The left and right bank slopes appeared to experience failure as a result of saturated soil conditions, causing the migration of material downgradient along the native clay layer of the borrow source slope as well as into the rock-armored channel of Adit Creek constructed in 2018.

ERRS cleared and grubbed vegetation located upgradient of the right bank slope, and then excavated and pushed the top of the bank grade to a 2:1 slope. To anchor the toe of the steep right bank, ERRS constructed a trench along the toe and keyed in a line of boulders. The saturated left bank material was then excavated and then backfilled with competent (unsaturated) material from the right bank area of the borrow source, and then ERRS compacted and graded it to a stable slope. Graded areas were protected with a layer of 6-inch armor, and then a 4-inch layer of mulch and topsoil mixture was compacted on top of the rock armor to encourage revegetation. Slash and logs were then placed on top of the stabilized slope.

Groundwater from the Adit Creek seep appeared to be perched on top of the native clay layer of the borrow source slope, and subsurface flow was observed to be concentrated within the saturated topsoil layer and at the clay-topsoil interface. To capture and divert the flow away from the slope, left and right bank channels were constructed to re-direct the flow into the existing Adit Creek center channel. The channels were constructed by trenching into the clay subsurface to an approximate depth of 18 inches, and a clay berm was placed on the down-slope bank of each respective channel. ERRS then placed a layer of the 6-inch rock armor to line the constructed channels. As each section was completed and construction moved downslope, ERRS placed slash and logs across the final slope. ERRS hauled approximately 200 CY of excavated borrow source material away from the borrow source area, and staged the material near the upper Furnace Creek entrance area to be used as backfill for the OPWA restoration activities.

8.2.2 Furnace Creek Old Furnace Area Repair Activities

ERRS conducted repair activities from July 24–25, 2019 to address the slope failure at the Furnace Creek removal area located along the right bank near STA 1+00 and below the Old Furnace location. START conducted in situ XRF analysis of the exposed face, with reported mercury concentrations ranging from 1,500 mg/kg to greater than 3,300 mg/kg. CDM Smith was on site July 18, 2019 to observe the slope failure areas in the Furnace Creek and borrow source locations.

On July 23, 2019, ERRS excavated an exploratory test pit at the upstream extent of the Old Furnace area slide. The test pit was placed at the toe of the slope failure along the right bank of Furnace Creek, near STA 0+70, and a few feet downgradient from the terminus of the set of three RCV features. The test pit was excavated to approximately 18 inches below top of bank. The test pit extended approximately one foot down into the restored Furnace Creek clay-backfilled channel bed, and the cut face also exposed the restored Furnace Creek topsoil-backfilled sloped banks, which proved to be unstable and sloughed off into the test pit. Saturated soils and groundwater were encountered in the test pit at the approximate elevation of the bed of the adjacent Furnace Creek channel, and low-flow discharge (0.5 to 1 gpm) was observed from the lower RCV into the exposed channel. The OSC relayed the saturated soil and high groundwater information to the CDM Smith design team for consideration in their final recommended repair design.

CDM Smith designed and delivered a repair plan on July 23, 2019. The CDM Smith design called for over-excavation of soils at the toe of the failed slope and the installation of a rock buttress installed into a key trench along the toe of the slope, backfilled with compacted 6-inch angular rock. The key trench design called for an installed depth of 3.5 feet below the channel top of bank and a width of 10 feet into the slope bank. The CDM Smith design plans are included in Appendix G.

A CDM Smith geologist arrived on site on July 24, 2019, to provide guidance and observe the implementation of the Old Furnace slope failure repair design. ERRS began the repair activities by first removing the layer of 6-inch rock armor from the repair area. The failed bank material overburden was then excavated to reduce pressure above the proposed trench area and to decrease the potential of the upslope trench wall collapsing. Starting at the downgradient end, ERRS excavated and constructed the trench in two section lengths at an average width of 5 feet. The trench was excavated to an average depth of 3 feet on the Furnace Creek channel face of trench. The saturated material excavated from the Old Furnace repair area was hauled and placed at the accessible end of the repository. ERRS backfilled and compacted the trench with a minimum 12-inch lift of the 6-inch rock, then lined the channel-side edge of the trench with 24- to 36-inch boulders. ERRS then placed an 18-inch layer of 8- to 14-inch rock across the extent of the excavated slope, from the top of the disturbed area down to the boulder toe, and compacted it into the slope surface to create a drainage layer. A second tier of boulders was then placed along the toe, arranged approximately half a boulder height above the first line of boulders and anchored behind the first tier of boulders. ERRS then placed borrow source backfill material in 6-inch lifts to bring the slope back to the original restored grade.

Groundwater seeps were encountered in several sections, both on the face of the bank slope at the downstream extent of the repair area near STA 1+50, and at the upstream extent of the slope-toe anchor trench near the STA 0+70 RCV feature. Saturated clay located at the downstream extent of the excavated trench was over-excavated an additional 12 to 18 inches to reach consolidated material competent to receive the slope-toe anchor backfill. ERRS placed and compacted additional 6-inch rock armor in this section of the trench to bring it to grade with the other sections of the backfilled trench. Saturated trench wall and floor substrate at the upgradient extent of the trench near the RCV feature was over-excavated until reaching competent, consolidated material. Excavation extended several inches into the consolidated native, darker silt material intermixed with fine gravel, which appeared to coincide with the elevation of the groundwater intrusion. Groundwater rapidly infiltrated in the backfilled trench at approximately 2- to 3-gpm, and overflowed the downstream toe of the trench into the Furnace Creek channel. ERRS placed a gravel pack of 1.5-inch-minus gravel along the length of the trench to act as a sediment filter for the piping groundwater exiting the trench at the stream channel interface, due to concern of potentially-contaminated groundwater from the native silt material free-flowing into Furnace Creek.

Final repair restoration activities included replacing the 6-inch rock armor along the bank slope, repairing sections of the Furnace Creek channel disturbed by excavator and haul truck activities, and replacing mulch and straw wattles. The CDM Smith-recommended buttress key trench depth of 3.5 feet was achieved within a minimum 85% depth (3.0 feet), or was exceeded, by the final field-fit trench. The width of the key trench was 5 feet, or one-half the CDM Smith design-recommended width. The length of the repaired area extended 37 feet along the Furnace Creek channel, and 20 feet from the edge of bank up to the top of the slope failure.

8.2.3 Furnace Creek Area Site Drainage and Adit Creek Reroute Grade Improvements

On July 16, 2019, ERRS re-routed approximately 120 linear feet of Adit Creek around the repository to improve drainage and flow. Work on the Adit Creek re-route included improving the channel grade, widening the channel, and increasing the height of the berm along the left bank. START checked the slope over the length of the improved channel with a laser level and confirmed that the slope was a constant 2% grade, with a fall of 2.5 feet over the approximate 120-foot run.

From July 22–23, 2019, ERRS installed water bars across the access road between the borrow source and the lower gate to address the surface water runoff during heavy precipitation along the main access road and onto the secondary driveway of the residence. ERRS placed a total of nine water bars between the borrow source and the residence. ERRS also constructed a stormwater ditch along the west side of the repository to capture surface flow from the borrow source road and direct it into the vegetation located downslope of the retention pond and to prevent surface flow run-on into the repository stormwater conveyance system and retention pond.

8.3 Demobilization

ERRS decontaminated and prepared equipment for demobilization on July 25 and 26, 2019. ERRS and START demobilized from the site on July 26, 2019. START collected GPS coordinates of the final restoration and repair work features. All remainders of the soil samples collected from the repository and OPWA leave surfaces were disposed of within the repository. START returned equipment to the Portland Logistics Center, and returned the remaining equipment and vehicles to Seattle Logistics Center. The remainder of the ERRS rental equipment was taken off site by August 3, 2019. An ERRS subcontractor applied hydroseed to restored and repaired areas in the fall of 2019, including the OPWA removal areas, the expanded section of the repository, the Furnace Creek Old Furnace repair area, the repaired areas of the BS01 borrow source, and the regraded North Laydown Area. The hydroseed application was the final site restoration action related to the planned removal activities.

8.4 Final Site Survey

ERRS subcontracted a licensed land surveyor to record post-removal site features to serve as a final record of the NTCRA. The survey subcontractor and EPA, ERRS, and START mobilized to the site on October 21, 2019. A site walk was conducted to orient the survey crew with the site features to be recorded. Appendix H contains the post-removal final record drawings survey.

Table 8-1 OPWA Removal Personnel Air Sampling

Sample ID	Location ID	Sub Location	Sample Date	Compound Specific Action Level (mg/m^3)	Result (mg/m^3)	Volume (L)
Arsenic as Particulates						
19072002	OPWA_WC01_P_As	Mini-excavator/Wood Chipper	7/9/2019	0.002	0.000187 U	400.9
19072010	OPWA_EXC02_P_As	Excavator/OPWA Area	7/10/2019		0.000148 U	505.26
19072018	OPWA_RP01_P_As	Dozer/Repository	7/11/2019		0.000131 U	572.56
19072005	OPWA_QC02P_As	Blank	7/9/2019		0.0750 U	--
19072011	OPWA_QC05P_As	Blank	7/10/2019		0.0750 U	--
19072021	OPWA_QC10P_As	Blank	7/11/2019		0.0750 U	--
Mercury as Particulates						
19072001	OPWA_EXC01_P&V_Hg	Excavator/OPWA Area	7/9/2019	0.005	0.000969 U	51.56
19072009	OPWA_WC02_P&V_Hg	Mini-excavator/Wood Chipper	7/10/2019		0.000830 U	60.26
19072017	OPWA_EXC03_P&V_Hg	Excavator/OPWA Area	7/11/2019		0.000750 U	66.63
19072004	OPWA_QC01P_Hg	Blank	7/9/2019		0.0500 U	--
19072012	OPWA_QC06P_Hg	Blank	7/10/2019		0.0500 U	--
19072019	OPWA_QC09P_Hg	Blank	7/11/2019		0.0500 U	--
Mercury Vapor						
19072001	OPWA_EXC01_P&V_Hg	Excavator/OPWA Area	7/9/2019	0.01	0.000441 U	51.56
19072009	OPWA_WC02_P&V_Hg	Mini-excavator/Wood Chipper	7/10/2019		0.000377 U	60.26
19072017	OPWA_EXC03_P&V_Hg	Excavator/OPWA Area	7/11/2019		**0.00200**	66.63
19072003	OPWA_QC01V_Hg	Blank	7/9/2019		0.0227 U	--
19072013	OPWA_QC06V_Hg	Blank	7/10/2019		0.0227 U	--
19072020	OPWA_QC09V_Hg	Blank	7/11/2019		0.0227 U	--

Key:

Bold - Indicates the analyte was detected above the method reporting limit
-- - Not applicable
ID - Identification
L - Liter
mg/m^3 - milligrams per cubic meter
U - The analyte was not detected at or above the method reporting limit

Table 8-2 OPWA Removal Action Analytical Results

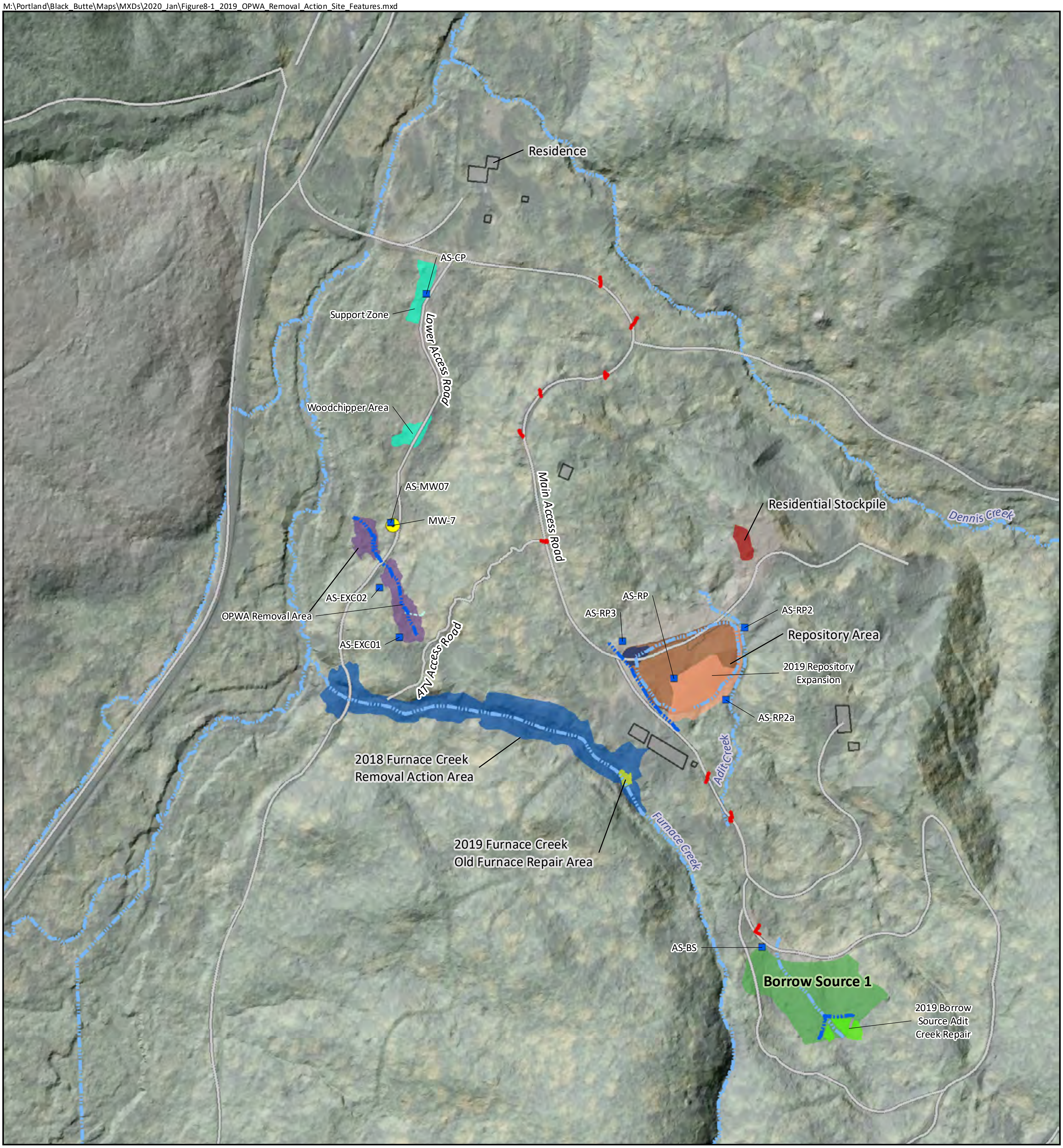
Sample ID	Location	Location Description	Depth Samples (ft bgs)	Sample Date	Sample Event	Mercury (mg/kg)		Arsenic (mg/kg)	
						XRF (EPA Method 6200)	Fixed Lab (EPA Method SW7471B)	XRF (EPA Method 6200)	Fixed Lab (EPA Method SW6010C)
OPWA Removal Area Leave Surface									
19072101	DU-L1	OPWA Lower/North Unit	0 to 0.5	7/15/2019	Post Removal Composite	**34.8**	**30.2**	46.2	35.3
19072102	DU-L2	OPWA Lower/North Unit	0 to 0.5	7/15/2019	Post Removal Composite	**78.7**	**50.9**	54.5	50.1
19072103	DU-U1	OPWA Upper/South Unit	0 to 0.5	7/15/2019	Post Removal Composite	**177**	**132**	65.15	43.4
19072104	DU-U2	OPWA Upper/South Unit	0 to 0.5	7/15/2019	Post Removal Composite	**67**	**62.5**	68.9	53.1
19072105	DU-U3	OPWA Upper/South Unit	0 to 0.5	7/15/2019	Post Removal Composite	**93**	**99.6**	76	64.3
19072106	DU-U3 (field duplicate)	OPWA Upper/South Unit	0 to 0.5	7/15/2019	Post Removal Composite	**122**	**87.3**	83.15	57.5
OPWA Excavated Material Placed in Repository Expanded Area									
RP-01	Repository	OPWA Expanded Repository Area	0 to 0.5	7/12/2019	Daily Composite	531	--	151.8	--
RP-02	Repository	OPWA Expanded Repository Area	0 to 0.5	7/13/2019	Daily Composite	314	--	124.9	--
RP-03	Repository	OPWA Expanded Repository Area	0 to 0.5	7/15/2019	Daily Composite	242	--	93.95	--

Results exceeding target removal criteria are bolded.

KEY:

-- - Not applicable
bgs - below ground surface
EPA - United States Environmental Protection Agency
ft - feet
ID - Identification
mg/kg - milligrams per kilogram
XRF - X-Ray flourescence

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure8-1_2019_OPWA_Removal_Action_Site_Features.mxd



Air Monitoring Station
Monitoring Wells
Road
Stream
Seep
Constructed Drainage Path
Water Bar
Keyed-In-Boulders
2018 Furnace Creek Removal Action Area
Residential Stockpile
2019 Borrow Source Adit Creek Repair
2019 Furnace Creek Old Furnace Repair
2019 Repository Expansion
2019 Support Zone
Ore Processing Waste Area (OPWA) Removal Area
Stormwater Retention Pond
Expanded Repository Area
Borrow Source
Building

N

0 50 100 200
Feet

Figure 8-1.
2019 NTCRA Site Features

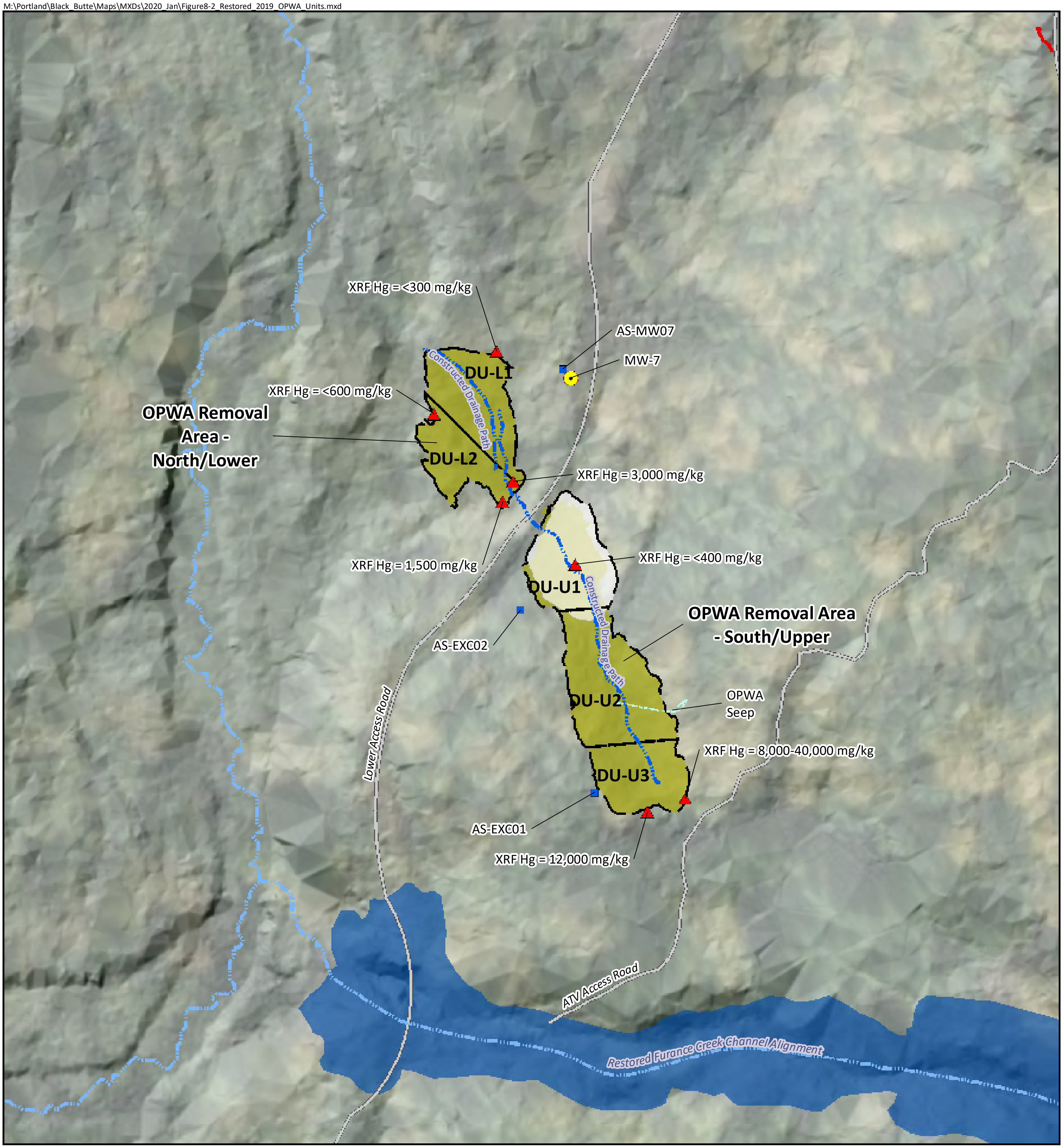
Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure8-2_Restored_2019_OPWA_Units.mxd



Air Monitoring Station
Contaminated Material Left In Place
Monitoring Wells
Road
Stream
Seep
Constructed Drainage Path
Water Bar
Rock Armor
Hydroseed
Furnace Creek Removal Action Area

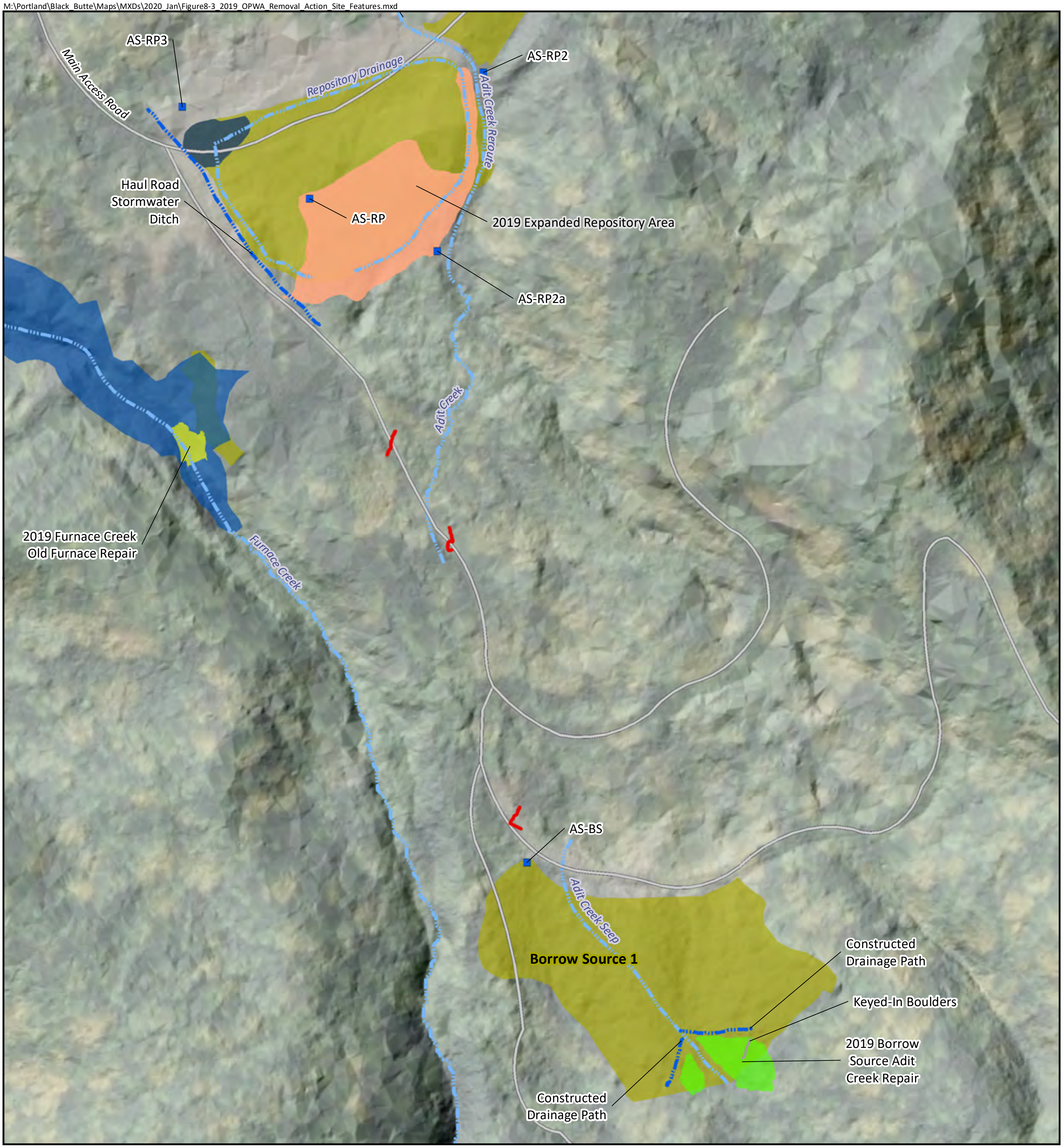
N

0 25 50 100
Feet

Figure 8-2.
Restored 2019 NTCRA Site Features: OPWA Units
Black Butte Mine Removal Site
Lane County, Oregon
January 2020

ecology and environment, inc.
Global Environmental Specialists

M:\Portland\Black_Butte\Maps\MXDs\2020_Jan\Figure8-3_2019_OPWA_Removal_Action_Site_Features.mxd



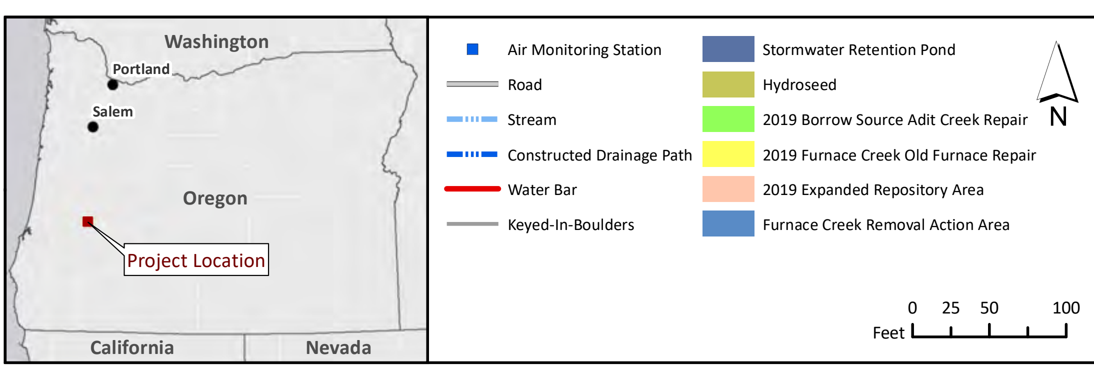


Figure 8-3.

2019 Furnace Creek Area Enhancements and Repairs

Black Butte Mine Removal Site

Lane County, Oregon

January 2020

ecology and environment, inc.
Global Environmental Specialists

9 Quality Assurance/Quality Control

Quality assurance (QA)/quality control (QC) data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware and reagents. Specific QC requirements for laboratory analyses are incorporated in the *USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods Multi-Media Multi-Concentration ISM02.4* (EPA 2016a) and the *USEPA Contract Laboratory Program Statement of Work for Organic Superfund Methods Multi-Media Multi-Concentration SOM02.4* (EPA 2016b). These QC requirements or equivalent requirements found in the analytical methods were followed for analytical work on the project. This section describes the QA/QC measures taken for the project and provides an evaluation of the usability of data presented in this report.

Data from the three START-subcontracted laboratories were reviewed by a START chemist. Data qualifiers and labels were applied as necessary according to the following guidance:

- EPA (2017a) *National Functional Guidelines for Inorganic Superfund Methods Data Review*.
- EPA (2017b) *National Functional Guidelines for Organic Superfund Methods Data Review*.
- EPA (2009) *Guidance for Labeling Externally Validated Laboratory Data for Superfund Use.*

  In the absence of other QC guidance, method- and/or SOP-specific QC limits were also utilized to apply qualifiers to the data.

Validation memoranda were prepared by the START Chemist for each laboratory report. Copies of the laboratory reports and validation memoranda are included as Appendix I.

9.1 Satisfaction of Data Quality Objectives

The following EPA (EPA 2000) guidance document was used to establish data quality objectives (DQOs) for this project:

- *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), EPA/600/R-96/055.

The EPA TM determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the field work produced sufficient data that met the DQOs stated in the SSSP (E & E 2018). A detailed discussion of accomplished project objectives is presented in the following sections.

9.2 QA/QC Samples

Trip blank QA samples were not required as no samples were collected for volatile organic compound analysis. Rinsate blank QA samples were collected at a rate of 1 per 20 samples collected using non-dedicated sampling equipment; there were no detections in the rinsate blank samples. QC samples included matrix spike/matrix spike duplicate (MS/MSD) and/or blank spike (BS) samples at a rate of one MS/MSD and/or BS per 20 samples per matrix.

9.3 Project-Specific Data Quality Objectives

The laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' and/or field team's abilities to meet project DQOs for precision, accuracy, and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratories and the field team were generally able to meet DQOs for the project.

9.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/MSD samples measure the precision of the analytical method. The RPD values were reviewed for all commercial laboratory samples. A total of 18 sample results (approximately 4.6% of the data) were qualified as estimated quantities based on precision outliers; therefore, the project DQO for precision was met.

9.3.2 Accuracy

Accuracy indicates the conformity of the measurements to fact. Laboratory accuracy is defined as the MS/MSD/BS percent recovery (%R) for all laboratory analyses. A total of 67 sample results (approximately 17.0 % of the data) were qualified as estimated quantities (J) based on MS/MSD/BS outliers; therefore, the project DQO for accuracy of 90% was exceeded.

9.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All laboratory data were reviewed for data validation and usability. No sample results were rejected; therefore, the project DQO for completeness of 90% was met.

9.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or environmental condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQO for representativeness was met.

9.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this site followed applicable field sampling techniques and specific analytical methodology. The DQO for comparability was met.

9.4 Laboratory QA/QC Parameters

The laboratory data also were reviewed for holding times/temperatures/sample containers, laboratory and filter blank samples, and serial dilution analyses. These QA/QC parameters are summarized below.

9.4.1 Holding Times/Temperatures/Sample Containers

All holding times, sample temperatures, and containers were acceptable.

9.4.2 Laboratory and Filter Blanks

All laboratory and filter blanks met the frequency criteria. The following potential contaminants of concern were detected in the laboratory and/or filter blanks:

- Inorganics: mercury.

  See the data validation memoranda for results qualified based on blank contamination.

9.4.3 Serial Dilution Analyses

Serial dilution analyses met the frequency criteria. A total of nine sample results (approximately 2.4 % of the data) were qualified as estimated quantities (J) based on serial dilution outliers.

This page intentionally left blank.

10 Summary

EPA completed a NTCRA at the Furnace Creek area in OU1 of the Black Butte Mine Site near Cottage Grove, Oregon. The 2018 Furnace Creek area removal activities occurred between May and August 2018, and removal activities at the site residence occurred between September and October 2018. In July 2019, EPA returned to the site to perform additional removal activities at the Former OPWA and to make some enhancements and repairs to portions of the Furnace Creek removal action.

The BBM is a former mercury mine located in southern Lane County, in the CFWR basin, approximately ten miles south of Cottage Grove, Oregon. Cinnabar was discovered at what would become the Black Butte Mine circa 1890. Mining operations at the BBM began circa 1897 and continued intermittently through 1968. The Old Furnace was located near the right bank of Furnace Creek, and tailings from furnace operations were presumably disposed of downgradient of the furnace along the right bank and within the channel of Furnace Creek. It is presumed that the mercury-laden tailings within Furnace Creek were generated prior to 1919. The BBM property is currently owned by The Land and Timber Company, which has used the property surrounding the site for logging.

In 2007, EPA completed a TCRA at the site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek and consolidated on top of the Main Tailings Pile located on site to form a repository. Tailings left in place on the slope above the creek were stabilized to limit erosion. Additionally, tailings and soil with elevated mercury concentrations located at the Old Furnace and New Furnace were capped in place to limit mobility of contamination.

Continued monitoring of surface water and sediment after the 2007 TCRA, conducted by ODEQ and EPA, indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Source areas located within the Furnace Creek catchment, consisting of tailings and co-mingled contaminated soils and sediment, were determined to be the dominant sources of mercury migrating to Garoutte Creek (CDM Smith, 2018c).

Furnace Creek was not included in the scope of the 2007 TCRA. To address the source of mercury migrating to Garoutte Creek, EPA elected to perform a NTCRA within the Furnace Creek area of the site. The primary goal of the NTCRA was to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury, and high mercury concentrations in sediment, that were discharging from Furnace Creek to the CFWR watershed. EPA's Remedial Program completed an EE/CA for the Furnace Creek area of OU1, and the recommended removal alternative was the excavation of mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel (CDM Smith 2016).

Additionally, the EPA Remedial Program investigated mine tailings and metals contamination at the residence located at the base of the BBM property. The residence investigation concluded that arsenic and mercury concentrations on the property exceeded the site-specific action levels, and EPA recommended that removal activities be conducted at the residential property under the Furnace Creek NTCRA.

EPA and its contractors mobilized to the site in May 2018 to begin preparations for the NTCRA. The 2018 removal activities included these primary activities: excavation of the Furnace Creek area of OU1; restoration of Furnace Creek and areas of OU1 disturbed during the removal; and the residential removal. Field work for the Furnace Creek removal action was performed from May through August 2018. The Furnace Creek work area was cleared and grubbed, and topographic surveys of Furnace Creek were conducted to aid and direct restoration of the creek channel gradient post-excavation. Benchmarks for the survey stations were established along the length of the removal area of Furnace Creek. An on-site borrow source (BS01) was characterized as suitable as a source for clean fill, and the source area was cleared and developed as a soil borrow source. Trees cleared during site preparation work were hauled to an on-site wood-chipper and converted to mulch for use during the restoration phase.

Excavated waste from the Furnace Creek area was loaded into an on-site haul truck and transported to the existing on-site repository from the 2007 TCRA. Excavation and removal were guided based on visual observations of tailings, and with XRF and MVA field instruments. During initial excavation activities, contaminated material was determined to be present within the Furnace Creek channel at a much greater depth than originally characterized. Based on this discovery, excavation of the floor of the channel was conducted to a depth of six feet throughout the length of the removal area. The left bank was excavated until native material and/or soil met the NTCRA clean-up criteria, where feasible. The right bank was excavated to uncontaminated clean material where feasible, or the right bank was excavated down to a stable slope, leaving contaminated material in place. Additionally, contaminated waste material containing microbeads of elemental mercury, and waste with large amounts of building materials (e.g., bricks and dimensional lumber) with very high reported concentrations of mercury vapor (>100 $\mu g/m^3$), were located on the right bank of Furnace Creek within the vicinity of the Old Furnace. Approximately 50 CY of material containing microbeads and elevated mercury levels was excavated from this location and placed on a lined stockpile area located at the repository. This material was analyzed by SPLP and based on the results EPA decided that the material was acceptable for on-site disposal in the repository. By the end of the excavation phase, a total of 676 loads containing 13,117 loose CY of material had been hauled and placed in the on-site repository, including 50 CY of material containing elevated mercury concentrations, which was segregated and contained in polyethylene sheeting prior to placement within the top of the repository.

Following the removal of contaminated sediment and tailings in the creek channel, EPA restored the Furnace Creek channel. Original grade was determined based on benchmarks and elevations recorded during the pre-removal surveys, and clean clay material from the on-site borrow source was placed within the channel and compacted to original grade. A 1-foot wide by 1-foot deep center channel, with a 3:1 slope on either side of the center channel running up to the floodplain, was excavated to create a channel with a total width of approximately seven feet. Stream cobble was then placed to a depth of 1 foot in sections of the channel not exceeding a 20% grade, and RCVs were installed in series through sections of the channel that exceeded a 20% grade. Contaminated material left in-place along the banks and slopes was capped with clean fill. Slopes graded to a slope greater than 3:1 received rock armor, and slopes at a slope of 3:1 or less received topsoil and the hydroseed mix. Approximately 9,400 CY of clay backfill, and approximately 2,700 CY of topsoil, were hauled from the borrow source and placed in the Furnace Creek channel and on the slopes. The expanded repository was capped during the restoration phase with clean soil obtained from the on-site borrow source. All disturbed areas were hydroseeded in August 2018. EPA demobilized from the site in August 2018, leaving a stockpile of clean borrow source material in anticipation of the residential cleanup, and for potential repair work.

EPA returned to the site in September 2018 and conducted a sampling event to investigate the extent of contamination on the residential property. In October 2018, EPA and its contractors returned to the site and conducted excavation and removal activities of contaminated surface soil and shallow subsurface soil around the residence. The excavated contaminated residential material was placed in a temporary stockpile in the North Laydown Area. The excavated areas of the residence were backfilled with clean borrow material from an off-site source. Two mercury flasks declared by the property owner were also shipped off site for disposal.

EPA and its contractors returned to the site again in July 2019 and conducted removal activities at the OPWA area and enhanced and repaired sections of the Furnace Creek removal area. The OPWA removal activities included excavation and removal of contaminated soil in the OPWA area, followed by restoration of the removal areas. The excavated material was placed in the existing repository, which was expanded to accommodate the additional material excavated from the OPWA removal area. Restoration activities included grading the excavated areas to a stable slope, construction of an armored rock center channel for drainage, and placement of clean backfill material sourced from both the Furnace Creek borrow source area and an off-site source. The expanded repository was capped during the restoration phase with material from the residential removal temporary stockpile, and the remainder of the soil from the residential removal was graded and blended into the topography of the North Laydown Area and then hydroseeded.

The Furnace Creek removal area site enhancements conducted during 2019 addressed issues related to features installed during the 2018 removal action, including conveyance issues along the Adit Creek drainage channel near the southeast edge of the repository, and runoff and erosion issues along the main access road leading from the residence to the repository. EPA and its contractors also conducted repairs to issues discovered during the 2019 OPWA removal action, including repair of a slope failure on the right bank of the Furnace Creek channel below the Old Furnace section of the Furnace Creek removal area, as well as repair of erosion and mass wasting due to excess drainage from the Adit Creek seep at the BS01 borrow source area.

In October 2019, a licensed land surveyor subcontractor recorded the post-removal site features to serve as a final record of the NTCRA.

As the Black Butte Mine Site is an ongoing Superfund site, remedial investigations and monitoring will continue beyond the completion of this NTCRA.

This page intentionally left blank.

11 References

CDM Smith and EA Engineering, Science and Technology, Inc. (CDM Smith), 2019. *Draft Ore Processing Waste Area Plan for the Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine Superfund Site, Cottage Grove, Oregon*. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. May, 2019.

_____, 2018a. Memorandum: *Results of Field Investigation at the Former Ore Processing Waste Area, Black Butte Mine Superfund Site, Operable Unit 1*. From EA Engineering, Science, and Technology, Inc., PBC (EA), and CDM Federal Programs Corporation (CDM Smith). To: U.S. Environmental Protection Agency, Region 10. November 20, 2018.

_____, 2018b. Memorandum: *Addendum 2 to the Final Non-Time Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon*. From EA Engineering, Science, and Technology, Inc., PBC (EA), and CDM Federal Programs Corporation (CDM Smith). To: U.S. Environmental Protection Agency, Region 10. July 25, 2018.

_____, 2018c. Memorandum: *Addendum I to the Final Non-Time Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon*. From EA Engineering, Science, and Technology, Inc., PBC, and CDM Federal Programs Corporation. To: U.S. Environmental Protection Agency, Region 10. July 3, 2018.

_____, 2018d. *Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon.* Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. April, 2018

_____, 2018e. *Draft Remedial Investigation Report, Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon*. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. January 19, 2018.

_____, 2016. *Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon.* Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. July 22, 2016.

Ecology and Environment, Inc. (E & E), 2008. Memorandum: Hazard Ranking System Score, Black Butte Mine, Cottage Grove, Lane County, Oregon. To: Ken Marcy, Task Monitor, EPA Seattle, WA. From: Renee Nordeen, START-3 Project Leader, E & E, Seattle, WA. January 25, 2008.

_____, 2006. *Black Butte Mine Site, Removal Assessment Report, Lane County, Oregon, TDD: 06-01-0005.* Submitted To: Marc Callaghan, On-Scene Coordinator, United States Environmental Protection Agency, Region 10. 811 SW Sixth Avenue, Portland, Oregon 97204. March 21, 2006.

_____, 1998. *Black Butte Mine, Site Inspection Report. TDD: 98-04-0004.* Contract: 68-W6-0008. Submitted To: Mark Ader, Task Monitor, U.S. Environmental Protection Agency, 1200 Sixth Avenue, Seattle, WA 98101. April 1998.

U.S. Environmental Protection Agency (EPA), 2017, First Amendment to the Action Memorandum, including a Request for Exemption from, the 12-Month and $2 Million Statutory Limits on Removal Actions and an Increase in the Project Cost Ceiling for a Non-Time-Critical Removal Action for the Furnace Creek Area at Operable Unit 1 of the Black Butte Mine Superfund Site, Lane County, Oregon (SEMS IDNO.OR0000515759), September 13, 2017.

_____, January 2017a, *National Functional Guidelines for Inorganic Superfund Methods Data Review*, OLEM 9355.0-135, EPA-540-R-2017-001.

_____, January 2017b, *National Functional Guidelines for Organic Superfund Methods Data Review*, OLEM 9355.0-136, EPA-540-R-2017-002.

_____, 2016a, *USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods Multi-Media Multi-Concentration ISM02.4*. October 2016.

_____, 2016b, *USEPA Contract Laboratory Program Statement of Work for Organic Superfund Methods Multi-Media Multi-Concentration SOM02.4*. October 2016.

_____, 2016c. Memorandum: *Request to conduct and Engineering Evaluation/Cost Analysis (EE/CA) for the proposed Non-Time Critical Removal Action at the Black Butte Mine Superfund Site, Lane County, Oregon.* From: Dave Tomten, Remedial Project Manager, To: Cami Grandinetti, Program Manager, Thru: Beth Sheldrake, Unit Manager. January 7, 2016.

_____, 2012. *Optimization Review, Black Butte Mine Superfund Site, Lane County, Oregon*. Office of Solid Waste and Emergency Response. EPA 542-R-12-003. July 2012.

_____, January 2009, *Guidance for Labeling Externally Validated Laboratory Data for Superfund Use*, EPA-540-R-08-005.

_____, 2008. *Final Removal Action Report for Black Butte Mine, Cottage Grove, Oregon*. Prepared by Kathy Parker, On-Scene Coordinator, United States Environmental Protection Agency. July 20, 2008.

_____, 2000, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, Office of Research and Development, Washington, D.C., EPA/600/R-96/055. August 2000.

A Photographs

This page intentionally left blank.

Photo 1 View of staging area for equipment, mobile laboratory, communications truck, and field offices.

Direction: Northwest Date: 05/21/18 Time: 11:46 Taken by: BC

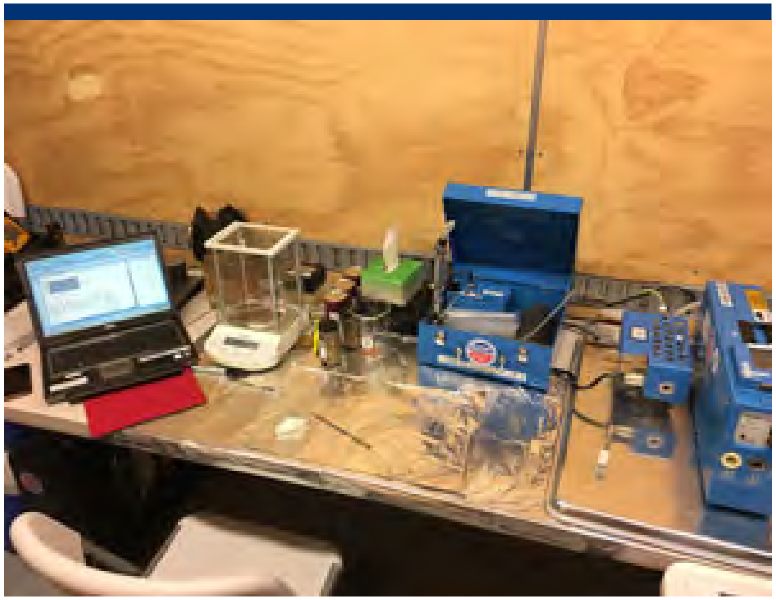


Photo 2 Mobile laboratory equipment and work area.

Direction: Interior View Date: 05/25/18 Time: 09:00 Taken by: VB

Photo 3 Looking upgradient along cleared and grubbed Furnace Creek channel towards Station 0+00.

Direction: Southeast Date: 05/22/18 Time: 14:28 Taken by: MF

Photo 4 Looking downgradient along cleared and grubbed Furnace Creek channel towards Station 5+00.

Direction: West Date: 05/23/18 Time: 07:33 Taken by: MF

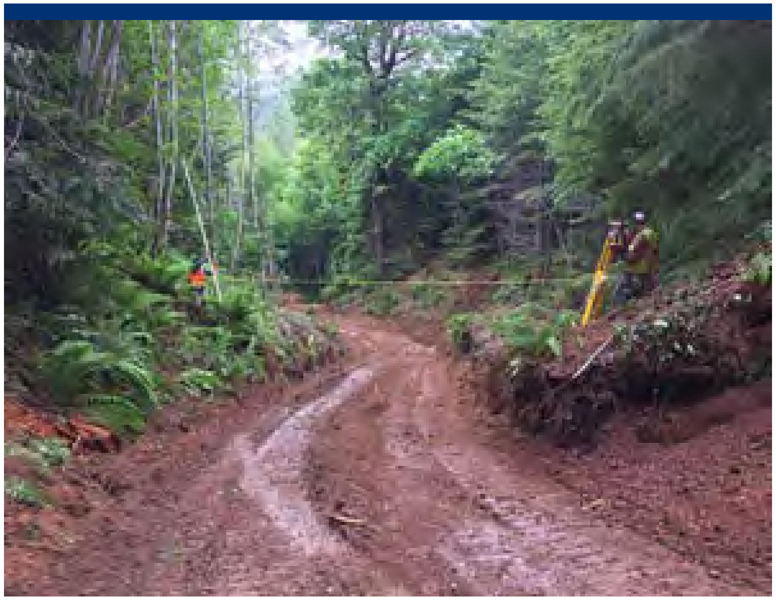


Photo 5 Pre removal, post clearing & grubbing, survey activities.

Direction: West Date: 05/25/18 Time: 11:24 Taken by: DB

Photo 6 Mulching operations of cleared woody material.

Direction: Northeast Date: 05/23/18 Time: 10:18 Taken by: BC

Photo 7 Borrow Source test pit sampling activities.

Direction: Down Date: 06/21/18 Time: 14:33 Taken by: SW

Photo 8 Subsurface soil sampling in Borrow Source 1.

Direction: Down Date: 05/22/18 Time: 13:00 Taken by: MF

Photo 9 Light gray ashy material in-situ at sample FC05SS location. Very high mercury concentration.

Direction: Down Date: 05/22/18 Time: 14:59 Taken by: MF

Photo 10 Light gray ashy material from sample FC05SS. Very high mercury concentration.

Direction: Down Date: 05/22/18 Time: 14:59 Taken by: MF

Photo 11 Pre removal, post clearing & grubbing, survey activities.

Direction: South Date: 05/25/18 Time: 11:58 Taken by: DB

Photo 1 In-situ screening of soil with XRF and ambient air monitoring with Jerome J505 within Furnace Creek Removal Area.

Direction: Down Date: 06/04/18 Time: 14:22 Taken by: JM

Photo 2 Viporized dust monitoring station near Furnace Creek removal activities.

Direction: Date: 06/05/18 Time: 11:53 Taken by: DB

Photo 3 Air monitoring for dust particulates with DustTrak at STA 5+50 LB.

Direction: North Date: 06/13/18 Time: 10:47 Taken by: MF

Photo 4 Removal activities utilizing benching near Station 1+50.

Direction: Down Date: 06/08/18 Time: 11:53 Taken by: JM

Photo 5 Test pit placed at STA 6+25, along left bank trench floor, revealing clay cap cover at 5 feet-plus deep.

Direction: Down Date: 06/12/18 Time: 13:31 Taken by: MF

Photo 6 Looking upstream at lower section excavation, starting at STA 6+50.

Direction: East Date: 06/12/18 Time: 14:05 Taken by: MF

Photo 7 Excavation and scraping of left bank to clean between STA 4+25 and 5+00.

Direction: Southwest Date: 06/14/18 Time: 16:13 Taken by: MF

Photo 8 Looking down at left bank and red tailings partially removed, from STA 5+00.

Direction: Southwest Date: 06/15/18 Time: 07:32 Taken by: MF

Photo 9 Looking upstream at partially excavated stream channel, and clean left bank, from STA 5+00.

Direction: East Date: 06/15/18 Time: 07:32 Taken by: MF

Photo 10 Tailings removal along right bank near station 3+50.

Direction: West Date: 06/16/18 Time: 07:48 Taken by: MF

Photo 11 Looking upgradient across completed channel excavation, to excavation activities at STA 3+00.

Direction: East Date: 06/16/18 Time: 11:34 Taken by: MF

Photo 12 Looking downgradient along excavated section of Furnace Creek from STA 2+00 and MW-10.

Direction: West Date: 06/19/18 Time: 14:00 Taken by: MF

Photo 13 Haul truck dumping excavated material at repository and dozer grading repository.

Direction: North Date: 06/19/18 Time: 15:20 Taken by: MF

Photo 14 Looking down ravine and collapsed culvert towards Garoutte Creek floodplain from STA 8+00.

Direction: West Date: 06/25/18 Time: 16:50 Taken by: MF

Photo 15 Excavator clearing left bank between STA 8+00 and 8+75.

Direction: West Date: 06/25/18 Time: 16:28 Taken by: MF

Photographed by: Bryan Ciecko (BC), Valeriy Bizyayev (VB), David Burford (DB),
Maren Fulton (MF), Manique Talaia-Murray (MTM), Seth Wing (SW),
Jake Moersen (JM), Tyler Chatriand (TC), Bryon Alexander (BA)

Photo 16 Looking up ravine and collapsed culvert at excavator and haul truck from Garoutte Creek floodplain from STA 9+00.

Direction: East Date: 06/27/18 Time: 17:03 Taken by: MF

Photo 17 Looking up at right bank and "hot" ashy material layer under tree near STA 8+75.

Direction: North Date: 07/09/18 Time: 08:40 Taken by: MF

Photo 18 Lined and covered waste material containing microbeads of mercury, staged adjacent to the repository. Air monitoring station near the well.

Direction: North Date: 06/11/18 Time: 08:02 Taken by: MF

Removal Phase (furnace creek, adit creek)

Photo 19 View from Station 2+00 looking upstream at deep removal section.

Direction: South Date: 06/08/18 Time: 13:08 Taken by: BC

Photo 20 Abandonment of monitoring well MW-11, adjacent to the repository.

Direction: Southwest Date: 06/21/18 Time: 09:05 Taken by: MF

Photo 21 Abandonment of monitoring well MW-10, adjacent to the STA 2+00.

Direction: Southwest Date: 07/13/18 Time: 10:05 Taken by: MF

Photo 22 Stream profile measurement system detail.

Direction: Down Date: 06/23/18 Time: 09:54 Taken by: MF

Photo 23 Stream profile measurement system near Station 3+00.

Direction: West Date: 06/23/18 Time: 12:51 Taken by: MF

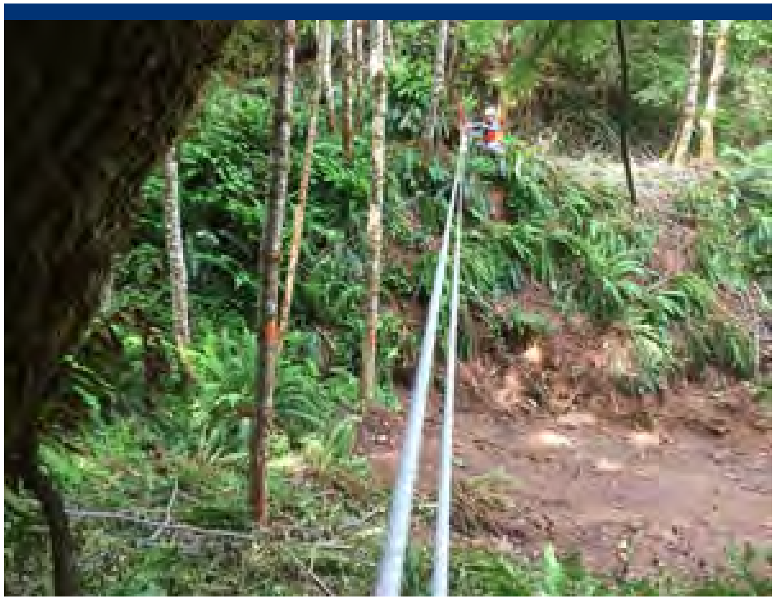


Photo 24 Stream profile measurement system at Station 0+00.

Direction: Southwest Date: 06/15/18 Time: 09:53 Taken by: MTM


Photo 25 Clearing and grubbing activities at Borrow Source 1.

Direction: Southeast Date: 06/11/18 Time: 16:08 Taken by: MF


Photo 26 Clearing and grubbing activities at Borrow Source 1.

Direction: Southeast Date: 07/11/18 Time: 16:09 Taken by: MF


Photo 27 Stockpiling of fill material from Borrow Source 1.

Direction: East Date: 07/11/18 Time: 10:36 Taken by: MF

Photo 28 Burial of soil containing high concentrations of mercury and micro beads within the repository.

Direction: West Date: 08/07/18 Time: 08:37 Taken by: TC

Photo 29 Burial of soil containing high concentrations of mercury and micro beads within the repository.

Direction: West Date: 08/07/18 Time: 08:37 Taken by: TC

Photo 1 Looking upgradient at dozer grading backfill material in Furnace Creek from STA 5+00.

Direction: East Date: 07/11/18 Time: 15:49 Taken by: MF

Photo 2 Compacting clean clay backfill in Furnace Creek channel

Direction: East Date: 07/12/18 Time: 11:53 Taken by: MF

Photo 3 Backfilling Furnace Creek with clean fill material.

Direction: Southwest Date: 07/13/18 Time: 16:06 Taken by: MF

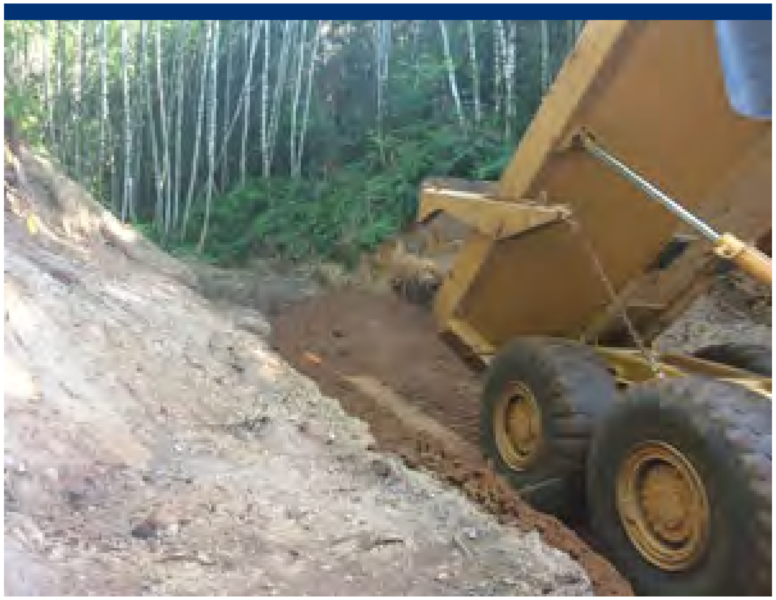


Photo 4 Backfilling Furnace Creek near Station 0+00, with clean fill material.

Direction: Down Date: 07/14/18 Time: 16:55 Taken by: MF

Photo 5 Lower reach of Furnace Creek removal area with backfilled and graded channel and slopes, near STA 8+50.

Direction: South Date: 07/18/18 Time: 07:42 Taken by: MF

Photo 6 Placement of key ledge on RCV gravel bedding, at terminus of lower series of RCVs at STA 8+89.

Direction: South Date: 07/25/18 Time: 16:25 Taken by: MF

Photo 7 View of cross-vane construction near Station 8+50.

Direction: West Date: 07/31/18 Time: Taken by: TC

Photo 8 Initial Rock cross-vane construction near Station 8+50.

Direction: West Date: 07/31/18 Time: Taken by: JM

Photo 9 View of completed cross-vanes between Stations 2+50 and 3+00.

Direction: East Date: 08/15/18 Time: 08:52 Taken by: MF

Photo 10 Completed wooden cross vane near Station 5+50.

Direction: East Date: 08/17/18 Time: 07:19 Taken by: MF

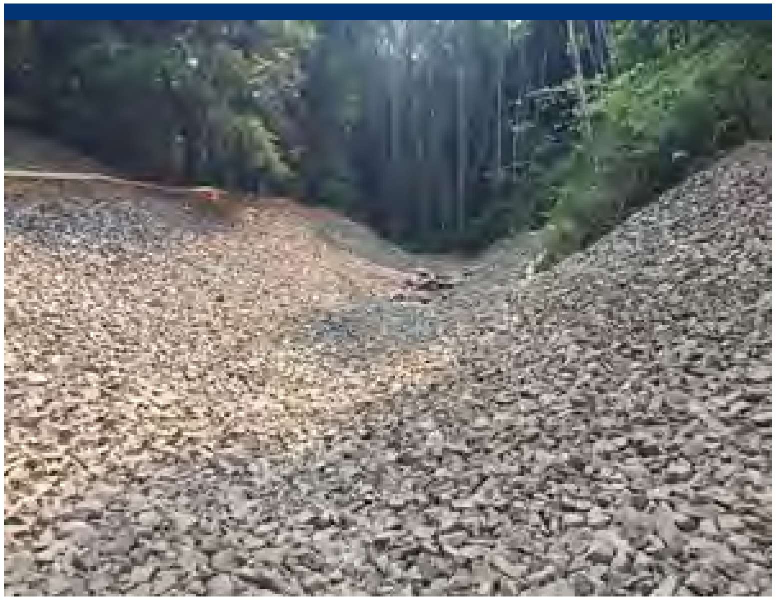


Photo 11 Looking upgradient along rock armoring and series of rock cross-vanes, towards Station 0+00 of Furnace Creek.

Direction: West Date: 08/16/18 Time: 12:50 Taken by: BC

Photo 12 Completed restoration near Station 2+50.

Direction: West Date: 08/21/18 Time: 12:49 Taken by: BC

Photo 13 Looking downgradient along restored Furnace Creek channel and slopes with slash.

Direction: West Date: 08/13/18 Time: 07:18 Taken by: MF

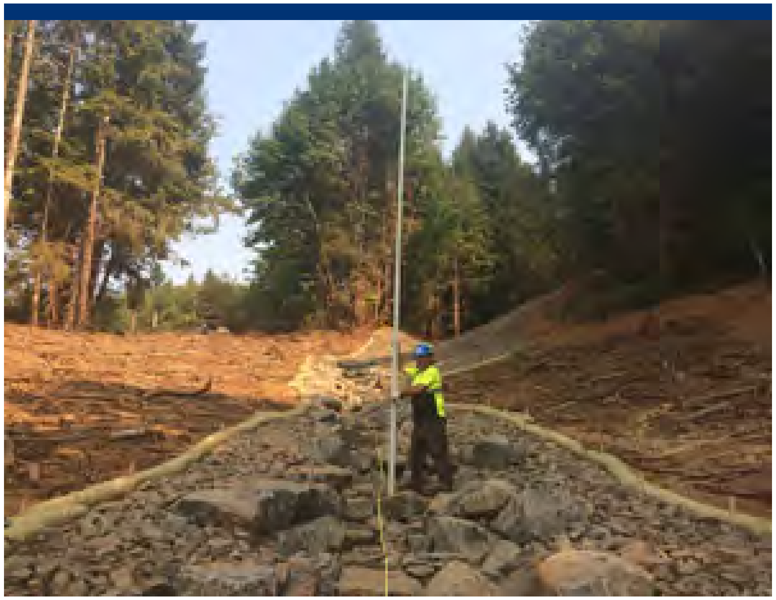


Photo 14 Conducting Post-Restoration longitudinal profile survey.

Direction: East Date: 08/14/18 Time: 16:01 Taken by: MF

Photo 15 Looking down at Adit Creek seep from upper extent of cleared Borrow Source.

Direction: West Date: 08/11/18 Time: 10:44 Taken by: MF

Photo 16 View of completed Adit Creek re-route around repository.

Direction: Southeast Date: 08/13/18 Time: 16:42 Taken by: MF

Photo 17 View of completed Adit Creek re-route around repository.

Direction: Southwest Date: 08/13/18 Time: 16:42 Taken by: MF

Photo 18 Overview of Borrow Source 1 slash and mulching activities.

Direction: South Date: 08/13/18 Time: 11:11 Taken by: MF

Photo 19 Borrow Source 1 and Adit Creek channel after restoration.

Direction: Southeast Date: 08/16/18 Time: 15:56 Taken by: MF

Photo 20 Borrow Source 1 after restoration and hydroseeding.

Direction: Southeast Date: 08/21/18 Time: 12:32 Taken by: BC

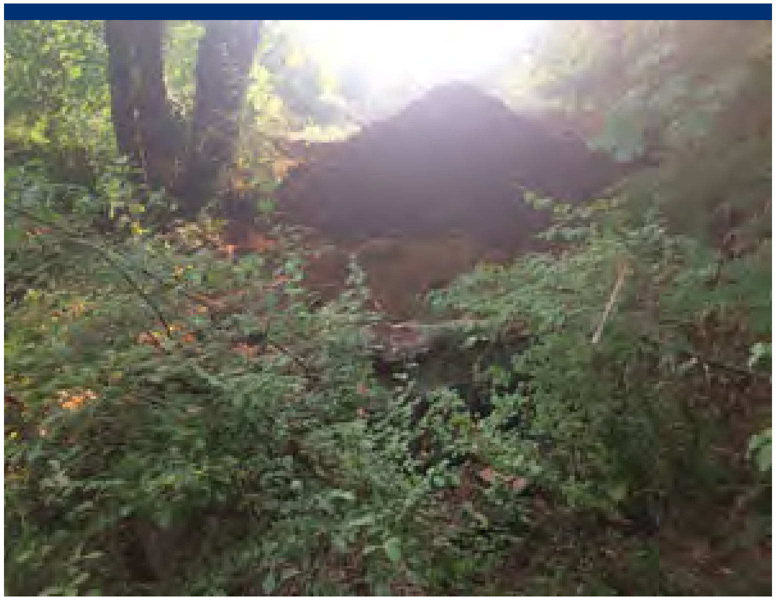


Photo 21 Old furnace structure prior to capping with clean fill material.

Direction: West Date: 08/15/18 Time: 09:44 Taken by: MF

Photo 22 Construction of retention pond for repository.

Direction: East Date: 08/16/18 Time: 08:11 Taken by: MF

Photo 23 Completed repository retention pond.

Direction: East | Date: 08/16/18 | Time: 16:11 | Taken by: MF

Photo 24 Hydroseeding activities at repository.

Direction: Southeast | Date: 08/21/18 | Time: 15:14 | Taken by: BC

Photo 25 View from completed repository looking down on stormwater retention pond and command post.

Direction: Northwest | Date: 08/21/18 | Time: 14:04 | Taken by: BC

Photo 26 Hydroseeding activities at repository.

Direction: Northwest | Date: 08/21/18 | Time: 14:10 | Taken by: BC

Photo 1 View of residential site and equipment staging.

Direction: Southeast Date: 09/26/18 Time: 13:49 Taken by: BC

Photo 2 Surface soil sampling from residential driveway.

Direction: Southwest Date: 09/26/18 Time: 11:47 Taken by: BC

Photo 3 Subsurface soil sampling with hand auger at residence.

Direction: Down Date: 09/26/18 Time: 09:19 Taken by: BC

Photo 4 Septic tank access port cover uncovered.

Direction: South Date: 09/26/18 Time: 13:00 Taken by: MF

Photo 5 Mercury flask relinquished by property owner during residential removal.

Direction: Down Date: 10/08/18 Time: 14:08 Taken by: BA

Photo 6 Dust control activities during residential removal.

Direction: Southeast Date: 10/09/18 Time: 10:20 Taken by: BA

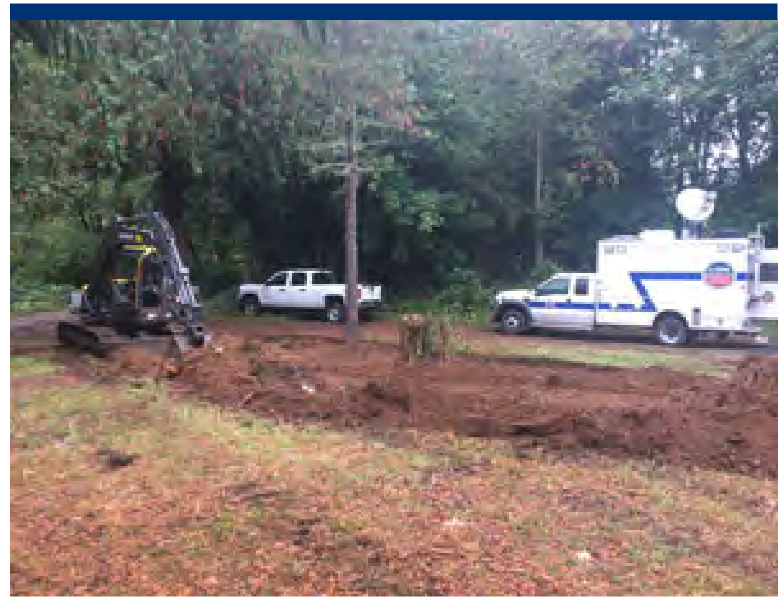


Photo 7 ERRS excavating DU10.

Direction: North Date: 10/09/18 Time: 13:06 Taken by: MF

Photo 8 DU10 and DU11 excavated to 1-foot, and excavated material staged for hauling to stockpile.

Direction: East Date: 10/09/18 Time: 17:21 Taken by: MF

Photo 9 DU06 and DU08 excavated to 1-foot depth.

Direction: East Date: 10/09/18 Time: 16:15 Taken by: MF

Photo 10 DU06 excavated to 1-foot depth, and DU09 scraped around base of trees.

Direction: South Date: 10/09/18 Time: 16:15 Taken by: MF

Photo 11 Painted line delineating placement of soil (to right/N) and gravel (to left/S) in DU10 and DU11.

Direction: West Date: 10/10/18 Time: 11:20 Taken by: MF

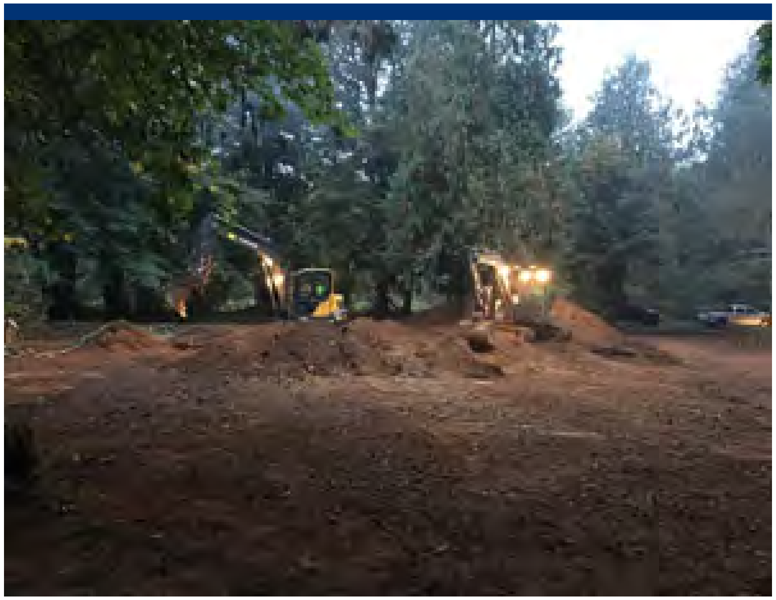


Photo 12 Excavation activities during residential removal.

Direction: Southeast Date: 10/10/18 Time: 07:23 Taken by: BA

Photo 13 DU10, DU03 & DU06 after 1-foot of soil removed.

Direction: Southwest Date: 10/10/18 Time: 11:07 Taken by: BA

Photo 14 ERRS scraping entrance to main driveway to determine stability of subgrade for gravel bedding.

Direction: Northeast Date: 10/10/18 Time: 13:17 Taken by: MF

Photo 15 START collecting composite sample of DU11.

Direction: Northeast Date: 10/10/18 Time: 15:19 Taken by: MF

Photo 16 START scanning bucket of excavator for mercury vapors with Lumex.

Direction: Southwest Date: 10/10/18 Time: 16:13 Taken by: MF

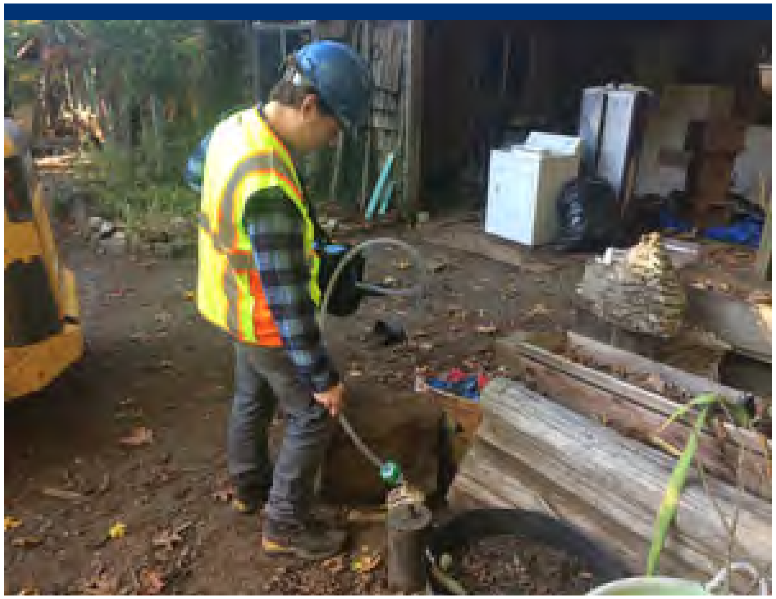


Photo 17 START scanning mercury flasks for mercury vapors with Lumex.

Direction: West Date: 10/10/18 Time: 16:18 Taken by: MF

Photo 18 Firepit area of residence prior to excavation.

Direction: North Date: 10/10/18 Time: 17:23 Taken by: MF

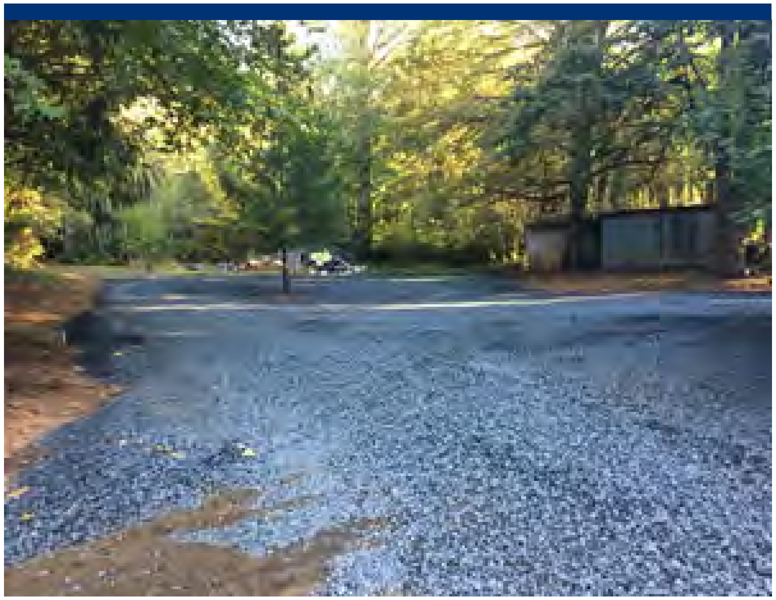


Photo 19 DU06 restored with gravel.

Direction: Southeast Date: 10/10/18 Time: 17:15 Taken by: BA

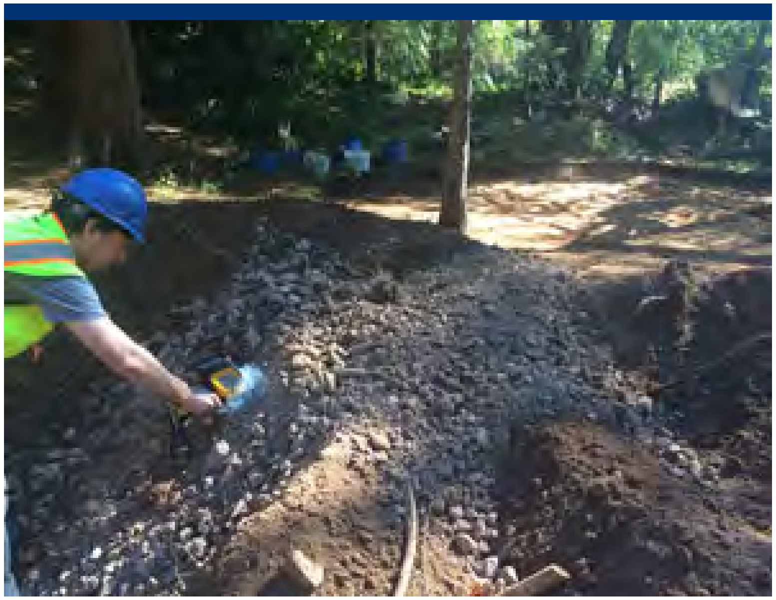


Photo 20 START screening excavated pale tailings from DU05 with XRF.

Direction: Southeast Date: 10/11/18 Time: 14:21 Taken by: MF

Photo 21 ERRS placing gravel into DU03, with backfill stakes marked at 1-foot.

Direction: Southwest Date: 10/11/18 Time: 15:25 Taken by: MF

Photo 22 ERRS excavating DU04 to one foot depth.

Direction: West Date:10/12/18 Time: 08:34 Taken by: MF

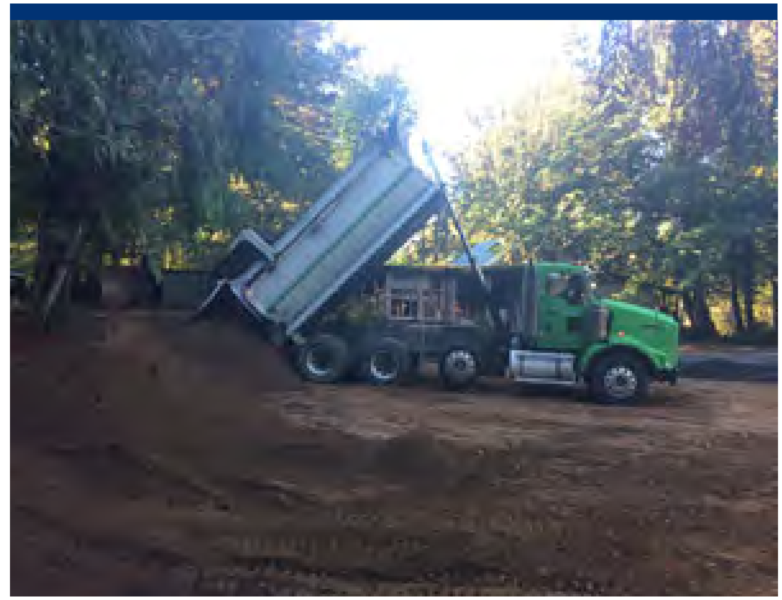


Photo 23 Offsite borrow source material delivered from RiverBend Materials.

Direction: South Date: 10/12/18 Time: 09:35 Taken by: MF

Photo 24 Protective soil backfill placed around septic tank system, prior to placement of gravel.

Direction: Southwest Date: 10/12/18 Time: 10:57 Taken by: MF

Photo 25 Staked out for one-foot backfill in DU10 and DU11.

Direction: East Date: 10/12/18 Time: 15:09 Taken by: MF

Photo 26 Completed shallow excavation along footpath entrance to residence.

Direction: North Date: 10/13/18 Time: 09:49 Taken by: MF

Photo 27 Protective soil backfill placed around water supply line, prior to placement of gravel.

Direction: South Date: 10/13/18 Time: 13:48 Taken by: MF

Photo 28 ERRS excavating DU15.

Direction: East Date: 10/13/18 Time: 14:54 Taken by: MF

Photo 29 ERRS grading soil around DU09.

Direction: Southeast Date: 10/15/18 Time: 10:27 Taken by: MF

Photo 30 Gravel placed along footpath entrance to residence.

Direction: North Date: 10/15/18 Time: 14:07 Taken by: MF

Photo 31 Gravel and clean soil backfill placed, compacted, and graded at DU10 and DU11.

Direction: West Date: 10/15/18 Time: 16:33 Taken by: MF

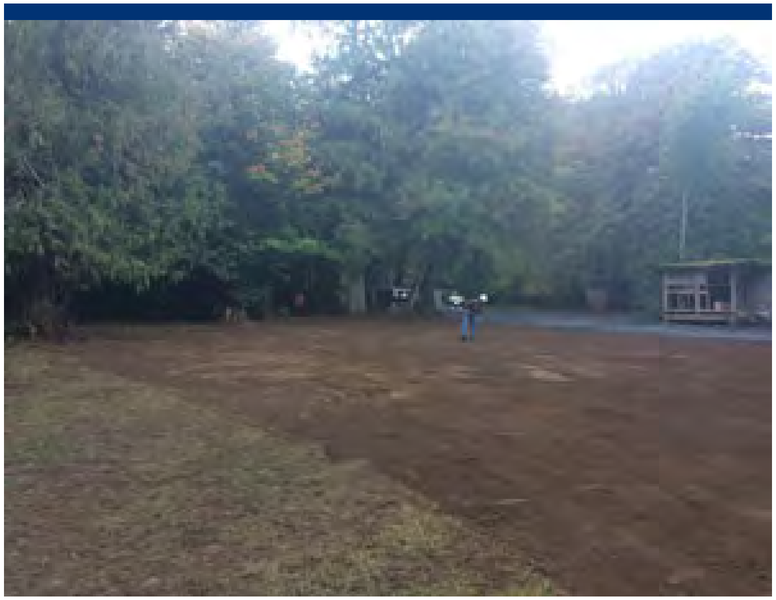


Photo 32 ERRS raking in grass seed in DU10 and DU11.

Direction: Southeast Date: 10/16/18 Time: 07:48 Taken by: MF

Photo 33 ERRS installing new gate at DU15.

Direction: East Date: 10/16/18 Time: 08:58 Taken by: MF

Photo 34 Subcontractor staging mercury flasks for off-site transportation and disposal.

Direction: Northwest Date: 10/16/18 Time: 13:39 Taken by: MF

Photo 35 Mercury flasks placed in overpack container, with sorbent.

Direction: Down Date: 10/16/18 Time: 13:42 Taken by: MF

Photo 36 Mercury flasks in labeled overpack container.

Direction: Down Date: 10/16/18 Time: 13:47 Taken by: MF

Photo 37 Gravel and clean soil backfill placed, compacted, and graded at DU04 and DU05.

Direction: Southwest Date: 10/17/18 Time: 09:21 Taken by: MF

Black Butte Mine

Lane County, Oregon

Residential Removal

Photo 38 Repository for residential excavation, located at north end of main staging area.

Direction: North Date: 10/17/18 Time: 13:29 Taken by: MF

Photo 39 Residential repository for excavation material stormwater controls.

Direction: West Date: 10/17/18 Time: 13:30 Taken by: MF

Photo 1 Air monitoring station AS-CP Dusttrak, COMMs rig, and START equipment trailer.

Direction: South Date: 7/9/19 Time: 12:19 Taken by: MF

Photo 2 Stockpiled 1.5-inch-minus rock and 6-inch rock armor, staged in support zone area.

Direction: East Date: 7/17/19 Time: 07:42 Taken by: MF

Photo 3 OPWA Upper/South unit, pre-removal condition.

Direction: East Date: 7/9/19 Time: 12:14 Taken by: MF

Photo 4 OPWA Lower/North unit, pre-removal condition

Direction: Northwest Date: 7/9/19 Time: 12:14 Taken by: MF

Photo 5 ERRS saturating OPWA Upper/South unit with the water truck for dust control prior to clearing/grubbing activities.

Direction: East Date: 7/9/19 Time: 14:02 Taken by: MF

Photo 6 ERRS conducting clearing and grubbing activities at OPWA Upper/South unit.

Direction: North Date: 7/9/19 Time: 15:15 Taken by: MF

Photo 7 START conducting mercury vapor monitoring of stockpiled root wads with Jerome J505.

Direction: Down Date: 7/10/19 Time: 10:07 Taken by: MF

Photo 8 EPA and START conducting a site walk of OPWA Upper/South unit prior to excavation activities.

Direction: South Date: Time: Taken by: MF

Photo 9 Upper/southernmost boundary extent of OPWA Upper/S unit. Contaminated ash material visible at base of tree.

Direction: South Date: 7/10/19 Time: 14:19 Taken by: MF

Photo 10 ERRS conducting dust control while excavating OPWA Upper/South unit.

Direction: South Date: 7/11/19 Time: 10:26 Taken by: MF

Photo 11 Excavated upper/southernmost boundary extent of OPWA Upper/S unit. Contaminated ash layer visible.

Direction: East Date: 7/11/19 Time: 09:59 Taken by: MF

Photo 12 Excavated 'clean' clay layer, located at upper/ southernmost boundary extent of OPWA Upper/S unit.

Direction: East Date: 7/11/19 Time: 10:35 Taken by: MF

Photo 13 ERRS excavating OPWA Upper/South unit and loading on-site haul truck.

Direction: West Date: 7/11/19 Time: 11:56 Taken by: MF

Photo 14 Excavated and exposed seep, located along north boundary of OPWA Upper/South unit.

Direction: North Date: 7/13/19 Time: 09:00 Taken by: MF

Photo 15 Air monitoring station AS-EXC02 Dusttrak, located on SW boundary of OPWA Upper/South unit.

Direction: Southeast Date: 7/12/19 Time: 08:07 Taken by: MF

Photo 16 Final excavated leave surface of northwestern extent of OPWA Upper/South unit.

Direction: Southeast Date: 7/12/19 Time: 16:58 Taken by: MF

Photo 17 ERRS excavating OPWA Lower/North unit.

Direction: South Date: 7/13/19 Time: 09:15 Taken by: MF

Photo 18 SE extent of OPWA Lower/North unit, excavated in 1-foot benches to target contaminated lenses of ashy material.

Direction: Southeast Date: 7/13/19 Time: 09:46 Taken by: MF

Photo 19 ERRS excavating contaminated lenses of ashy material at SE extent of OPWA Lower/North unit.

Direction: Northwest Date: 7/13/19 Time: 10:27 Taken by: MF

Photo 20 Exposed contaminated lens of ashy material in SE extent of OPWA Lower/North unit.

Direction: North Date: 7/13/19 Time: 11:58 Taken by: MF

Photo 21 START conducting mercury vapor monitoring of exposed lens of ashy material in OPWA Lower/North unit.

Direction: Down Date: 7/13/19 Time: 10:39 Taken by: MF

Photo 22 Excavated swale area in southwestern extent of OPWA Lower/North unit.

Direction: West Date: 7/13/19 Time: 10:07 Taken by: MF

Photo 23 Conducting XRF *in situ* monitoring of excavated ground surface in OPWA Lower/North unit.

Direction: West Date: 7/13/19 Time: 14:06 Taken by: MF

Photo 24 Final excavated leave surface of southeastern extent of OPWA Lower/North unit.

Direction: Southeast Date: 7/15/19 Time: 07:46 Taken by: MF

Photo 25 Final excavated leave surface of southern extent of OPWA Lower/North unit.

Direction: South Date: 7/15/19 Time: 07:46 Taken by: MF

Photo 26 Final excavated leave surface of western extent of OPWA Lower/North unit.

Direction: West Date: 7/15/19 Time: 07:47 Taken by: MF

Photo 27 Final excavated leave surface of N extent OPWA Lower/N unit. Note: ashy material left in-place (<300 mg/kg Hg).

Direction: North Date: 7/15/19 Time: 07:47 Taken by: MF

Photo 28 ERRS placing rock armor on contaminated material left in-placed at southernmost extent of OPWA Upper/S unit.

Direction: South Date: 7/17/19 Time: 13:03 Taken by: MF

Photo 29 Restored section of OPWA Upper/South unit, at southernmost extent of unit boundary.

Direction: South Date: 7/23/19 Time: 11:01 Taken by: MF

Photo 30 Restored section of OPWA Upper/South unit, with rock-armored seep and constructed drainage channel.

Direction: East Date: 7/18/19 Time: 12:11 Taken by: MF

Photo 31 Restored section of OPWA Upper/South unit, with rock-armored constructed drainage channel, mulch and slash.

Direction: East Date: 7/19/19 Time: 15:55 Taken by: MF

Photo 32 ERRS placing boulders in keyed-in trench along toe of right bank slope of OPWA Upper/South unit.

Direction: East Date: 7/19/19 Time: 08:47 Taken by: MF

Photo 33 Restored section of OPWA Upper/South unit, with rock-armored slopes and constructed drainage channel.

Direction: North Date: 7/19/19 Time: 15:57 Taken by: MF

Photo 34 Laser level set up in OPWA Lower/North unit to check for slope and drainage gradient.

Direction: Southwest Date: 7/23/19 Time: 14:03 Taken by: MF

Photo 35 Off-site haul truck delivering loam material for clean backfill in OPWA Lower/South unit.

Direction: North Date: 7/19/19 Time: 09:05 Taken by: MF

Photo 36 ERRS placing 1-foot clean cover cap in OPWA Lower/South unit.

Direction: South Date: 7/23/19 Time: 16:21 Taken by: MF

Photo 37 Restored section of OPWA Lower/North unit, with rock-armored constructed drainage channel and riprap.

Direction: West Date: 7/26/19 Time: 08:10 Taken by: MF

Photo 38 Rock-armored overflow spillway at northwest extent of OPWA Lower/North unit.

Direction: Southwest Date: 7/26/19 Time: 08:13 Taken by: MF

Photo 39 Restored OPWA Lower/North unit, looking towards restored OPWA Upper/South unit.

Direction: Southeast Date: 7/26/19 Time: 08:13 Taken by: MF

Photo 40 ERRS grading and prepping repository to receive material excavated from OPWA removal area.

Direction: East Date: 7/09/19 Time: 11:59 Taken by: MF

Photo 41 Air monitoring station AS-RP Dusttrak, located on top of repository. ERRS grading and prepping repository.

Direction: Southeast Date: 7/11/19 Time: 11:29 Taken by: MF

Photo 42 ERRS placing excavated contaminated material hauled from OPWA removal area into repository.

Direction: Southwest Date: 7/11/19 Time: 11:22 Taken by: MF

Photo 43 ERRS grading southern slope of expanded repository area.

Direction: East Date: 7/12/19 Time: 16:47 Taken by: MF

Photo 44 ERRS loading stockpiled residential removal material into haul truck, located in north laydown area.

Direction: Northeast Date: 7/15/19 Time: 16:58 Taken by: MF

Photo 45 ERRS placing stockpiled residential removal material for main repository 'clean' cap.

Direction: Southwest Date: 7/15/19 Time: 16:55 Taken by: MF

Photo 46 ERRS conducting final grading activities on expanded repository area.

Direction: East Date: 7/16/19 Time: 15:38 Taken by: MF

Photo 47 Looking east along toe of south extent of expanded repository, and stormwater drainage channel.

Direction: East Date: 7/18/19 Time: 18:02 Taken by: MF

Photo 48 Looking up at BS01 borrow source erosion and Adit Creek seep slope failure at top of slope.

Direction: South Date: 7/11/19 Time: 16:18 Taken by: MF

Photo 49 Looking up at Adit Creek seep slope failure at top of slope of BS01.

Direction: South Date: 7/11/19 Time: 16:12 Taken by: MF

Photo 50 Looking upslope at right bank slope failure of Adit Creek seep at BS01.

Direction: South Date: 7/11/19 Time: 15:47 Taken by: MF

Photo 51 Looking downslope at right bank slope failure of Adit Creek seep at BS01.

Direction: Northwest Date: 7/11/19 Time: 15:32 Taken by: MF

Photo 52 Looking downslope at main channel of Adit Creek seep at BS01, with material from left bank slope failure visible.

Direction: North Date: 7/11/19 Time: 15:55 Taken by: MF

Photo 53 Left bank slope failure of Adit Creek seep at BS01.

Direction: West Date: 7/11/19 Time: 15:54 Taken by: MF

Photo 54 Left bank slope failure of Adit Creek seep at BS01.

Direction: East Date: 7/11/19 Time: 15:56 Taken by: MF

Photo 55 Looking downslope at left bank slope failure of Adit Creek seep at BS01.

Direction: North Date: 7/11/19 Time: 15:57 Taken by: MF

Photo 56 ERRS clearing vegetation above right bank slope failure of Adit Creek seep at BS01, and pulling down slope material.

Direction: Northwest Date: 7/19/19 Time: 17:05 Taken by: MF

Photo 57 Left bank slope of Adit Creek seep pulled down to 2:1 slope.

Direction: East Date: 7/20/19 Time: 09:18 Taken by: MF

Photo 58 ERRS compacting soil/mulch cover over 6-inch rock armor layer on right bank slope of Adit Creek seep.

Direction: Southwest Date: 7/20/19 Time: 11:06 Taken by: MF

Photo 59 Repaired right bank slope failure area with keyed-in boulders along toe of slope, and rock armor.

Direction: Southeast Date: 7/20/19 Time: 12:00 Taken by: MF

Photo 60 Repaired left bank slope failure area of Adit Creek seep, with slash and soil/mulch cover over rock armor layer.

Direction: South Date: 7/22/19 Time: 09:21 Taken by: MF

Photo 61 Left bank Adit Creek seep intercept channel installed by ERRS to direct flow into main Adit Creek channel.

Direction: West Date: 7/22/19 Time: 09:21 Taken by: MF

Photo 62 Right bank Adit Creek seep intercept channel installed by ERRS to direct flow into main Adit Creek channel.

Direction: East Date: 7/22/19 Time: 10:31 Taken by: MF

Photo 63 Looking downslope along main channel of Adit Creek seep, and completed left bank and right bank channels.

Direction: North Date: 7/22/19 Time: 16:38 Taken by: MF

Photo 64 Looking up at BS01 borrow source repairs to address erosion and Adit Creek seep slope failure at top of slope.

Direction: South Date: 7/24/19 Time: 10:40 Taken by: MF

Photo 65 Looking upstream at Furnace Creek Old Furnace right bank slope failure. Downstream extent of slide marked in pink.

Direction: Southeast Date: 7/23/19 Time: 08:08 Taken by: MF

Photo 66 Slope failure and exposed contaminated bank located near right bank of Furnace Creek at STA 1+00.

Direction: East Date: 7/16/19 Time: 15:50 Taken by: MF

Photo 67 Slope failure and exposed contaminated bank located near right bank of Furnace Creek at STA 1+00.

Direction: Northeast Date: 7/16/19 Time: 15:51 Taken by: MF

Photo 68 ERRS excavating test pit at upstream extent of toe of Furnace Creek Old Furnace slope failure. Water in pit.

Direction: Northwest Date: 7/23/19 Time: 08:39 Taken by: MF

Photo 69 ERRS loading clean backfill excavated from Old Furnace slope failure.

Direction: Northwest Date: 7/24/19 Time: 14:08 Taken by: MF

Photo 70 Saturated soils due to subsurface seep at downstream extent of excavated Old Furnace slope failure.

Direction: North Date: 7/24/19 Time: 17:01 Taken by: MF

Photo 71 ERRS backfilling key trench with 6-inch rock for Furnace Creek Old Furnace slope failure repair.

Direction: Northwest Date: 7/24/19 Time: 16:30 Taken by: MF

Photo 72 ERRS excavating saturated soils surrounding subsurface seep, located at downstream extent of excavation.

Direction: Northwest Date: 7/24/19 Time: 16:53 Taken by: MF

Photo 73 ERRS placing boulder toe anchor above rock-filled key trench at base of Furnace Creek Old Furnace slide repair.

Direction: Southwest Date: 7/24/19 Time: 17:26 Taken by: MF

Photo 74 ERRS compacting clean backfill over rock layer slope in Furnace Creek Old Furnace slide repair area.

Direction: North Date: 7/24/19 Time: 18:30 Taken by: MF

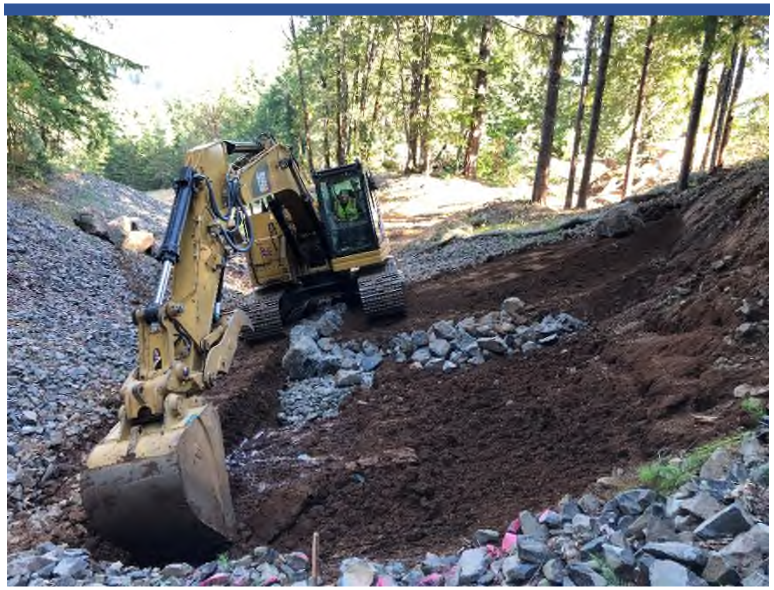


Photo 75 ERRS excavating upgradient end of key anchor trench at toe of Furnace Creek Old Furnace slide repair area.

Direction: Northwest Date: 7/25/19 Time: 08:32 Taken by: MF

Photo 76 Groundwater infilling upgradient end of key anchor trench at toe of Furnace Creek Old Furnace slide repair area.

Direction: Northwest Date: 7/25/19 Time: 08:24 Taken by: MF

Photo 77 Groundwater infilling upgradient end of key anchor trench at toe of Furnace Creek Old Furnace slide repair area.

Direction: Southeast Date: 7/25/19 Time: 08:44 Taken by: MF

Photo 78 Groundwater and exposed tailings in key anchor trench at toe of Furnace Creek Old Furnace slide repair area.

Direction: Down/SE Date: 7/25/19 Time: 09:03 Taken by: MF

Photo 79 ERRS placing clean topsoil backfill over rock backfill layer in Furnace Creek Old Furnace slide repair area.

Direction: West Date: 7/25/19 Time: 09:26 Taken by: MF

Photo 80 ERRS placing clean topsoil backfill over rock backfill layer in Furnace Creek Old Furnace slide repair area.

Direction: North Date: 7/25/19 Time: 10:40 Taken by: MF

Photo 81 Completed boulder toe anchor at base of Furnace Creek Old Furnace slide repair, and installed rock layer backfill.

Direction: Southwest Date: 7/25/19 Time: 11:14 Taken by: MF

Photo 82 Groundwater flowing out from anchor trench installed for Furnace Creek Old Furnace slide repair action.

Direction: North Date: 7/25/19 Time: 09:33 Taken by: MF

Photo 83 1.5-inch-minus gravel pack placed in interstices of boulder toe anchor at base of Furnace Creek Old Furnace slide.

Direction: Down/East Date: 7/25/19 Time: 11:53 Taken by: MF

Photo 84 ERRS compacting restored slope in Furnace Creek Old Furnace slide repair area.

Direction: North Date: 7/25/19 Time: 13:22 Taken by: MF

Photo 85 Completed Furnace Creek Old Furnace slide repair.

Direction: Southeast Date: 7/25/19 Time: 14:48 Taken by: MF

Photo 86 Section of Adit Creek reroute with negative drainage causing overflow, located on east side of repository.

Direction: East Date: 7/9/19 Time: 12:00 Taken by: MF

Photo 87 ERRS conducting work on Adit Creek reroute enhancement to improve flow and drainage around repository.

Direction: South Date: 7/16/19 Time: 08:19 Taken by: MF

Photo 88 Widened and deepened Adit Creek reroute enhancement to improve flow and drainage around repository.

Direction: North Date: 7/16/19 Time: 15:39 Taken by: MF

Photo 89 Widened and deepened Adit Creek reroute enhancement to improve flow and drainage around repository.

Direction: Southwest Date: 7/16/19 Time: 15:41 Taken by: MF

Photo 90 Completed Adit Creek reroute enhancement to improve flow and drainage around repository.

Direction: Southwest Date:7/22/19 Time: 16:53 Taken by: MF

Photo 91 Repository drainage channel excavated by ERRS to be wider and deeper to improve flow and capacity.

Photo 92 Repository stormwater retention pond with 4”-6” of sediment excavated by ERRS.

Direction: Date: 7/22/19 Time: 16:50 Taken by: MF

Photo 93 Drainage channel to direct surface flow from main access road away from repository stormwater retention pond.

Direction: Southwest Date: 7/22/19 Time: 16:50 Taken by:

Photo 94 Water bar (shown prior to receiving gravel armor) across borrow source access road, and downgradient of BS01.

Direction: North Date: 7/23/19 Time: 10:42 Taken by: MF

Photo 95 Completed water bar placed across main access road, near entrance gate and residence upper drive.

Direction: South Date: 7/23/19 Time: 07:52 Taken by:

Photo 96 ERRS conducting rental equipment decontamination in staging area with water truck.

This page intentionally left blank.

B Cultural Resources Reports

This page intentionally left blank.

Report #

SHPO Use

Year: 2018

State Historic Preservation Office Report Cover Page

Title: **Results of a Cultural Resource Study of a part of the Black Butte Mine Site, Lane County, Oregon**

REPORT

Author(s): Bill R. Roulette, Aimee A. Finley, and Thomas E. Becker

Agency/Client: Ecology and Environment, Inc.

District/Contractor: Applied Archaeological Research, Inc.

Agency/Client Report#: 18-2026

Project Acres: 13.1

Survey Acres: 13.1

LOCATION

County(ies): Deschutes

Township:		Range:		Section(s):	Township:		Range:		Section(s):
23	S	3	W	8					

TESTING

Archaeological Permit Number(s):

Accession Number:

Reports submitted to: Tribes: ☐ UOMNCH: ☐ LCIS: ☐

Curation:

Report Addresses Testing: ☐

CONSULTATION

Have tribes been contacted or consulted? No

List tribes:

List any other groups contacted or consulted:

PA/MOA

Report is associated with: PA ☐ MOA ☐

REPORTS WITHOUT A COMPLETE AND ACCURATE COVER PAGE AND APPROPRIATE ADDITIONAL PAGES MAY BE RETURNED. CHECK THE SHPO WEBSITE TO MAKE SURE YOU HAVE THE MOST CURRENT VERSION.

Report #

SHPO Use

State Historic Preservation Office
Report Summary of Resources and NRHP Eligibility

RESOURCES

	Archaeological: Site:	Isolate:	Built Environment:	TCP:	HPRCSIT:	Other:
Count:	1		1			

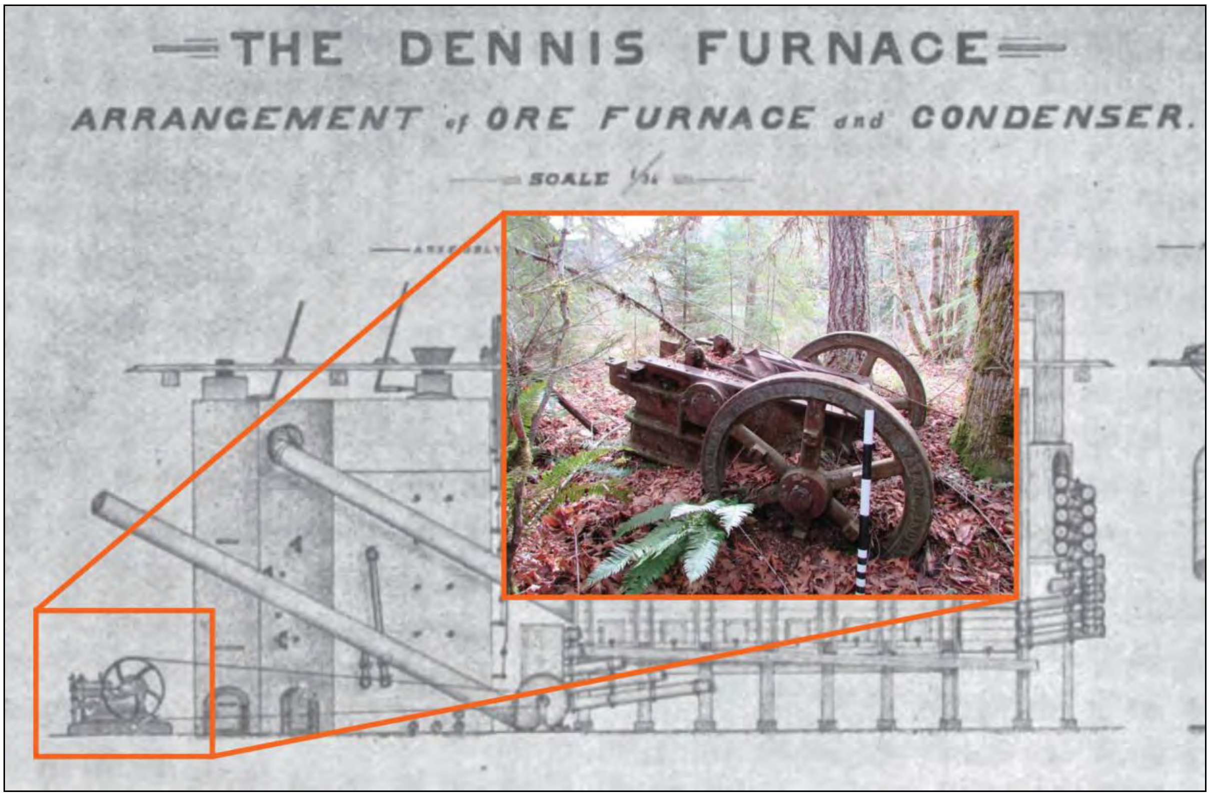
***Please be sure all archaeological forms have been submitted on-line**

NRHP ELIGIBILITY

EVALUATE PROPERTIES UNDER ALL FOUR CRITERIA.
BE SURE TO INCLUDE JUSTIFICATION IN THE REPORT

Oregon On-Line Form #:	Trinomial:	Temp# or Name:	Criterion A:	Criterion B:	Criterion C:	Criterion D:
21551		AAR 2026-1	Unevaluated	Unevaluated	Unevaluated	Unevaluated
		BlackButte Mine C	Not Eligible	Not Eligible	Not Eligible	Not Eligible

RESULTS OF A CULTURAL RESOURCE STUDY OF A PART OF THE BLACK BUTTE MINE SITE, LANE COUNTY, OREGON



Prepared for
Ecology and Environment, Inc.
Seattle, Washington

APPLIED ARCHAEOLOGICAL RESEARCH, INC., REPORT NO. 2026

APPLIED ARCHAEOLOGICAL RESEARCH, INC.
Cultural Resource Management and Historic Preservation

4001 NE Halsey Street, Suite 3
Portland, OR 97232
Phone (503) 281 9451
Fax (503) 281 9504

RESULTS OF A CULTURAL RESOURCE STUDY OF A PART OF THE BLACK BUTTE MINE SITE, LANE COUNTY, OREGON

By:

Bill R. Roulette, M.A., RPA,
Aimee A. Finley, M.S.
and
Thomas E. Becker, M.A., RPA,

Prepared for
Ecology and Environment, Inc.
Seattle, Washington

May 8, 2018

APPLIED ARCHAEOLOGICAL RESEARCH, INC., REPORT NO. 2026

Discere Temptare

ABSTRACT

The Environmental Protection Agency (EPA) proposes a non-time-critical removal of contaminated materials from a part of the historical Black Butte Mine located about 15 miles south of Cottage Grove in the south-central part of Lane County, Oregon. Cinnabar was extracted at the mine at various times between the late 1880s and late 1960s. Furnace Creek runs through the mine complex. Tailings, waste rock, and sediment in the stream drainage have been shown to have elevated concentrations of mercury. The creek is a tributary to Garoutte Creek, which flows into the Coast Fork Willamette River that in turn empties into the Cottage Grove Reservoir. The EPA has determined that the potential release of high concentrations of particulate mercury in surface water that could travel downstream in the drainage system poses a risk to public health or welfare or the environment. The non-time-critical removal will address this risk by stabilizing, removing, or containing the contaminated tailings, waste rock, and sediment from the part of the stream drainage within the mine complex.

Because of the EPA's involvement, the removal action is an undertaking of the federal government and is subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800, to the extent practicable. EPA contracted with Ecology and Environment, Inc. (E&E) to provide technical assistance and support under Superfund Technical Assessment and Response Team IV contract number EP-S7-13-07. E&E retained Applied Archaeological Research, Inc. (AAR) to conduct a cultural resource study of the area of potential effects for the removal action.

The project area of potential effects is composed four partly contiguous areas designated Works Areas 1-4. As a result of the field survey, structural ruins remains and scattered objects of material culture were observed in Work Areas 2 and 3. Given the dates of mine operation, the cultural material has been recorded as a historic-era archaeological site that is temporarily designated AAR 2026-1. An archaeological site record form has been prepared for the site and submitted to the Oregon State Historic Preservation Office. The ruins and objects included in the site represent an incidental amount of debris that appears to be associated with the two earliest periods of mine operations, ca. 1897 to 1927, and the two latest, ca. 1956-1968.

In addition, a standing structure was found in the northern part of Work Area 2. It was recorded as a historic property and an Oregon State Historic Preservation Office clearance form has been completed for it. Based solely on its location, the building is presumed to be associated with the operation of the Black Butte Mine, but its specific function is unknown. It is constructed using materials, such as corrugated fiberglass and corrugated metal panels, mill-cut boards, and tar paper, that are not identifiable as historical, and it lacks formal architectural style. As a consequence, it cannot be dated to a discrete period.

AAR's study was not designed or intended to evaluate the significance of the entire Black Butte Mine site or its eligibility to be listed on the National Register of Historic Places. However, it did provide information that can be used to make a preliminary assessment of the contributory value of site AAR 2026-1 and the standing structure to the site's National Register of Historic Places eligibility.

As described in the report, it is AAR's preliminary assessment that neither site AAR 2026-1 nor the standing structure contributes to the potential significance of the Black Butte Mine and its eligibility to be listed on the National Register of Historic Places. For this reason, it is AAR's opinion that the removal action will not have an adverse effect on historic properties. AAR does not recommend additional cultural resources investigations of the area of potential effects for the removal action.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Project Description

The Environmental Protection Agency (EPA) proposes a non-time-critical removal of contaminated materials from a part of the historical Black Butte Mine located about 15 miles south of Cottage Grove in the south-central part of Lane County, Oregon (Figure 1). Cinnabar was extracted at the mine at various times between the late 1880s and late 1960s. The ore was crushed and roasted in kilns to extract mercury vapor, which was collected and bottled for shipment. Furnace Creek runs through the mine complex. Tailings, waste rock, and sediment in the stream drainage have been shown to have elevated concentrations of mercury. The creek is a tributary to Garoutte Creek, which flows into the Coast Fork Willamette River that in turn empties into the Cottage Grove Reservoir. The EPA has determined that the potential release of high concentrations of particulate mercury in surface water that could travel downstream in the drainage system poses a risk to public health or welfare or the environment. The non-time-critical removal will address this risk by stabilizing, removing, or containing the contaminated tailings, waste rock, and sediment from the part of the stream drainage within the mine complex.

Although the land where the Black Butte Mine is located is privately owned, because of the EPA's involvement, the removal action is an undertaking of the federal government and is subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800 (Section 106), to the extent practicable. EPA contracted with Ecology and Environment, Inc. (E&E) to provide technical assistance and support under Superfund Technical Assessment and Response Team (START) IV contract number EP-S7-13-07. E&E retained Applied Archaeological Research, Inc. (AAR), to conduct a cultural resource study of the area of potential effects (APE) for the removal action. This report describes the results of AAR's study, which included in-depth research on the mine, a survey of the APE for the removal action, a survey of built environment resources, recording a standing structure as a historic property, and recording the part of the mine complex located in the project APE as a historic-era cultural resource. An Oregon State Historic Preservation Office (SHPO) archaeological site record form accompanies this report as Appendix A. An Oregon SHPO clearance form for the standing structure is included in the report as Appendix B.

Background research was conducted by Bill R. Roulette, M.A., RPA, and by Thomas Becker, M.A., RPA. Fieldwork was conducted by Mr. Becker on April 3, 2018. Because of the documented contaminants at the site, the fieldwork was conducted under a health and safety plan prepared and approved in advance of the site visit. Mr. Becker has completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) 29 CFR 1910.120(e) training and has current certification. He wore modified Level D personal protective equipment during the fieldwork and wore a respirator fitted with mercury vapor cartridges as necessary during it. Aimee A. Finley, M.S., prepared the Oregon SHPO clearance form using photographs and information collected in the field by Mr. Becker.

Description of the Area of Potential Effects

The APE is located in the southeast quarter of Section 8, Township 23 South, Range 3 West, Willamette Meridian. It is at an elevation of between 1,000 and 1,300 feet above mean sea level (amsl), rising from its northwest to its southeast corner. It is situated along the southern edge of the Coast Fork Sub-basin of the Upper Willamette Basin of the Willamette Region. It is located on the northwest flank of Black Butte, which is bordered by Garoutte Creek on the west and Dennis Creek on the north. A section of Furnace Creek flows through it. Furnace Creek is an intermittent stream that drains the northwest face of Black Butte. As noted, it flows northwest into Garoutte Creek, a tributary of Coast Fork Willamette River.

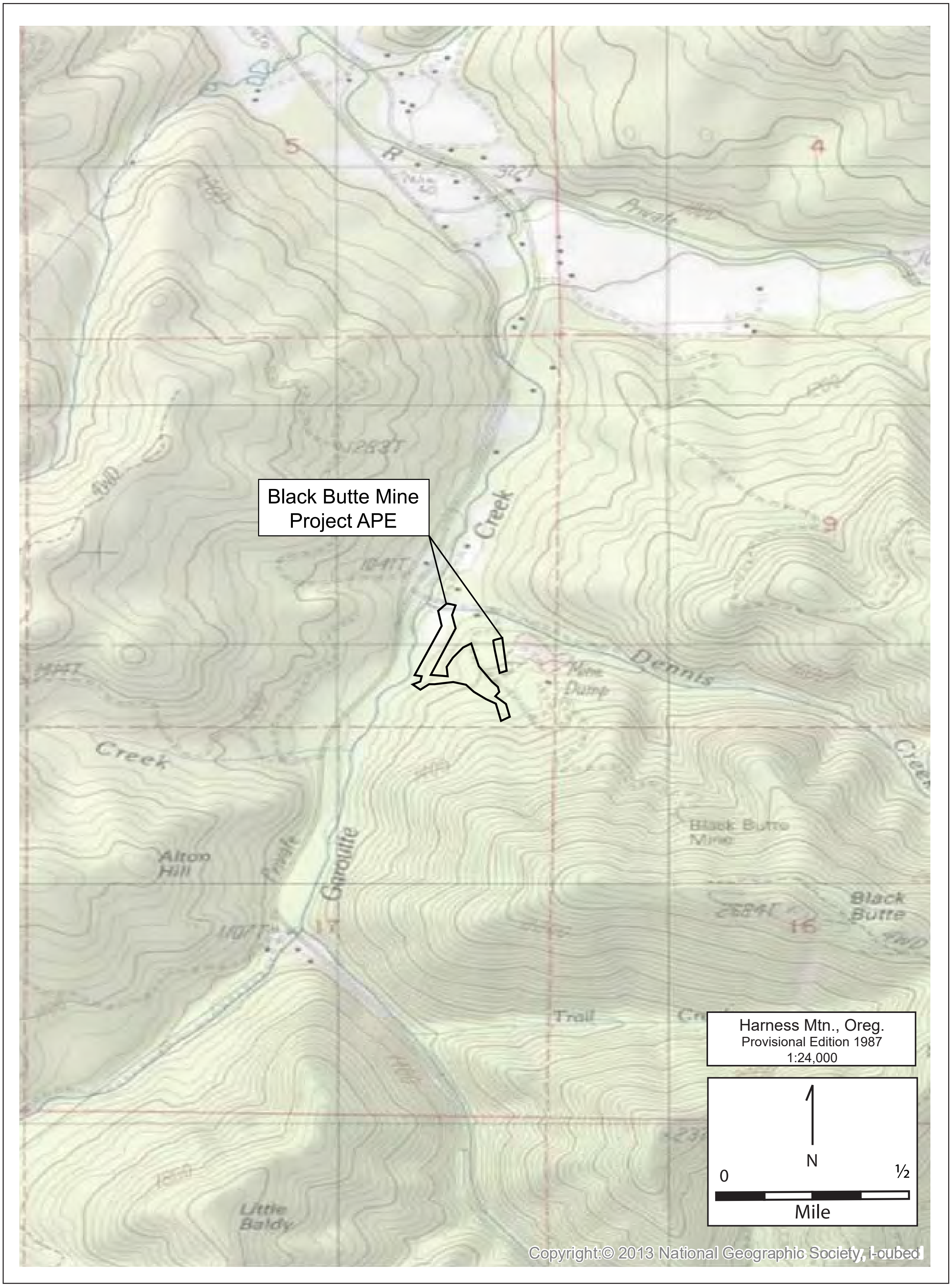


Figure 1. Location of the Black Butte Mine project APE.

The APE is located in what would have been the northernmost part of the Black Butte Mine complex. At present, it is not readily recognizable as the scene of a mining operation. It is overgrown with an unmanaged woodland composed of mixed deciduous and conifer trees with an understory composed of Scotch broom, Himalayan and trailing blackberry, vine maple, wild flowers, grasses, ferns, and shrubs.

The APE is an irregularly-shaped tract composed of four work areas designated Work Area 1 through 4 that together contain approximately 13.1 acres (Figure 2). Work Areas 1, 2 and 3 are contiguous and focused on Furnace Creek. Work Area 4 is removed from the others and while part of the removal action is not directly related to the remediation of Furnace Creek.

Work Area 1 is 3.4 acres in size. It consists of a section of an existing two-track road and buffers on each side of the road. The road will serve as point of access for machinery to reach the western end of Furnace Creek and will be used as a haul road. The road is currently an unimproved two-track. It runs generally southward from the main site access road (Figure 3). With buffers, the section of it in the APE is approximately 920 feet long and 160 feet wide. Prior to construction activities, vegetation will be removed, and gravel may be laid down on the road.

Work Area 2 measures approximately 770 x 400 feet and encompasses approximately 5 acres (Figure 4). It is north of Furnace Creek and east of Work Area 1. It mainly will be used for accessing Furnace Creek and for staging. In an as-of-yet undetermined location, the road in Work Area 1 will be extended to Work Area 2 to provide access to the creek. The work area will be cleared of vegetation and gravel may be laid down on the road. At the outset of the project, Work Area 2 was known to contain some remnant of the mine's original processing plant referred to as the Old Furnace to distinguish it from a later processing plant referred to as the New Furnace. Whatever remains of the old plant may be removed during the project.

Work Area 3 contains about 3.2 acres and consists of the section of the Furnace Creek ravine that will be the focus of the removal action (Figure 5). It measures approximately 1,400 feet east-to-west and 100 feet north-to-south. Contaminated soils and debris will be removed from the banks of the ravine and bed of the creek using pieces of heavy machinery. The material will be placed in haul trucks and transported to an on-site repository.

Work Area 4 is about 1.4 acres in size and measures approximately 430 feet north-to-south and 140 feet east-to-west. It is centered on a small, unnamed intermittent stream that at present flows toward an on-site repository. In the work area the stream may be re-routed around the repository and into a small drainage to the north (Figure 6).

Site Background

In 2007, at the request of the Oregon Department of Environmental Quality, EPA conducted a time-critical removal action in a different part of the Black Butte Mine site after it was determined to be a contributor to mercury contamination in Cottage Grove Reservoir (Andersen 1996; Curtis 2003). The APE for the 2007 removal action was primarily located east of the current APE but it overlaps to a small degree with Work Areas 2 and 3 of the current APE (Figure 2). The action focused on the removal of tailings from Dennis Creek and re-grading a large tailings pile above the creek to prevent erosion. Mercury-impacted tailings and soil at the location of the Old Furnace and New Furnace were capped with sediment.

Figure 2. Configuration of the project APE showing Work Areas 1-4. The area surveyed in 2007 is outlined in blue.

Figure 3. View looking south of Work Area 1.

Figure 4. View looking west of Work Area 2.

Figure 5. View looking east of Work Area 3.

Figure 6. View looking north of Work Area 4.

A cultural resources survey was conducted at the parts of the site to be impacted by the 2007 removal activities (Smits et al. 2007). As a result of the survey several features related to the historical mine were observed such as standing structures, collapsed structures, mining-related equipment, and mining landscape features including tailing piles and mine-related roads (Smits et al. 2007). These features were not formally recorded as an archaeological resource. Instead, Smits et al. (2007) recommended that they should be documented and also evaluated for eligibility to be listed on the National Register of Historic Places (NRHP). It was their opinion that "…the furnace and remnants of the structure would be considered contributing elements of the mine that would likely be considered as an eligible National Register of Historic Places property" (Smits et al. 2007:6). Although Smits et al. (2007) did not record the site the Oregon SHPO's Oregon Archaeological Records Remote Access (OARRA) database has a tickler in its location. A tickler is used to indicate the presence of a cultural resource that has not been formally recorded. In the present case it marks the location of the mine as known from historical sources.

RESULTS OF BACKGROUND RESEARCH

Previous Work in the Project Vicinity

According to the SHPO OARRA database, other than the aforementioned survey associated with the 2007 time-critical removal action, four cultural resource investigations have been conducted within one mile of the APE (Southard 1991a, 1991b, 1991c, 1997). Each was connected to timber sales on federal lands managed by the Bureau of Land Management. No cultural resources were found during them.

Historical Context

Mercury, or quicksilver, is a distinctive, shiny, heavy metal. It was known to the ancient world and has been used in the amalgamation and refining of gold and silver for nearly 2,000 years. Throughout the Middle Ages the metal was in great demand by alchemists because of its fusibility properties. By the sixteenth century its physical properties were well known (Zidle 1967:17). Following the Industrial Revolution, new uses for the metal were found in manufacturing, medicine, dentistry, munitions, and agriculture. Because of the costs to extract and process quicksilver-bearing ore, mercury production has typically been tied to the value of the end product, which has fluctuated over time (Zidle 1967). In Oregon, mercury mining experienced two boom periods. The first was between 1916 and 1919 and was largely driven by the need for mercury fulminate by munitions makers during World War I. The second boom period was between 1927 and 1945. During this period world prices for mercury were driven up by the efforts of the Spanish-Italian Mercury Cartel to control the market and were sustained by the need for mercury during World War II (Brooks 1963:15-18; Zidle 1967:49-57). The Black Butte Mine operated discontinuously from the 1890s into the 1960s. It had five periods of commercial operation: ca.1898-1908, 1916-1919, 1927-1943, 1955-1957, and 1964-1968. The second and third of these periods were clearly influenced by, but do not perfectly conform to, the boom periods of Oregon mercury production.

Over time, ore processing took place in two different areas of the mining complex. The original processing site, centered on the Old Furnace, overlaps with the current project APE (Figure 7). The Old Furnace was in operation during the first two periods of mining operations, ca.1898-1908, and 1916-1919. As will be described below, by 1929 it was dissembled when the New Furnace was built to its south and outside of the project APE. For that reason, this review focuses on the first two periods of mine operations that are most pertinent to the present study.

First Period, ca. 1898-1908

The deposits of cinnabar that would become the Black Butte Mine were discovered in 1890 by S.P. Garoutte (Brooks 1963; Wells and Waters 1934:40). As was described at a later date, seams of high-grade ore were found along a series of fractures in the local andesitic bedrock. The bedrock was also found to contain a large quantity of low-grade cinnabar ore. In 1897, the Black Butte Quicksilver Mining Co., owned by John Barneson, John A. Campbell, and J. Behrman, operated the mine (*Eugene Daily Guard* 1897). Sometime, and presumably in the 1890s, the Old Furnace and the condenser system was constructed. The furnace was a Scott-Huttner, which was the industry standard at the time and was capable of processing 40 tons of ore a day (*Mining Reporter* 1905:162). It was housed in a large structure beside which were a series of brick-chambered condensers that were operated by natural draft.

By 1904 over 12,000 feet of adits, upraises, shafts, and winzes had been opened, reaching a vertical depth of 1,500 feet (as measured downward from the top of Black Butte). The ore shoots were said to increase in richness with depth, with some drifts opened up to 2,000 feet along the length of a fracture (Stafford 1904:99-100).

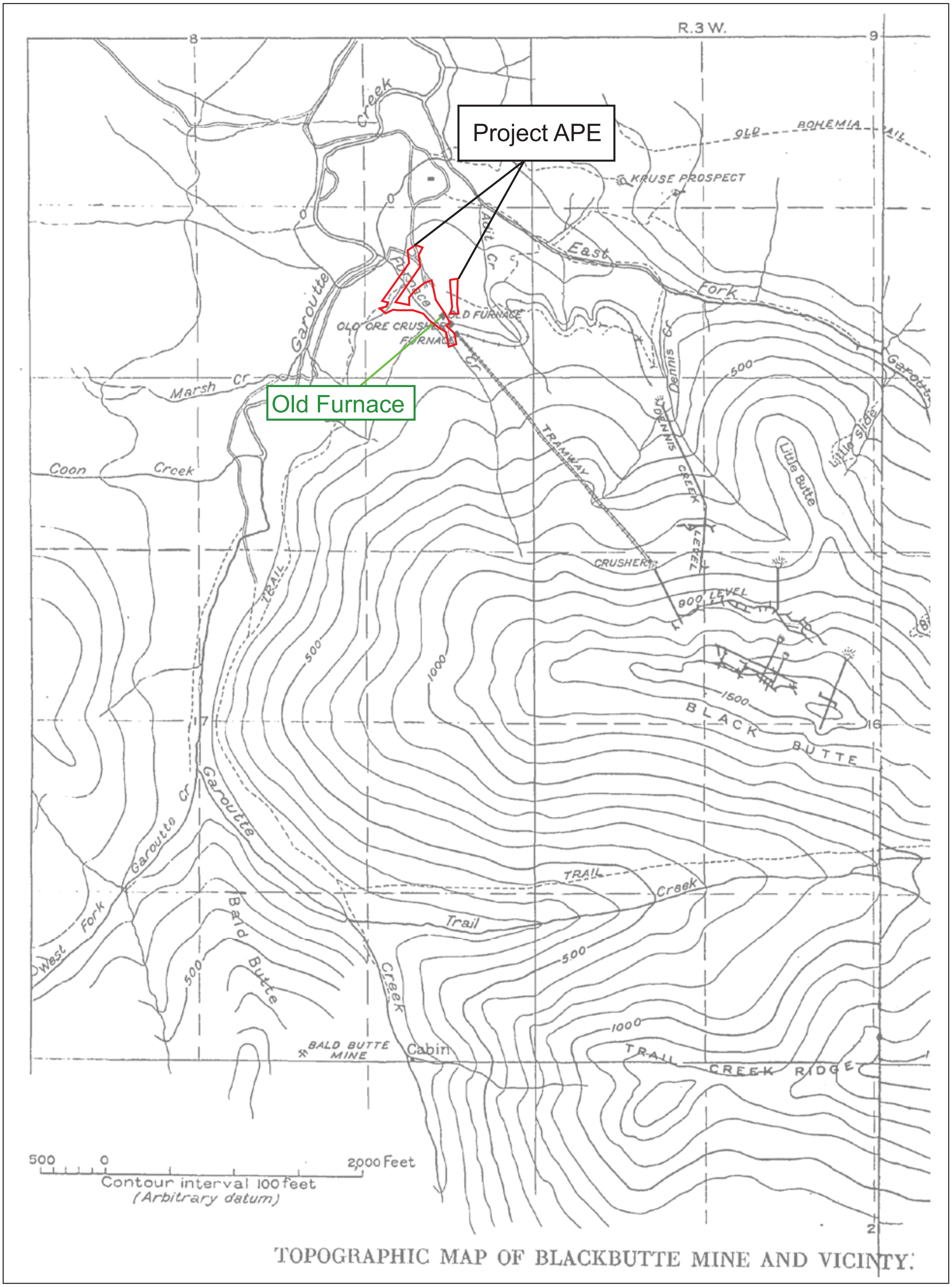


Figure 7. The Black Butte Mine complex as it appeared in its third period of operation, 1927-1943 showing the location of the "Old Furnace" in the project APE (adapted from Wells and Waters 1934, Plate 8).

By 1905, it was found that while the Scott-Huttner furnace was very capable of processing high-quality ore, it was inadequate for reducing the low-grade ores that were common at the site. In an attempt to more efficiently extract mercury from the low-grade ore, General Manager William B. Dennis designed and built a small, experimental furnace at Black Butte Mine that operated for a few months in 1905. Called the Dennis Roasting Furnace, he received a U.S. Patent for his design as well as for a wood-gas producer that improved its efficiency. The wood-gas producer helped produce a cleaner fuel from the resinous fir trees growing on the property (Schuette 1938). The furnace used separate roasting zones which maintained a constant temperature difference between ore and the heating gases, which increased production by shortening the roasting time. Whereas the Scott-Huttner furnace could roast 40 tons in 24 hours, based on the productivity of the experimental-scale furnace, a production-scale version of it would be able to process up to 500 tons per day (*Mining Reporter* 1905:162; *Mining and Scientific Press* 1908: 365). However, due to a drop in the price of mercury in 1905, Dennis never constructed a production-scale furnace (Schuette 1938).

The mine remained idle in 1906, but was in operation by 1907 (*Mining and Scientific Press* 1908:365). In lieu of constructing a new Dennis Roasting Furnace, Dennis modified the existing Scott-Huttner furnace to increase its efficiency and made other additions. The plant was electrified and outfitted with electrical lighting. A new crushing plant was constructed that was equipped with a Sturtevant coarse-ore crusher and a Gates gyratory fine-ore crusher capable of crushing 200 tons per 12 hours. A new, specially-designed 125-ton capacity dryer was also constructed.

The modified furnace featured a wood fire that was maintained above the stack, which was 40 feet high, with the hot gas drawn down through the use of electric fans (*Mining and Scientific Press* 1908:245). The draft was produced by two No. 70 Sturtevant exhausters that were powered by a 35-horse power variable-speed motor. Improvements were also made to the existing condensing plant following Dennis' own design that made it so that gases from ore roasting were vented at or below atmospheric temperature, which allowed for perfect condensation of the mercury vapor eliminating the chemical or mechanical loss of the metal (*Mining and Scientific Press* 1908:365).

In the mine, by 1908, work was being conducted at the 100-, 200-, 300- and 400-foot levels. An aerial tramway was used to transport ore to the furnace from the 600-foot level. A record of production for this period is incomplete, but a minimum of 1,126 flasks were produced (Brooks 1963). For unspecified reasons, but presumably because of a drop in mercury prices, the mine ceased operations before the end of 1908.

Second Period, 1916-1919

The mine remained closed until 1916 (Brooks 1963). With an increase in the demand for mercury during World War I, the mine was reopened by B. B. Lawrence and Associates from New York, managed by Earl B. Crane. That group operated the mine until 1919. During this period, improvements were again made to the Scott-Huttner furnace and condensing system (Brooks 1963). The furnace capacity was increased with an artificial down-draft system which used two 42-inch suction fans to increase capacity by 25 percent. Changes to the condenser system included the addition of an intermediate water-cooled, cast-iron pipe condenser and an elaborate supplemental condenser constructed of brick and concrete and 18-inch clay pipes, referred to as the Dennis terra cotta pipe condenser (Schuette 1931:37-8; 1938:82). A sketch of what it looked like during this period is included in Schuette's *Quicksilver in Oregon* technical report (Schuette 1938:82, Figure 9). The sketch shows the layout of the original furnace and condenser plant as it would have appeared during the first period of operation after the 1907 upgrades along with the improvements made to it during the second period (Figure 8). The sketch lacks a scale but even so, it can be seen that the the processing plant that included the furnace, the condensing system, and the cooling plant was a substantial structure.

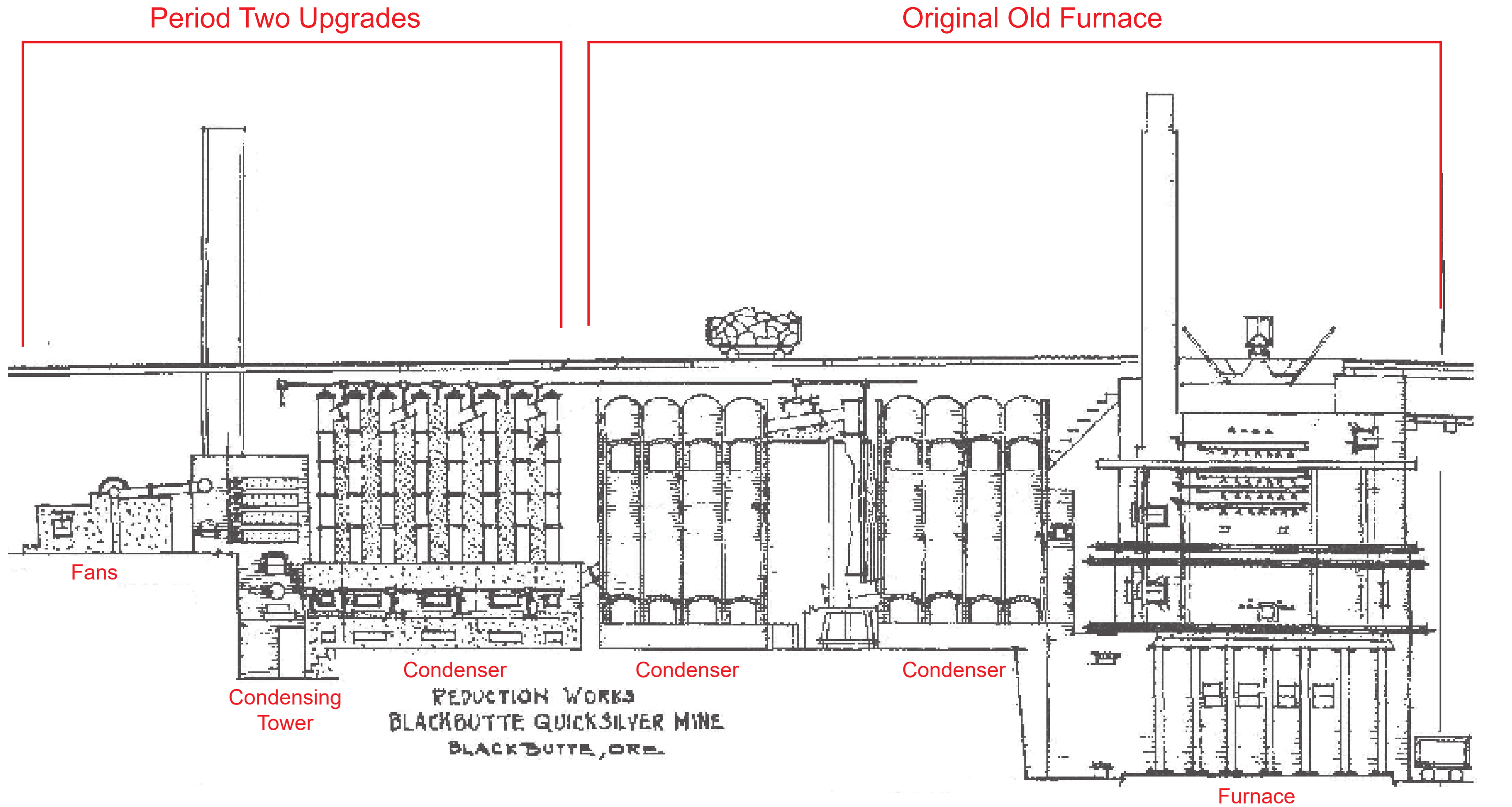


Figure 8. Elevation schematic of the "old" Black Butte plant depicting the facility as it appeared in its first and second periods of operation (adapted from Schuette 1938:82, Figure 9).

In total, 1,254 flasks were produced at Black Butte Mine between 1916 and 1919. However, with the end of the war demand for mercury plummeted and the mine could not be operated at a profit and so it was shuttered once again. Its fate was similar to mercury mines across the country following the collapse of the mercury market. Domestically, the number of operating mercury mines fell from 66 in 1916 to 11 in 1921 (Zidle 1967:57).

Third Period, 1927-1943

In 1927, the property was purchased by the Quicksilver Syndicate. The old Scott-Huttner furnace was dismantled and by 1929, the New Furnace building was constructed. It housed two 60-foot-long rotary furnaces. The new furnaces increased the mill's capacity to process ore to 150 tons per day. During the third period the mine operated at the 500-, 600-, 900-, 1,100-, 1,300-, and 1,600-foot levels, with a tramway that extended upwards to the 900-foot level. The various levels were entered via adits located on the northeast side of the butte, and connected to each other by raises. In 1930, production was focused on the 900-foot and 600-foot levels (Wells and Waters 1934:40). During this period, including the mine works complex covered approximately 200 acres (Figure 7). On the 1930s, between miners and those that worked in the processing plant, the facility employed about 40 workers. Approximately 140 tons of ore were being processed per day yielding between 4.5 and 5.5 pounds of mercury per ton (Schuette 1931:37). By the early 1940s, the ore deposits were largely played out. After re-treating old furnace tailings the mine closed in 1943 (Brooks 1963). With a total of 13,342 flasks produced, the period between 1927 and 1943 was the most productive time of mine operations.

Fourth Period, 1955-1957

After having been closed for a dozen years the mine was reopened by the Mercury & Chemicals Corp. of New York, which explored, developed, and mined ore from the 900- and 1,100-foot levels (Brooks 1963). The company installed a 100-ton rotary furnace and new ore bins. In all, 342 flasks were produced during this period.

Fifth Period, 1964-1968

With an increase in international prices for mercury, the Black Butte Mine was reopened in December 1964 by the American Mercury Corp., although the property was still owned by the Quicksilver Syndicate (Mason 1965:1-2, 14). An oil-fired furnace was installed that had a capacity of 80 tons per day with a recovering of 2.5 to 3 pounds of mercury per ton. Thirty people were employed at the mine in 1964. Work focused on the 900- and 1,100-foot levels, with the 1,100-foot level adit used for access and loading the ore into trucks to be transported a half mile to the furnace plant. In addition, explorations were conducted below the 1,100-foot level (Mason 1965:14). Between 1965 and 1967 it appears that mining operations ceased. However, they resumed for a brief period between 1967 and 1968 when ore was mined from the 1,250-foot level. No additional information related to this final period is available (Brooks 1971).

FIELD METHODS AND RESULTS

Archaeological Field Methods

Fieldwork was conducted by AAR archaeologist Thomas Becker, M.A., RPA, on April 3, 2018. It was limited to a pedestrian survey during which the ground surface was closely examined for archaeological material. When cultural material was encountered, to the extent possible it was identified and described in a field notebook, photographed, plotted on a project map, and left in place. However, due to the presence of mercury, objects were not handled. Dense vegetation, steep terrain, and security fencing precluded a comprehensive, systematic survey of the entire APE. Where it was possible to do so, such as Work Areas 1 and 3, the APE was surveyed by walking transects spaced no more than 10 meters apart. In Work Areas 2 and 4 transects were placed opportunistically both in terms of their placement and their spacing.

Built Environment Study Methods

The APE contains a standing structure. Research was conducted to determine its age. It was photographed to document its setting and detail of their construction.

Results of the Archaeological Fieldwork

Due to vegetation, surface visibility was no better than one-percent in most of the work areas. It was comparatively best in Work Areas 1 and 3 where a two-track road and creek banks provided some soil exposures, but even in those areas visibility was no more than five-percent. Despite overall poor surface visibility, structural debris, a standing structure, and scattered objects of material culture were observed in Work Areas 2 and 3. Given the dates of mine operation, other than the standing structure, which was recorded as a historic property, the cultural material observed in the APE has been recorded as a historic-era archaeological site that temporarily is designated AAR 2026-1. A site documentation form has been submitted to the Oregon SHPO. A copy of it is included in this report as Appendix A. The site primarily is located in Work Area 2 but extends into Work Area 3. It is 300 feet long measured northwest to southeast, and 120 feet wide measured on a perpendicular axis (Figure 9).

The site includes structural debris that is located in the southeastern part of Work Area 2 near the north bank of Furnace Creek. The debris consist of broken slabs of metal-beam-reinforced concrete and brick (Figure 10). The slabs represent the ruins of a collapsed structure that likely was a small part of the Old Furnace/condenser plant which was dismantled around 1927. The upper surface of the topmost slab has a series of round holes in it. The holes are likely where tile pipes that were part of the supplemental condenser system installed ca. 1916-1919 entered the mercury collection building (Figure 11). The ruins are roughly rectangular. They are between 3.5 and 7 feet tall. They have a maximum length of 30 feet measured north and south on their west end and 15 feet wide measured east to west on their north end.

Several lengths of the broken tile pipe and one large complete ceramic pipe fitting were observed near the ruins (Figure 12). They are interpreted as elements of the Dennis terra cotta pipe condenser, which is known to have included similar pipe (Schuette 1931:37-8). The sections of pipe are constituents of a small scatter of materials located south of the ruins, which extends into the Furnace Creek ravine. The scatter also contains red bricks and a large sheet metal object that is in the shape of a cone with a spout at one end that likely was part of the furnace's venting system, and lengths of iron and corrugated metal pipe. No maker or manufacturer marks were noted on the bricks or other objects. Overall, the scattered materials are spread throughout an area that measures about 30 feet by 50 feet. They seemingly represent all that remains of the Old Furnace plant. This indicates that when that plant was dismantled at the beginning of the mine's third period of operation, the vast majority of it was hauled away.

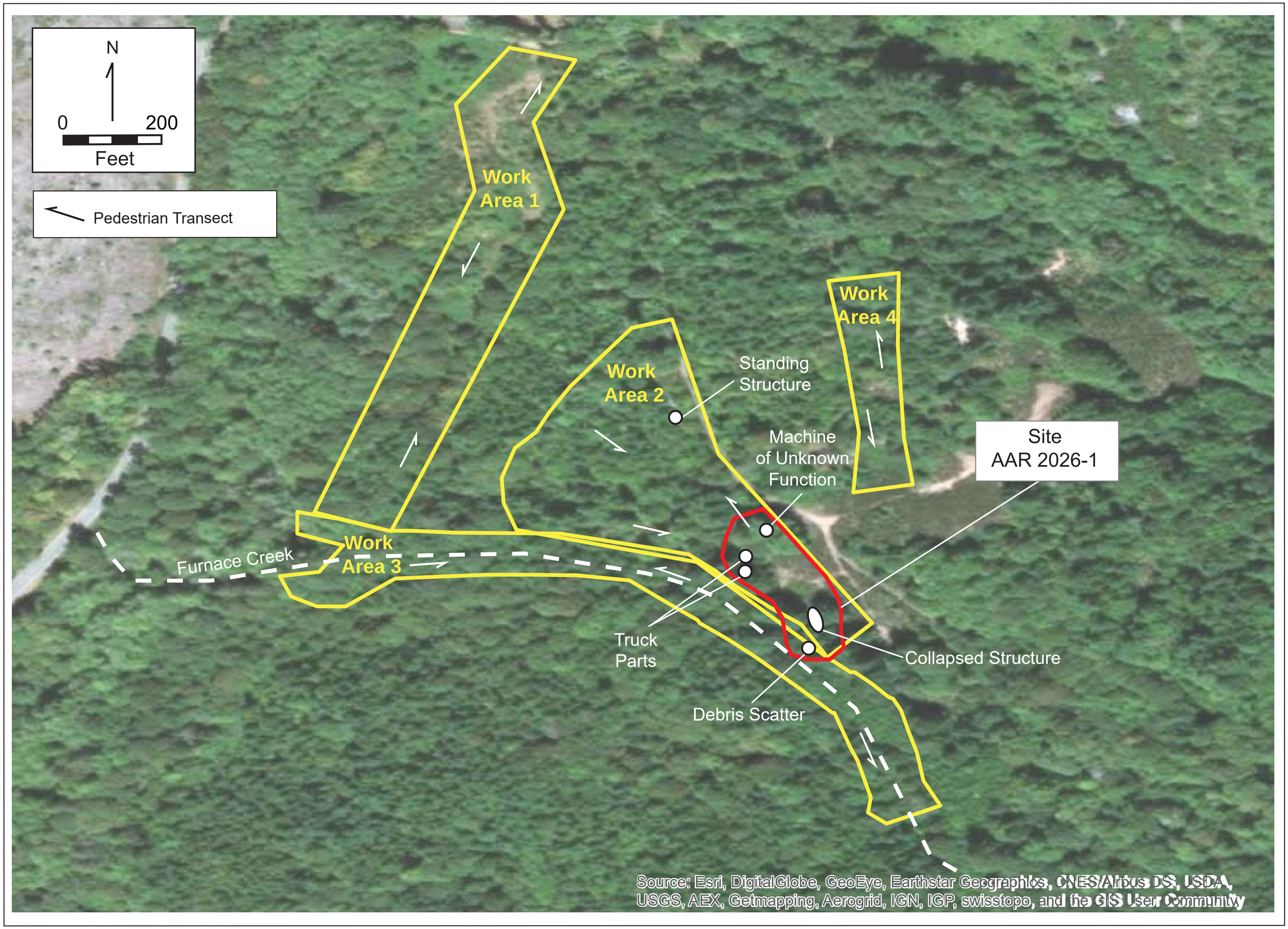


Figure 9. Image of the project APE showing the location of the pedestrian transects, site AAR 2026-1 with its constituent parts, and the standing structure.

Figure 10. View looking north of the structural remains from the Old Furnace plant. Scale is one meter long.

Figure 11. View looking south of the top of the uppermost slab showing the round holes where tile condenser pipes would have entered the mercury collection building.

Figure 12. Ceramic tile pipe, ceramic fitting, and a large sheet metal object found near the structural debris.

A piece of machinery of unknown function was found in the northeastern part of Work Area 2. The machine is solid metal. It is approximately 5 feet long and 2 feet wide (Figure 13, inset). It has two spoked wheels at one end that are approximately 4 feet in diameter. Each wheel has six two-inch wide spokes. The outside part of each wheel rim is embossed with the words "AMERICAN ROAD MACHINERY CO. FORT WAYNE INDIANA" (Figure 14). Research into that company shed no light onto what the machine may represent.

Between the two wheels is a depression that likely was an engine well. The engine has been removed. With its wheels, the machine could have been some kind of rolling stock. However, it is more likely that the wheels were used to turn belts that powered some other piece of equipment. It is similar in overall form to a device shown in an illustration of the Dennis Furnace that was published in *Mining Reporter* in 1905 (Figure 13). In the illustration the device is shown turning belts that supplied power to the condensers, possibly to operate the draft or cooling systems.

The site also includes a truck cab and what appears to be part of the chassis or bed of the same vehicle. The truck parts are located about 180 feet northwest of the structural debris. The cab is upside down. Parts of it are crushed and all of its windows have been broken (Figure 15). The truck appears to have originally been painted red, but was later painted blue. The exposed part of the nearby chassis/bed is painted in the same colors suggesting that it and the cab are elements of the same vehicle. An emblem on the driver's side door of the cab reads "L-190 Series," which identifies the vehicle as an International Harvester L Series, which was first produced around 1950. Vehicles in the L Series were often used as fire or logging trucks (VanNatta 2017).

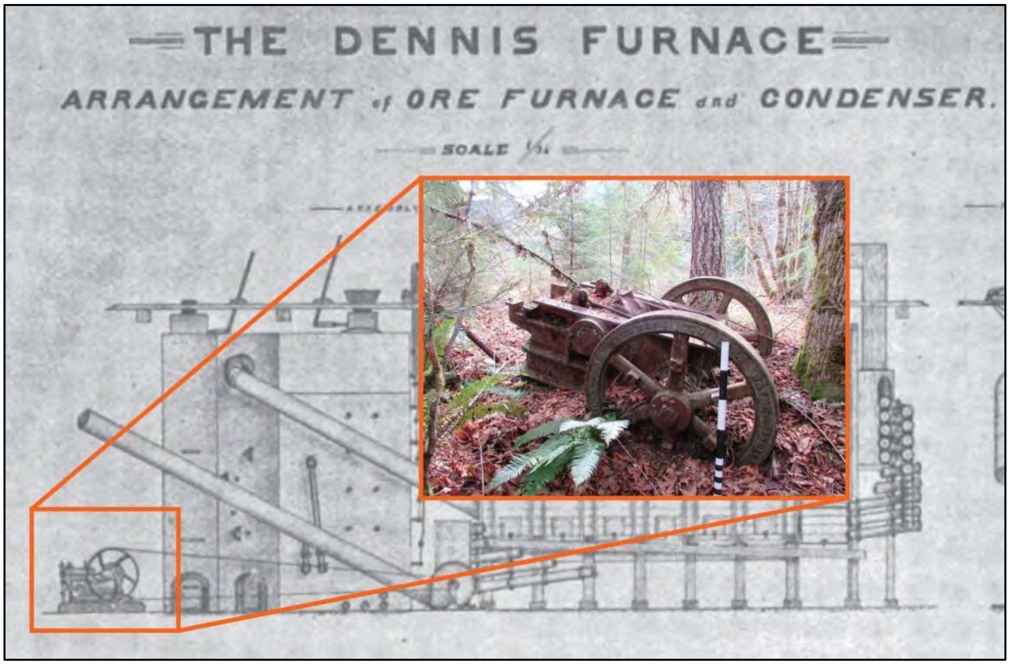


Figure 13. Image from Volume LII, No. 7 of *Mining Reporter* dated August 17, 1905, showing engine turning belts that supplied power to the condensers in the Dennis Furnace, with an inset showing the piece of equipment found in Work Area 2.

Figure 14. Detail of the spoked wheels on the piece of equipment. The embossed lettering reads "AMERICAN ROAD MACHINERY CO. FORT WAYNE, INDIANA." Scale is one meter long.

Figure 15. International Harvester L-series truck cab located in Work Area 2. Scale is one meter long.

Result of the Built Environment Study

A standing structure is located in the northern part of Work Area 2. It has been recorded as a historic property. An Oregon SHPO clearance form has been completed for it and a copy of the form is included in the report as Appendix B.

It is constructed of materials, such as corrugated fiberglass and corrugated metal panels, mill-cut boards, and tar paper, that are not identifiable as historical, and it lacks formal architectural style. As a consequence, it cannot be dated to a discrete period. It is in the general location of a structure shown on a 1:64,000-scale topographic map published in 1954 by the United States Geological Survey (USGS) however the small scale of the map makes it difficult to pinpoint specific features (USGS 1954).

The building is presumed to be associated with the operation of the Black Butte Mine, but its specific function is unknown. It is in disrepair and was not entered during fieldwork. It is a wood-framed, rectangular building with a west-facing front façade. It is approximately 30 feet long and 10 feet wide (Figure 15). It is one story in height and has a shed roof. The structural system was not observed but it is assumed to be a braced-frame form with wire nail fasteners. It is composed of two bays, one on either side of a central entry. One exterior wall is clad in horizontally-placed wood boards that in places retain a tar paper covering. Other exterior walls are covered with corrugated metal or fiberglass siding. The roof is corrugated metal. Corrugated metal and fiberglass have been in use since the early twentieth century. It does not appear to rest on a foundation. It has a single horizontal, sliding aluminum window on its north side. A manufacturing decal still affixed to the window possibly indicates that the window is not original (Figure 16). An opening on its south side likely contained a similar window. Electrical wires lead to the structure from the north. It likely was used during the fourth or fifth period of mine operations, ca. 1956-1968, as an office or storage facility.

Figure 16. View looking east of the west façade of the standing structure in Work Area 2.

Figure 17. Detail of the structure's north façade.

SUMMARY, PRELIMINARY ASSESSMENT OF SIGNIFICANCE, AND RECOMMENDATIONS

Summary

During the survey of Work Areas 2 and 3, materials were observed that are related to or potentially related to the historical Black Butte Mine. Given the date of mine operations, the materials have been recorded as a historic-era archaeological site that temporarily is designated AAR 2026-1. The site contains structural ruins, a machine of unknown function, parts to a truck, and a light scatter of objects believed to be related to the Old Furnace plant.

The structural ruins represent a small part of the Old Furnace/condenser plant that dates to the mine's two earliest periods of operation, ca. 1897 to 1927. A sheet metal object and sections of ceramic tile pipe and a ceramic fitting observed near the remains very likely represent debris from the Old Furnace/condenser plant, which was dismantled around 1929. The machine of unknown function is of uncertain age but is presumed to date generally to the same period. A truck cab and chassis/bed dates to the 1950s or later and are believed to be associated with the mine's fourth and fifth periods of operation, ca. 1956-1968.

As defined by the results of the current project, the site is 300 feet long measured northwest to southeast, and 120 feet wide measured on a perpendicular axis. It undoubtedly extends beyond the current project APE to the part of the mine complex that was surveyed in 2007 (Smits et al. 2017). However, for present purposes, the site is defined by the cultural material observed by AAR during the survey of the current project APE.

In addition, a standing structure was found in the northern part of Work Area 2. It was recorded as a historic property and an Oregon SHPO clearance form has been completed for it. Based solely on its location, the building is presumed to be associated with the operation of the Black Butte Mine, but its specific function is unknown. It is constructed of materials that are not identifiable as historical and it lacks formal architectural style. As a consequence, it cannot be dated to a discrete period. It is in the general location of a structure shown on a 15-minute topographic map published by the USGS in 1954 and thus could date to the mid-twentieth century. At the same time, the small scale of the map makes it difficult to pinpoint specific features.

Preliminary Assessment of Significance

Counting the mine works and the ore processing and mercury production areas, the Black Butte Mine complex covered approximately 200 acres at its fullest extent. AAR's study focused on a small part of the complex and it was not designed or intended to evaluate the significance of the entire Black Butte Mine site or its eligibility to be listed on the NRHP. However, the study did provide information that can be used to make a preliminary assessment of the contributory value of AAR 2026-1 and the standing structure to the mine's significance and potential NRHP eligibility.

The Code of Federal Regulations (CFR) at Part 60.4 states that to be eligible for listing on the NRHP, a cultural resource must be significant in American history, architecture, archeology, engineering, or culture and possess integrity of location, design, setting, materials, workmanship, feeling, and associations. In addition, the resource must also possess one of the following:

A. be associated with events that have made a significant contribution to the broad patterns of our history; or
B. be associated with the lives of persons significant in our past; or

C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

Integrity of AAR 2026-1

As described by Nobel and Spude (1997:19) "Integrity is the ability of a property to convey its significance." In making the preliminary assessment of the contributing value of AAR 2026-1 to the Black Butte Mine's overall potential to be a NRHP-eligible resource we note that the site consists of a small assemblage that includes structural ruins and individual artifacts that are from different periods of mine operations and which do not form a cohesive assemblage. The ruins and items believed to be associated with the early period of mine operations constitute an essentially incidental amount of material compared to the historical scale of the Old Furnace plant (Figure 8). For this reason, it is AAR's assessment that the site itself does convey and therefore does not contribute to conveying the potential significance of the mine complex.

Application of Criteria to AAR 2026-1

In terms of Criterion A, there can be no doubt that during its first three periods of operation, the Black Butte Mine was of state and local historical importance as a leading producer of mercury in Oregon and as an episodically important employer in Lane County. With regard to Criteria B and C, the case could be made that William B. Dennis, who was the general manager at the mine during its first period of operation, was an important person in the history of U.S. mercury production and mining engineering and that his Dennis Roasting Furnace represented the work of a master. However, those themes, while tangentially linked to AAR 2026-1, are not clearly evoked or reflected in the contents of the site. Finally, under Criterion D, it is our assessment that the materials comprising site AAR 2026-1 do not in themselves represent an important source of information about the history of the mine and that additional archaeological fieldwork at the site would not likely yield important information.

For all of the above reasons, it is AAR's preliminary assessment that the part of the mine complex in the APE does not contribute to the potential significance of the Black Butte Mine or its eligibility to be listed on the NRHP. All available and pertinent information related to it was collected during the survey. No further work is recommended as it is unlikely to provide additional information of a nature that would change our preliminary assessment of its contributory value.

Integrity of the Built Environment Resource

Other than its location, no physical attribute of the standing structure in Work Area 2 conveys an association with mining or the Black Butte Mine. As such, it is AAR's assessment that it does not contribute to conveying the potential significance of the mine complex.

Application of Criteria to the Standing Structure

Most likely related to the fourth or fifth period of mining operations, when the mine operated sporadically and produced little mercury compared to its earlier periods, the standing structure is not associated with events that made a significant contribution to local, state, or national history. No evidence was found to suggest it is associated with a person that was significant in history. It does not represent the work of a master or embody the distinctive characteristics of a type, period, or method of construction, and it is not a source of information important in history.

For these reasons, it is AAR's opinion that it does not meet the registration requirements for listing on the NRHP, and should not be considered to be an historic property when assessing impacts of the proposed project. All available and pertinent information related to it was collected during the survey. No further work is recommended as it is unlikely to provide additional information of a nature that would change its eligibility status.

Conclusion and Recommendation

AAR concludes that the removal action will not have an adverse effect on historic properties. AAR does not recommend additional cultural resource investigations for the part of the Black Butte Mine complex located in the APE.

To further ensure that that project has no effect on historic properties, this report includes as Appendix C an unanticipated discovery plan that should be used during the removal action. The plan should be provided to and reviewed by contractors involved in earthmoving to ensure implementation of proper protocols in the event that archaeological deposits are encountered during construction.

As outlined in the plan, should potentially significant historical or pre-contact archaeological materials be found during project implementation, all activities in the vicinity of the finds shall cease immediately and the Oregon SHPO shall be promptly notified and Oregon Revised Statue 358.920 and 36 CFR 800.13 consulted to ensure compliance with applicable state and federal laws.

If during excavations human remains, funerary objects, sacred objects, and/or items of cultural patrimony are identified, all work will halt immediately. The Oregon SHPO, affected tribes, and appropriate City or County representatives will be contacted. Procedures outlined under Oregon State law (ORS 97.740-760 and ORS 358.905-955) will be followed and work will not resume until mitigation measures have been agreed upon by all parties.

REFERENCES CITED

Andersen, Keith
1996 *Preliminary Assessment: Black Butte Mine.* Oregon Department of Environmental Quality, Site Assessment Section, Western Region, Eugene, Oregon. Prepared for U.S. Environmental Protection Agency, Seattle, Washington.

Brooks, Howard C.
1963 *Quicksilver in Oregon*. Oregon Department of Geology and Mineral Resources, Bulletin 55.
1971 *Quicksilver Deposits in Oregon*. Oregon Department of Geology and Mineral Resources, Miscellaneous Paper 15.

Curtis, Lawrence R.
2003 *Final Report: Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir.* Department of Environmental and Molecular Toxicology, Oregon State University, Corvallis, Oregon. Prepared for U.S. Army Corps of Engineers, Portland, Oregon.

Eugene Daily Guard
1897 Owners of the Black Butte Mines Will at Once Commence Prospect Work. 20 November. Eugene, Oregon.

Mason, Ralph S.
1965 Oregon's Mineral Industry in 1965. *The Ore Bin*, 27(1). Oregon Department of Geology & Mineral Industries, Salem.

Mining and Scientific Press
1908 Quicksilver Mines of Oregon. 14 March: 365. Dewey Publishing Company, New York.

Mining Reporter
1905 Volume LII, July to December. The Industrial Printing & Publishing Company, Denver, Colorado.

Mining World
1940 *Black Butte Quicksilver*. Volume 2(1):17-19.

Oregon Daily Journal
1905 Oregon Invention Recognized: Dennis Mercury Furnace to be Permanent Exhibit of Smithsonian institution. 11 October: 6. Portland, Oregon.

Parks, H. M., and A. M. Swartley
1916 *Handbook of Mining Industry of Oregon.* Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, vol. 2, no. 4.

Schuette, C. N.
1931 *Quicksilver.* U.S. Department of Commerce, Bureau of Mines Bulletin 335. United States Government Printing Office, Washington, D.C.
1938 *Quicksilver in Oregon.* State of Oregon Department of Geology and Mineral Resources, Bulletin No. 4.

Smith, Warren D.
1938 *The Geology and Mineral Resources of Lane County, Oregon*. State of Oregon Department of Geology and Mineral Industries, Portland.

Smits, Nicholas, J., Jason M. Allen, and John L. Fagan
2007 *Archaeological Survey at the Black Butte Mine, Lane County, Oregon*. Report prepared for Ecology and Environment, Portland, Oregon. On file, Oregon State Historic Preservation Office, Salem.

Southard, Michael D.
1991a *Big Laurel Timber Sale, South Valley* U.S. Department of the Interior, Bureau of Land Management, Eugene District, Oregon.
1991b *On Black Butte Timber Sale, South Valley.* U.S. Department of the Interior, Bureau of Land Management, Eugene District, Oregon.
1991c *Black Butte Thinning, South Valley.* U.S. Department of the Interior, Bureau of Land Management, Eugene District, Oregon.
1997 *Alton Hill T.S., South Valley.* U.S. Department of the Interior, Bureau of Land Management, Eugene District, Oregon.

Stafford, Orin Fletcher
1904 *The Mineral Resources and Mineral Industries of Oregon for 1903*. Department of Chemistry, University of Oregon, Eugene.

State of Oregon
1940 *Oregon Metal Mines Handbook*. State of Oregon Department of Geology and Mineral Resources, Bulletin No. 14-C Southwestern Oregon, Vol. 1- Coos, Curry, and Douglas Counties.

U.S. Geological Survey (USGS)
1954 Anlauf, Oreg., 15-minute topographic quadrangle. Map on file, Applied Archaeological Research, Inc. Portland.

VanNatta Truck Museum
2017 *International Harvester "L" and "R" Series*. Electronic document http://www.vannattabros.com/truck3.html ,accessed April 5, 2018.

Wells, Francis G., and Aaron C. Waters
1934 *Quicksilver Deposits of Southwestern Oregon*. U.S. Department of the Interior, Geological Survey Bulletin 850. United States Government Printing Office, Washington, D.C.

Zidle, Tobias
1967 *Investigation into Mercury Price Increase of 1964-1967 and Implications for Future Condition of the Mercury Market*. Unpublished Master's Thesis, Department of Geology and Geophysics and Industrial Management, Massachusetts Institute of Technology, Cambridge, Massachusetts.

APPENDIX A

Archaeological Resource Documentation Form for AAR 2026-1

State of Oregon Archaeological Site Record

Administrative Data

Smithsonian Number:		**Alt Site Nbrs:**	AAR 2026-1
Site Name:	Black Butte Mine	**Form Type:**	New
Managing Office*:	Other agency or organization (describe)	**County:**	Lane
Owners(s):	Private		
Ownership/Management Notes:	The site is owned by a private timber company, but the project is being managed by the U.S. Environmental Protection Agency		

National Register Status:

Status	Role	Date	Author
Unevaluated	Fieldworker	04/12/2018	Thomas E. Becker

Site Identification

Site Type	• Mine		
Features*:	• Historic Structure Remains • Mining feature • Mining Mill • Other Mining Equipment	**Cultural Periods(s)*:**	• 19th Century • Early 20th Century (1900-1930) • Depression/WWII (1929-1950) • Recent (post 1950)

Dimensions:	**Length**	300	**Width**	120	**Units**	Feet	**Area**	36000 Sq f
Depth of Cultural Deposits	0 cm							
General Age	Historic							

Location Data

Legal Description:

Township	Range	Section	¼	¼	¼	DLC	Meridian
23 S	3 W	8					Willamette

UTM Coordinates

Type	East	North	Method	Zone	Datum
Feature	494372	4825001	GPS < 10m	10	83

Map References

Map Name/Year	Revision Year
HARNESS MTN 7'	1987

Access Description

From the intersection of London and Weyerhauser roads, approximately 17 miles south of Cottage Grove, head north on London Road for 270 feet. Turn right and drive approximately 350 ft to a gate. From the gate, continue on this road for 1,600 ft to a fork in the road. Park, and proceed on foot approximately 200 ft south to the old furnace.

Environmental Data

Province	Willamette Valley
Basin	Willamette
Subbasin	COAST FK WILLAMETTE
Drainage Name	Garroutte Creek
Elevation	From 1100 To 1300 ft
Aspect	Aspect: NW
Depositional Environment	• Residual
Soil Description	Soil was not observed on site.
Vegetation Description	
Culturally Significant Vegetation	

Water Sources

Name	Type	Stream Type	Stream Class	Distance	Direction
Furnace Creek	Stream	Intermittent	NA	0 *meters*	0 *deg*

Site Setting

Site Description

Site Description	The Black Butte Mine site (temporarily designated AAR 2026-1) is comprised of the remains of a collapsed structure and scattered objects of material culture observed in Work Areas 2 and 3 in the overall project area described in Roulette et al. 2018. The site includes structural debris that is located in the southeastern part of Work Area 2 near the north bank of Furnace Creek. The debris consists of broken slabs of metal-beam-reinforced concrete and brick. The slabs represent the ruins of a collapsed structure that likely was a small part of the Old Furnace/condenser plant which was dismantled around 1927. The upper surface of the topmost slab has a series of round holes in it. The holes are likely where tile pipes that were part of the supplemental condenser system installed ca. 1916-1919 entered the mercury collection building. The ruins are roughly rectangular. They are between 3.5 and 7 feet tall. They have a maximum length of 30 feet measured north and south on their west end and 15 feet wide measured east to west on their north end. Several lengths of the broken tile pipe and one large complete ceramic pipe fitting were observed near the ruins. They are interpreted as elements of the Dennis terra cotta pipe condenser, which is known to have included similar pipe. The sections of pipe are constituents of a small scatter of materials located south of the ruins, which extends into the Furnace Creek ravine. The scatter also contains red bricks and a large sheet metal object that is in the shape of a cone with a spout at one end that likely was part of the furnace's venting system, and lengths of iron and corrugated metal pipe. No maker or manufacturer marks were noted on the bricks or other objects. Overall, the scattered materials are spread throughout an area that measures about 30 feet by 50 feet. They seemingly represent all that remains of the Old Furnace plant. This indicates that when that plant was dismantled at the beginning of the mine's third period of operation, the vast majority of it was hauled away. A piece of machinery of unknown function was found in the northeastern part of Work Area 2. The machine is solid metal. It is approximately 5 feet long and 2 feet wide. It has two spoked wheels at one end that are approximately 4 feet in diameter. Each wheel has six two-inch wide spokes. The outside part of each wheel rim is embossed with the words "AMERICAN ROAD MACHINERY CO. FORT WAYNE INDIANA." Research into that company shed no light onto what the machine may represent. Between the two wheels is a depression that likely was an engine well. The engine has been removed. With its wheels, the machine could have been some kind of rolling stock. However, it is more likely that the wheels were used to turn belts that powered some other piece of equipment. It is similar in overall form to a device shown in an illustration of the Dennis Furnace that was published in Mining Reporter in 1905. In the illustration the device is shown turning belts that supplied power to the condensers, possibly to operate the draft or cooling systems. The site also includes a truck cab and what appears to be part of the chassis or bed of the same vehicle. The truck parts are located about 180 feet northwest of the structural debris. The cab is upside down. Parts of it are crushed and all of its windows have been broken. The truck appears to have originally been painted red, but was later painted blue. The exposed part of the nearby chassis/bed is painted in the same colors suggesting that it and the cab are elements of the same vehicle. An emblem on the driver's side door of the cab reads "L-190 Series," which identifies the vehicle as an International Harvester L Series, which was first produced around 1950. Vehicles in the L Series were often used as fire or logging trucks.
Dates of Use	From: 1897; To: 1967; BP/AD/BC: AD; Method: Historic Record
Site Observations	Present / Quantity: Brick 20; Metal Other 20; Other 20
Estimated Counts	Prehistoric: Historic: 60

Rock Art

No Rock Art Specified

Site Condition

Visit Date	04/03/2018
Site Condition	Poor- Site Damage between 60% and 95%
Field Recorder	Thomas E. Becker, Applied Archaeological Research, Inc.
Artifacts Collected?	No
Activities/Work Performed	Pedestrian survey and recording
	• Weathering

Impacts/Impact Agents	• Erosion • Road • Logging • Decay • Mining
Protective Measures Recommended	

Bibliographic References

Author	Publication Year	Title	Agency/Organization	Primary Reference	User Agency
Bill R. Roulette, Aimee A. Finley, and Thomas E. Becker	2018	Results of a Cultural Resource Study of a part of the Black Butte Mine Site, Lane County, Oregon	Applied Archaeological Research, Inc.	Yes	

Files Uploads

- Site AAR 2026-1 Fig 1.pdf
- Site AAR 2026-1 Fig 2.pdf
- Site AAR 2026-1 Figures 3-6.pdf

Form Entry Recorder:	Aimee Finley	Date: 04/12/2018

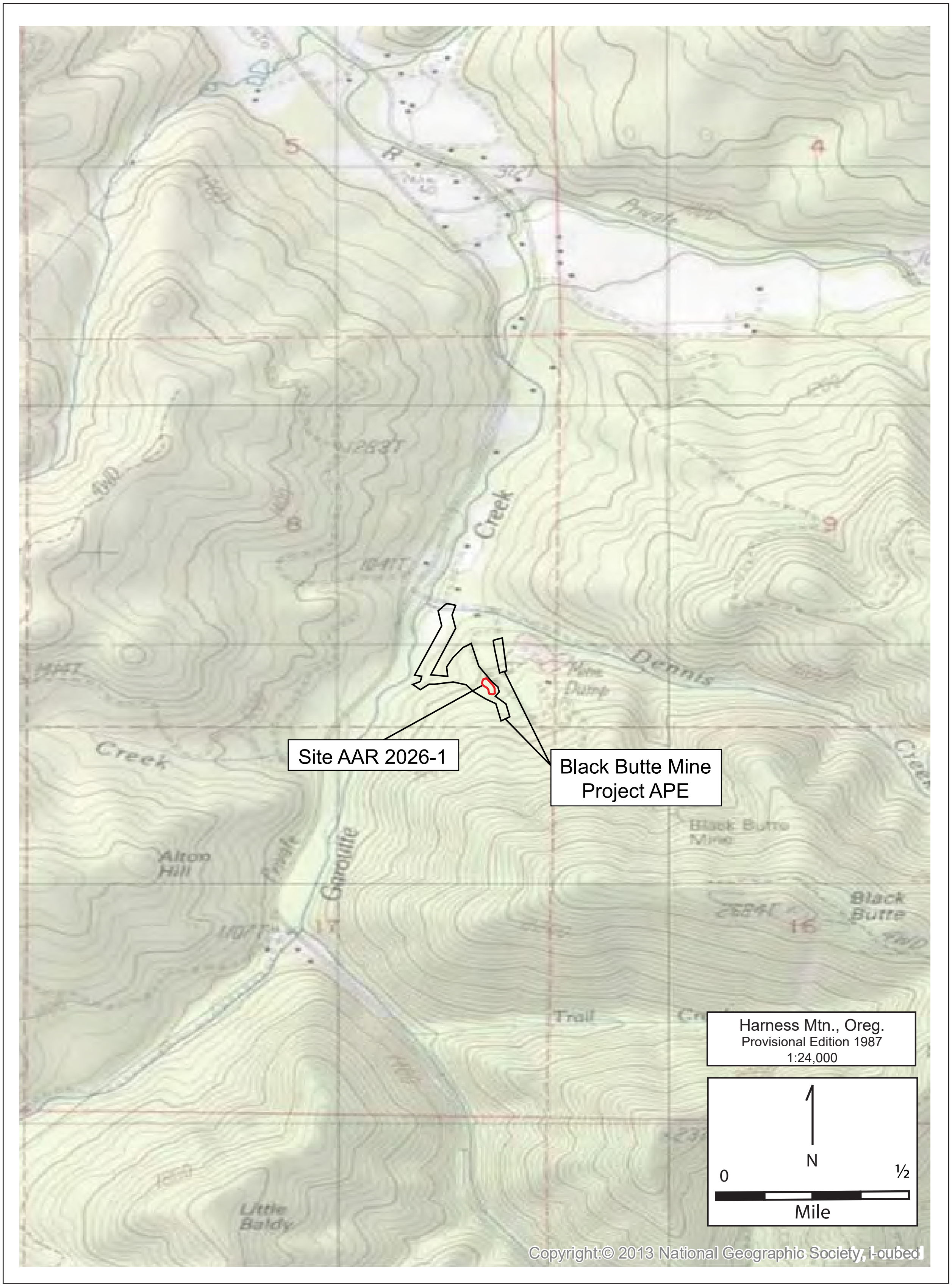


Figure 1. Location of site AAR 2026-1 (outlined in red) within the Black Butte Mine project APE.

Figure 2. Configuration of site AAR 2026-1 within the Black Butte Mine project APE.

Figure 3. View looking north of the architectural remains believed to be part of the Old Furnace. Scale is one meter long.

Figure 4. Sheet metal object, sections of ceramic pipes, and the ceramic fitting found near the ruins of the Old Furnace.

Figure 5. International Harvester L-series truck cab located in Work Area 2. Scale is one meter long.

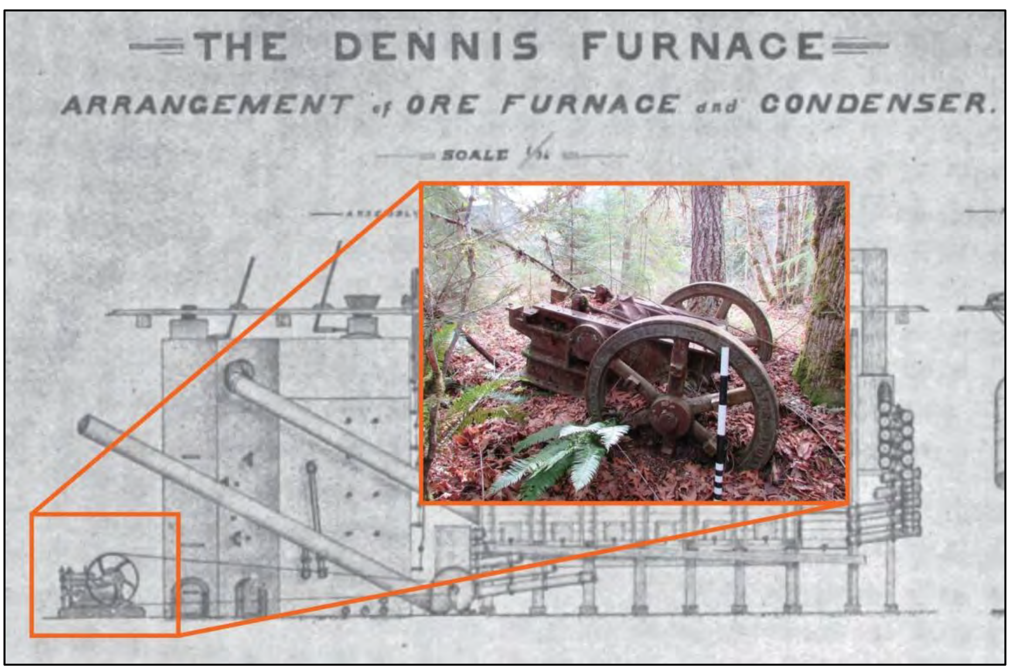


Figure 6. Image from Volume LII, No. 7 of *Mining Reporter* dated August 17, 1905, showing an engine turning belts that supplied power to the condensers in the Dennis Furnace, with an inset showing the piece of equipment found in Work Area 2.

APPENDIX B

Oregon State Historic Preservation Office Clearance Form

OREGON SHPO CLEARANCE FORM

Do not use this form for ODOT or Federal Highway projects or to record archaeological sites

*This form is for: **federal** cultural resource reviews (Section 106); **state** cultural resource reviews (ORS 358.653)*

SECTION 1: PROPERTY INFORMATION	**SHPO Case Number:**
Property Name: Black Butte Mine outbuilding	
Street Address: on the flank of Black Butte, about 15 miles south of Cottage Grove	
City: Cottage Grove vicinity	County: Lane
Agency Project #	Project Name: Black Butte Mine Remediation Project

If there is not a street address, include the Township, Range, and Section, cross streets, or other address description

Owner:	☒ Private	☐ Local Gov	☐ State Gov	☐ Federal Gov	☐ Other:_________

Are there one or more buildings or structures? ☐ YES ☒ NO – If no, skip to Section 2 and append photo(s)

Is the property listed in the National Register of Historic Places? ☐ YES – Individually ☐ YES – In a district ☒ NO

Original Construction date: ____1954___ ☒ Check box if date is estimated

Siding Type(s) and Material(s): corrugated metal — Window Type(s) and Material(s): horizontal slider

Has the property been physically altered? ☐ No Alterations ☒ Few Alterations ☐ Major / Many Alterations

SECTION 2: APPLICANT DETERMINATION OF ELIGIBILITY *- Check the appropriate box*

The purpose of this review is to avoid impacts to properties that are "eligible" (historic) or already listed in the National Register of Historic Places. Fully establishing historic significance can be very costly and time consuming. Therefore initial evaluations are based on age (50 years or greater) and integrity (historic appearance), which are the minimum qualifications for listing in the National Register. Additional documentation may be needed further in the process, but typically initial evaluations allow the review process to proceed expeditiously.

☐ The property is considered **Eligible** at this time because it is already listed in the National Register ***or***
- is at least 50 years old ***and*** retains its historic integrity (minimal alterations to key features)
- has potential significance (architectural or historical)

☒ The property is considered **Not Eligible** at this time because it:
- is less than 50 years old ***or*** is 50 years or older but there have been major alterations to key features
- is known to have no significance, based on National Register-level documentation and evaluation

SECTION 3: APPLICANT DETERMINATION OF EFFECT *- Check the appropriate box*

☒ The project has **NO EFFECT** on historic properties, either because there is no eligible property involved or because the property will not be impacted physically or visually.

☐ The project will have a minor impact on a property that is eligible or already listed in the National Register, and therefore there is **NO ADVERSE EFFECT**. Minor impacts include replacement of some, but not all, siding, doors, or windows, etc.

☐ The project will have a major impact on a property that is eligible or already listed in the National Register, therefore there is an **ADVERSE EFFECT**. Major impacts include full or partial demolition, complete residing, full window replacement, etc.

STATE HISTORIC PRESERVATION OFFICE COMMENTS – *Official use only*

Eligibility:
☐ Concur with the eligibility determination above.
☐ Do not concur with the eligibility determination above.

Effect:
☐ Concur with the effect determination above.
☐ Do not concur with the effect determination above.

RECEIVED STAMP

RLS	
ILS	

Signed: ________________________________ Date: ______________

CONTACT INFORMATION STAMP

Comments:

OREGON SHPO CLEARANCE FORM

Do not use this form for ODOT or Federal Highway projects or to record archaeological sites

SECTION 4: PREVIOUS ALTERATIONS TO THE BUILDING OR STRUCTURE

Only complete this section for buildings that are 50 years old or older. Describe any alterations that have already occurred to the building, such as material replacement, including siding, windows, and doors; any additions, including garages; and any removal or addition of architectural details, such as brackets, columns, and trim. Provide estimated dates for the work. Attach additional pages as necessary.

A standing structure was documented during a cultural resource study of part of the Black Butte Mine where environmental remediation activities are proposed. It is not dateable based on its form or construction materials. It is in the general location of a structure shown a 1:64,000-scale topographic map published in 1954 by the United States Geological Survey (USGS), however the small scale of the map makes it difficult to pinpoint specific features. The building is associated with the operation of the Black Butte Mine, but its specific function is unknown.

The building is in disrepair and was not entered during fieldwork. It is a wood-framed, rectangular building with a west-facing front façade. It is approximately 30 feet long and 10 feet wide. It is one story in height and has a shed roof. The structural system was not observed but it is assumed to be a braced-frame form with wire nail fasteners. It is composed of two bays, one on either side of a central entry. One exterior wall is clad in horizontally-placed wood boards that in places retain a tar paper covering. Other exterior walls are covered with corrugated metal or fiberglass siding. The roof is corrugated metal. Corrugated metal and fiberglass have been in use since the early twentieth century. It does not appear to rest on a foundation. It has a single horizontal, sliding aluminum window on its north side. A manufacturing decal still affixed to the window possibly indicates that the window is not original. An opening on its south side likely contained a similar window. Electrical wires lead to the structure from the north. It likely was used during the fourth or fifth period of mine operations, ca. 1956-1968, as an office or storage facility.

SECTION 5: PROJECT DESCRIPTION

Describe what work is proposed, including what materials will be used and how they will be installed. Specifically identify what historic materials will be retained, restored, replaced, or covered. Include drawings, photos, cut sheets (product descriptions), additional sheets, and other materials as necessary. For vacant lots, please describe the intended use.

The building is located north of a section of Furnace Creek that runs through a ravine that is the focus of the proposed remediation action. It is in the northern part of Work Area 2, as defined for the project, and is located in an area that will be used for project staging. No direct project-related impacts to the building are planned. The building is in derelict condition and will likely continue to deteriorate over time.

SECTION 6: FUNDING SOURCE

☐ ARRA ☐ FCC ☐ FERC ☐ HUD ☐ ODOE ☐ USDARD ☐ USFS

☒ Other: Environmental Protection Agency

SECTION 7: AGENCY CONTACT INFORMATION

Name of Organization Submitting the Project: Environmental Protection Agency, Region 10	
Project Contact Name and Title: Randy Nattis, On Scene Coordinator	
Street Address, City, Zip: 805 SW Broadway, Suite 500, Portland, OR 97208	
Phone: 503-326-3250	Email: Nattis.randy@epa.gov
Date of Submission: May 2018	

SECTION 8: ATTACHMENTS

REQUIRED	☒ 3 – 4, color, 4 x 5 photographs of the subject property, digital or print. One photo is sufficient for vacant property
AS NEEDED *Contact SHPO staff with questions*	☐ Project area map, for projects including more than one tax lot
	☐ Additional drawings, reports, or other relevant materials
	☐ Continuation sheet for sections 4 or 5, or additional context to determine National Register Eligibility.

SHPO Mailing Address: Review and Compliance, Oregon SHPO, 725 Summer St. NE, Suite C, Salem, OR 97301
Documents meeting all aspects of the digital submission policy may be submitted by email to ORSHPO.Clearance@oregon.gov

OREGON SHPO CLEARANCE FORM

Do not use this form for ODOT, Federal Highway projects or to record archaeological sites

CONTINUATION SHEET

- *Include additional documentation for Section 4 or 5 as necessary. Attach maps, drawings, and reports as needed to illustrate current conditions and the planned project. If submitting this form by email, photos and maps may be inserted into continuation sheets.*
- *If completing a complete Determination of Eligibility (DOE) or Finding of Effect (FOE), use continuation sheets as necessary or include appendixes.*

View of the Black Butte Mine outbuilding.

Detail of the outbuilding entry.

APPENDIX C

Inadvertent Discovery Plan

Inadvertent Discovery Plan for Cultural Resources

Black Butte Mine Non-Time-Critical Removal of Contaminated Materials

The Environmental Protection Agency (EPA) proposes to stabilize, remove, or contain mercury contaminated tailings, waste rock, and sediment from a part of Furnace Creek that flows through the Black Butte Mine complex

The Inadvertent Discovery Plan (IDP) should be followed if cultural materials including human remains are encountered during construction.

Protocol for coordination in the event of inadvertent discovery:

- In the event of an inadvertent discovery of possible cultural materials, including human remains, all work will stop immediately in the vicinity of the find. A 30-meter buffer should be placed around the discovery with work being able to proceed outside of this buffered area unless additional cultural materials are encountered.

- The area will be secured and protected.

- The project manager/land manager will be notified. The project/land manager will notify the State Historic Preservation Office (SHPO). If possible human remains are encountered, the Oregon State Police, Commission on Indian Services (CIS), SHPO, and appropriate Tribes will also be notified.

  Oregon State Police: Chris Allori 503-731-4717
  CIS: Karen Quigley 503- 986-1067
  Appropriate Tribes: As designated by CIS
  SHPO: Dennis Griffin 503-986-0674, John Pouley 503-986-0675, or Matt Diederich 503-986-0577.
- No work may resume until consultation with the SHPO has occurred and a professional archaeologist is able to assess the discovery.

- If human remains are encountered, do not disturb them in any way. *Do not call 911*. Do not speak with the media. Secure the location. Do not take Photographs. The location should be secured and work will not resume in the area of discovery until all parties involved agree upon a course of action.

- A professional archaeologist may be needed to assess the discovery and they will consult with SHPO and appropriate Tribal Governments to determine an appropriate course of action.

- Archaeological excavations may be required. This is handled on a case by case basis by the professional archaeologist and project manager, in consultation with SHPO and appropriate Tribes.

When to stop work:

Construction work may uncover previously unidentified Native American or Euroamerican artifacts. This may occur for a variety of reasons, but may be associated with deeply buried cultural material, access restrictions during project development, or if the area contains impervious surfaces throughout most of the project area which would have prevented standard archaeological site discovery methods.

Aside from the cultural material currently exposed at the ground (including a set of structural ruins, a truck cab, a trick chassis/bed, ceramic tile pipe, a sheet metal cone/spout, a metal machine of unknown function, corrugated pipe, and scattered brick), work must stop when the following types of artifacts and/or features are encountered:

Native American artifacts may include (but are not limited to):

- Flaked stone tools (arrowheads, knives scrapers etc.);
- Waste flakes that resulted from the construction of flaked stone tools;
- Ground stone tools like mortars and pestles;
- Layers (strata) of discolored earth resulting from fire hearths. May be black, red or mottled brown and often contain discolored cracked rocks or dark soil with broken shell;
- Human remains;
- Structural remains- wooden beams, post holes, fish weirs.

Euroamerican artifacts may include (but are not limited to):

- Glass (from bottles, vessels, windows etc.);
- Ceramic (from dinnerware, vessels etc.);
- Metal (nails, drink/food cans, tobacco tins, industrial parts etc.);
- Building materials (bricks, shingles etc.);
- Building remains (foundations, architectural components etc.);
- Old wooden posts, pilings, or planks (these may be encountered above or below water);
- Remains of ships or sea-going vessels, marine hardware etc.;
- Old farm equipment may indicate historic resources in the area.
- Even what looks to be old garbage could very well be an important archaeological resource;

When in doubt, call it in!

<u>Proceeding with Construction</u>

- Construction can proceed only after the proper archaeological inspections have occurred and environmental clearances are obtained. This requires close coordination with SHPO and the Tribes.

- After an inadvertent discovery, some areas may be specified for close monitoring or ‘no work zones.’ Any such areas will be identified by the professional archaeologist to the Project Manager, and appropriate Contractor personnel.
- In coordination with the SHPO, the Project Manager will verify these identified areas and be sure that the areas are clearly demarcated in the field, as needed.

Report #

SHPO Use

State Historic Preservation Office
Report Cover Page

Year: 2019

Title: **Results of a Cultural Resources Survey of Work Area 5 at the Black Butte Mine Site, Lane County, Oregon**

REPORT

Author(s): Donald D. Pattee and Bill R. Roulette

Agency/Client: Ecology and Environment, Inc.

District/Contractor: Applied Archaeological Research, Inc.

Agency/Client Report#: 2226

Project Acres: 0.42

Survey Acres: 0.42

LOCATION

County(ies): Lane

Township:		Range:		Section(s):	Township:		Range:		Section(s):
23	S	3	W	8					

TESTING

Archaeological Permit Number(s):

Accession Number:

Reports submitted to: Tribes: ☐ UOMNCH: ☐ LCIS: ☐

Curation:

Report Addresses Testing: ☐

CONSULTATION

Have tribes been contacted or consulted? Yes

List tribes: EPA will have consulted with affected tribes

List any other groups contacted or consulted:

PA/ MOA

Report is associated with: PA ☐ MOA ☐

REPORTS WITHOUT A COMPLETE AND ACCURATE COVER PAGE AND APPROPRIATE ADDITIONAL PAGES MAY BE RETURNED. CHECK THE SHPO WEBSITE TO MAKE SURE YOU HAVE THE MOST CURRENT VERSION.

RESULTS OF A CULTURAL RESOURCE SURVEY OF WORK AREA 5 AT THE BLACK BUTTE MINE SITE, LANE COUNTY, OREGON

By
Donald D. Pattee, M.A., RPA
and
Bill R. Roulette M.A., RPA

Prepared for:
Ecology and Environment. Inc.
Seattle, Washington

August 27, 2019

APPLIED ARCHAEOLOGICAL RESEARCH, INC., REPORT NO. 2226

NOT FOR PUBLIC DISTRIBUTION

APPLIED ARCHAEOLOGICAL RESEARCH, INC.
Cultural Resource Management and Historic Preservation

4001 NE Halsey Street, Suite 3
Portland, OR 97232
Phone (503) 281-9451

INTRODUCTION

Project Description

The Environmental Protection Agency (EPA) is conducting a non-time-critical removal of contaminated materials from parts of the historical Black Butte Mine located in rural Lane County, Oregon. Cinnabar ore was mined at the site at various times between the late 1880s and late 1960s and was processed to manufacture mercury. Furnace Creek runs through the mine complex. Elevated concentrations of mercury have been found in tailings, waste rock, and sediment in the stream drainage. The creek is a tributary to Garoutte Creek, which flows into the Coast Fork Willamette River that in turn empties into the Cottage Grove Reservoir. The EPA has determined that the potential release of high concentrations of particulate mercury in surface water that could travel downstream in the drainage system poses a risk to public health or welfare or the environment. The non-time-critical removal has focused on mediating this risk through stabilizing, removing, or containing the contaminated tailings, waste rock, and sediment from the part of the stream drainage within the mine complex. Subsequent site investigations and inspections have identified an additional area of high mercury and arsenic concentrations at the former Ore Processing Waste Area (OPWA) that EPA has recommended for removal as part of this 2019 removal action.

The removal action is an undertaking of the federal government and is subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800 (Section 106), to the extent practicable. The EPA contracted with Ecology and Environment, Inc. (E&E) to provide technical assistance and support under Superfund Technical Assessment and Response Team (START) IV contract number EP-S7-13-07. E&E retained Applied Archaeological Research, Inc. (AAR) to conduct a cultural resource study of the area of potential effects (APE) for the removal action. A report describing the results of the study was completed in 2018 (Roulette et al. 2018). As the clean-up activities progressed, a deposit of ashy material that contains a high concentration of mercury was found within the OPWA that was outside of the APE defined for the 2018 cultural resources study. As a result, the APE has been expanded to include that area and AAR was retained to update the cultural resources study to include it (Figure 1).

This report describes the results of AAR's study of the land added to the APE. It supplements AAR's 2018 report (Roulette et al. 2018) and does not include context statements regarding the local environmental setting, cultural development of the native groups that occupied the Willamette Valley, or of the historical operation of the Black Butte Mine. Those descriptions are included in AAR's previous report. Due to the current APE's close proximity to AAR's previous study area, it was not necessary to supplement context statements with new information.

Donald D. Pattee, M.A., RPA conducted the study with assistance from Bill R. Roulette, M.A., RPA. Fieldwork at the mine site was conducted under a health and safety plan prepared and approved in advance of the site visit. Mr. Pattee has completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) 29 CFR 1910.120(e) training and has current certification. He wore modified Level D personal protective equipment during the fieldwork and wore a respirator fitted with mercury vapor cartridges as necessary during it.

Description of the APE

The APE is located near the toe of the west-facing flank of Black Butte in southeast quarter of Section 8, Township 23 South, Range 3 West, Willamette Meridian. Elevations across the APE range between approximately 1,070 and 1,125 feet above mean sea level. It is situated along the southern edge

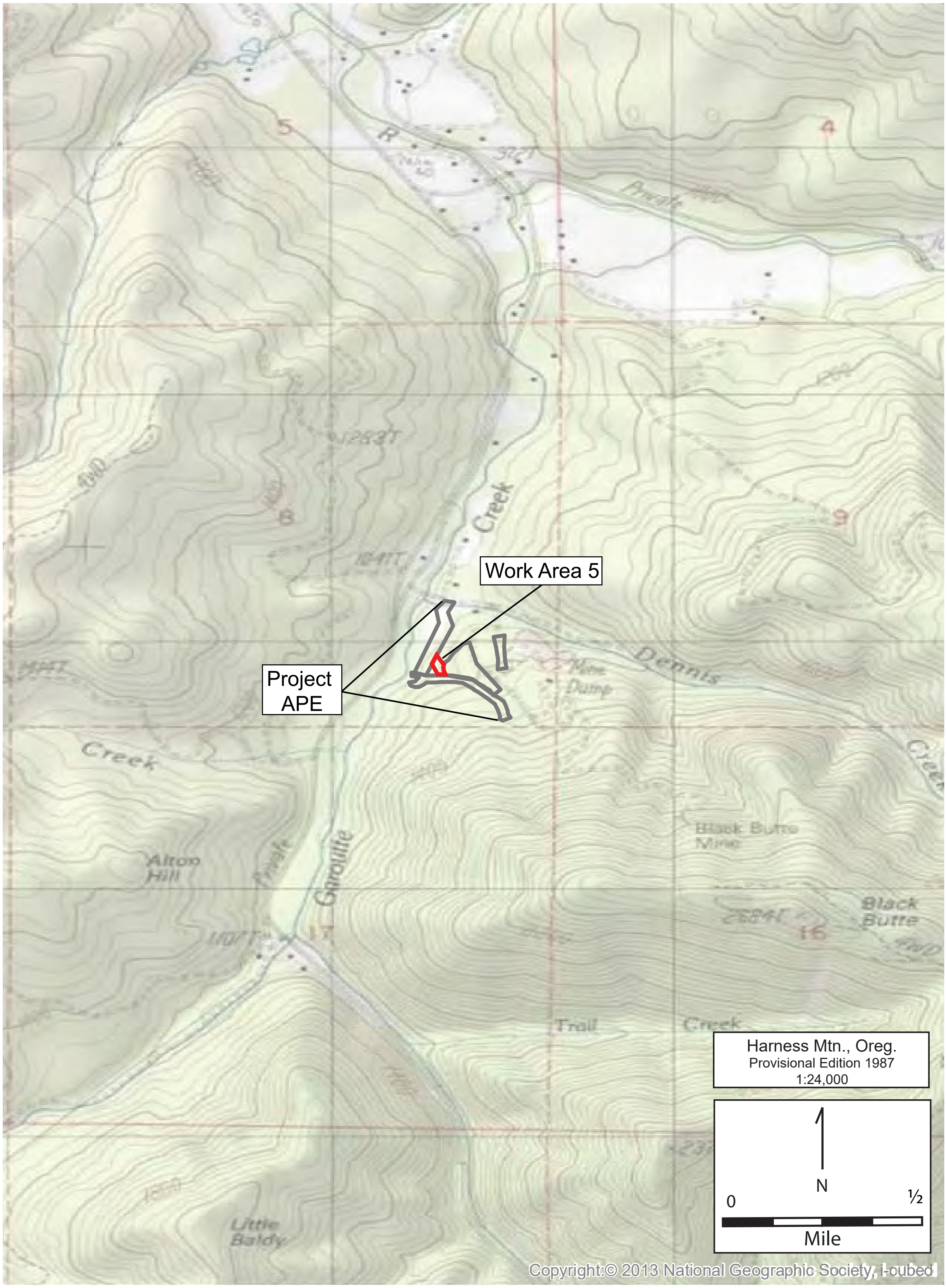


Figure 1. Location of the Black Butte Mine project APE and Work Area 5, which was the subject of AAR's current study.

of the Coast Fork Sub-basin of the Upper Willamette Basin of the Willamette Region about 15 miles south of Cottage Grove in the south-central part of Lane County, Oregon (Roulette et al. 2018).

As defined for AAR's 2018 study the APE included four work areas where removal actions were to be conducted. They were designated Work Areas 1 through 4 (Figure 2). Together they encompassed approximately 13 acres. The newly added land for removal activities is designated Work Area 5. It is contiguous with Work Areas 1, 2, and 3 and measures approximately 75 x 300 feet. It is 0.42 acre in size. It is in the oldest part of the historical mining complex close to where the original ore crusher and furnace were located.

Background

In 2007, the Oregon Department of Environmental Quality requested that the EPA conduct a time-critical removal action in a different part of the Black Butte Mine site after it was determined to be a contributor to mercury contamination in the Cottage Grove Reservoir (Andersen 1996; Curtis 2003). The action focused on the removal of tailings from Dennis Creek and re-grading a large tailings pile above the creek to prevent erosion. Mercury-impacted tailings and soil at the location of the Old Furnace and New Furnace were capped with sediment.

A cultural resources survey was conducted at the parts of the site to be impacted by the 2007 removal activities (Smits et al. 2007). As a result of the survey several features related to the historical mine were observed such as standing and collapsed structures, mining-related equipment, and mining landscape features including tailing piles and mine-related roads (Smits et al. 2007). These features were not formally recorded as an archaeological resource. Although Smits et al. (2007) did not record the site the Oregon State Historic Preservations Office's (SHPO's) Oregon Archaeological Records Remote Access (OARRA) database has a tickler in its location. A tickler is used to indicate the presence of a cultural resource that has not been formally recorded. In the present case it marks the location of the mine as known from historical sources.

During AAR's 2018 survey, concrete slabs, brick, tile piping, and sheet metal that represented the remnants of dismantled mining structures, a large wheeled piece of machinery of unknown function and a truck chassis were observed in Work Areas 2 and 3 (Roulette et al. 2018). The cultural material was recorded as an historic-era archaeological site and given the temporary field designation, site AAR 2026-1. A record form for the site was submitted to the Oregon SHPO in April 2018 but to date it has not been assigned a Smithsonian trinomial. A standing structure observed in Work Area 2 was recorded as an historic property. It was interpreted to have been used as an office or storage facility in the early-1950s. It was AAR's opinion that site AAR 2026-1 and the standing structure were not eligible to be listed on the National Register of Historic Places.

METHODS AND RESULTS

Fieldwork was conducted by AAR project archaeologist Donald D. Pattee, M.A., RPA, on June 17, 2019. It consisted of a pedestrian survey during which the ground surface was closely examined for archaeological material. Work Area 5 contains an immature forest composed of mixed conifers. The trees prevented the use of systematically arranged survey transects so instead the work area was investigated using opportunistically arranged transects that were spaced no more than 15 feet apart.

The ground surface in parts of the work area was obscured by forest duff, woody debris, and vegetation. In other parts, the duff layer was thinner and visibility was close to 50 percent (Figure 3).

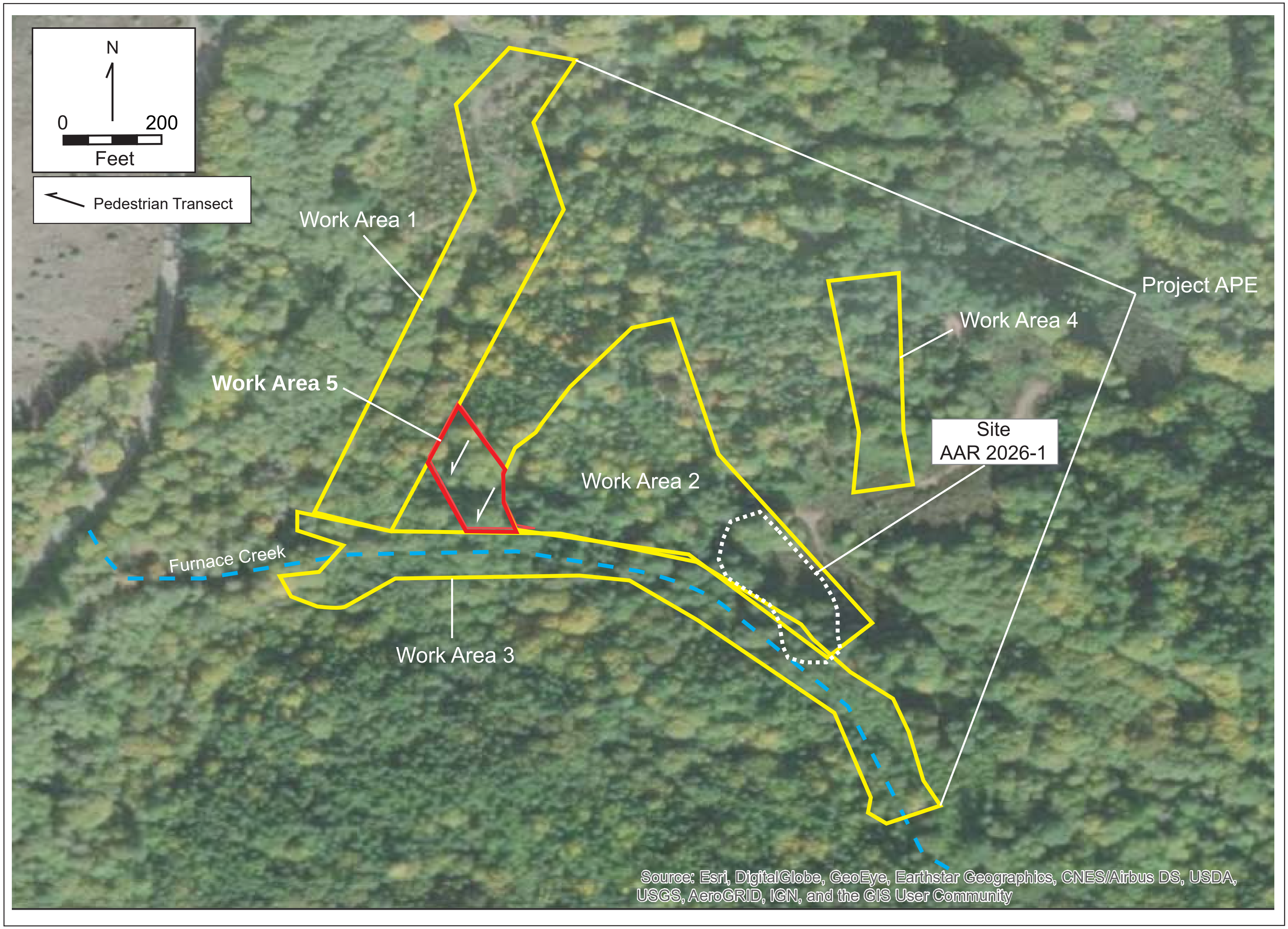


Figure 2. Aerial photomap showing Work Area 5 (highlighted red) and its relation to Work Areas 1-4 and site AAR 2026-1.

Figure 3. Representative view looking northwest of Work Area 5 showing its general character as seen during the fieldwork.

The surface of the work area was hummocky, which could have been caused by tree throws or past earthmoving events (Figure 4). It is located in the OPWA and the unevenness might also be due to the surface being underlain by ore processing wastes. Rocks believed to be ore waste were observed at the surface in a part of the work area (Figure 5). No artifacts or standing structures were found. Because the work area is in area suspected of containing harmful levels of mercury and arsenic, no subsurface probes were excavated to search for buried archaeological deposits. We assess as very low the likelihood that such deposits are present in the work area.

CONCLUSION AND RECOMMENDATIONS

As seen in Work Areas 2 and 3, artifacts comprising AAR 2026-1 were present on the ground surface. Had similar material been present in Work Area 5 they would have been observed. On that basis we conclude that the site does not extend into the work area.

Based on the results of the survey AAR recommends a finding of **no effect on historic properties** for the removal action in Work Area 5. AAR does not recommend additional cultural resource investigations in the work area. To further ensure that that project has no effect on historic properties, an inadvertent discovery plan included as Appendix C in AAR's 2018 survey report should be used during the removal action. The plan should be provided to and reviewed by contractors involved in earthmoving to ensure implementation of proper protocols in the event that archaeological deposits are encountered during construction.


Figure 4. View of Work Area 5 looking north showing an example of a hummock seen at frame right.


Figure 5. Possible ore waste rock seen on the surface of Work Area 5. View is west.

As outlined in the plan, should potentially significant historical or pre-contact archaeological materials be found during project implementation, all activities in the vicinity of the finds shall cease immediately and the Oregon SHPO shall be promptly notified and Oregon Revised Statue 358.920 and 36 CFR 800.13 consulted to ensure compliance with applicable state and federal laws.

If during excavations human remains, funerary objects, sacred objects, and/or items of cultural patrimony are identified, all work will halt immediately. The Oregon SHPO, affected tribes, and appropriate City or County representatives will be contacted. Procedures outlined under Oregon State law (ORS 97.740-760 and ORS 358.905-955) will be followed and work will not resume until mitigation measures have been agreed upon by all parties.

REFERENCES CITED

Andersen, Keith
1996 *Preliminary Assessment: Black Butte Mine.* Oregon Department of Environmental Quality, Site Assessment Section, Western Region, Eugene, Oregon. Prepared for U.S. Environmental Protection Agency, Seattle, Washington.

Curtis, Lawrence R.
2003 *Final Report: Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir.* Department of Environmental and Molecular Toxicology, Oregon State University, Corvallis, Oregon. Prepared for U.S. Army Corps of Engineers, Portland, Oregon.

Roulette, Bill R., Aimee A. Finley, and Thomas E. Becker
2018 *Results of a Cultural Resources Study of a Part of the Black Butte Mine Site, Lane County, Oregon.* On file, Oregon State Historic Preservation Office, Salem.

Smits, Nicholas, J., Jason M. Allen, and John L. Fagan
2007 *Archaeological Survey at the Black Butte Mine, Lane County, Oregon*. Report prepared for Ecology and Environment, Portland, Oregon. On file, Oregon State Historic Preservation Office, Salem.

C Site-Specific Sampling Plans/ Sample Plan Alteration Form/Site-Specific Data Management Plan

This page intentionally left blank.

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

July 13, 2018

Randy Nattis, On-Scene Coordinator
United States Environmental Protection Agency
805 SW Broadway, Suite 500
Portland, Oregon 97205

Re: Final Site-Specific Sampling Plan
Black Butte Mine / Furnace Creek Non-Time Critical Removal Action (Air Monitoring)
Contract Number EP-S7-13-07, Task Order Number 25

Dear Mr. Nattis:

Enclosed please find the final Air Monitoring Site-Specific Sampling Plan (SSSP) for the non-time critical removal action (NTCRA) of the Furnace Creek area of the Black Butte Mine Site, located near Cottage Grove in Lane County, Oregon. A draft version of this SSSP dated May 30, 2018, was used during field work for the NTCRA.

If you have any question regarding this submittal, please call me at (206) 624-9537.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Steven Hall

Steven G. Hall
START-IV Removal Team Leader

Enclosure

cc: Kathy Parker, OSC, QA Coordinator, EPA Region 10, Seattle, Washington
Bryan Ciecko, START PM, E & E, Portland, Oregon

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY MANAGEMENT PROGRAM

Air Monitoring Site Specific Sampling Plan

Project Name: Black Butte Mine – Air Monitoring Site ID: 10EK

Author: M. Fulton Company: E & E Date Completed: 5/30/2018 (Draft) / 7/13/2018 (Final)

This Air Monitoring Site Specific Sampling Plan (SSSP) is prepared and used in conjunction with the Site Specific Sampling Plan, and the Quality Assurance Plan (QAP) for the Emergency Management Program for conducting air monitoring and collecting air monitoring samples during this Removal Program project. The information contained herein is based on the information available at the time of preparation. As better information becomes available, this SSSP will be adjusted.

When inadequate time is available for preparing the SSSP in advance of the sampling event, a Field Sampling Form may be prepared on-site immediately prior to sampling. This full length version of the SSSP is written after the sampling event and the completed Field Sampling Form attached to it.

1. Approvals

Name, Title	Telephone, Email, Address	Signature
Randy Nattis **On-Scene Coordinator**	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	
Kathy Parker **EMP Quality Assurance Coordinator**	206-553-0062, parker.kathy@epa.gov USEPA , M/S: ECL-133, 1200 Sixth Ave. Suite 900, Seattle, WA 98101	

I. Project Management and Organization

2. Personnel and Roles involved in the project:

Name	Telephone, Email, Company, Address	Project Role	Data Recipient
Randy Nattis	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	On Scene Coordinator	Yes
Bryan Ciecko	503-248-5600 x4602, bciecko@ene.com, 333 SW 5th Avenue, Suite 600, Portland, OR 97204	START Project Manager	Yes
Steve Hall	206-920-1739, sghall@ene.com E&E, 2101 Third Ave Suite 1700 Seattle, WA 98104	START Removal Team Leader	Yes
Kathy Parker	206 553-0062, parker.kathy@epa.gov USEPA , M/S: ECL-133, 1200 Sixth Ave. Suite 900, Seattle, WA 98101	EMP Quality Assurance Coordinator	No

Mark Woodke	206-624-9537, mwoodke@ene.com, E & E 720 Third Ave, Suite 1700 Seattle, WA 98104	START Quality Assurance Reviewer	Yes
Carlene McCutcheon	602-437-3340, Carlene.McCutcheon@testamericainc.com 4625 E. Cotton Center Blvd. Suite 189 Phoenix, AZ 85040	Laboratory contact	No

3. Physical Description and Site Contact Information:

Site Name	Black Butte Mine	
Site Location	The site is located approximately 10 miles south of Cottage Grove, in Lane County, Oregon (Figure 1).	
Property Size	The Furnace Creek removal action area is approximately 3 acres (Figure 2).	
Site Contact	Randy Nattis	**Phone Number:** 503-628-9419
Nearest Residents	Approximately ¼ mile	**Direction:** Northwest
Primary Land Uses Surrounding the Site	Forest/timber lands	

4. The proposed schedule of project work follows:

Activity	Estimated Start Date	Estimated Completion Date	Comments
Draft SSSP Review/Approval	May 30, 2018	June 4, 2018	The draft SSSP was prepared and used at the beginning of field work.
Final SSSP Review/Approval	July 13, 2018	July 16, 2018	This SSSP was finalized and submitted on July 13, 2018.
Mobilize to / Demobilize from Site	May 21, 2018	September 21, 2018	
Sample Collection	June 4, 2018	September 21, 2018	Air monitoring will begin with excavation of contaminated materials.
Laboratory Sample Receipt	June 6, 2018	September 21, 2018	
Laboratory Analysis	June 6, 2018	September 25, 2018	48-hour TAT
Data Validation	June 11, 2018	October 5, 2018	

5. Historical and Background Information

Describe briefly what you know about the site that is relevant to sampling and analysis for this investigation.

The Black Butte Mine (BBM) is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River basin, approximately ten miles south of Cottage Grove, Oregon (Figure 1). The BBM is located on the northwest flank of Black Butte. The landowner is The Land and Timber Company, which has used the property surrounding the site for logging.

The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Ore Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits (Figure 2).

Dennis Creek borders the northeast side of the site and flows westward into Garoutte Creek, approximately 0.25 miles downstream of BBM. Furnace Creek, an intermittent stream, borders the southwest side of the site and also flows into Garoutte Creek. Furnace Creek is adjacent to the Old Ore Furnace Area, and mill tailings are located in the creek channel and drainage basin. Garoutte Creek flows northward approximately six miles to the Coast Fork Willamette River, which empties into Cottage Grove Reservoir, a reservoir used extensively for recreational activities including contact recreation (i.e. swimming, canoeing, and scuba diving) and fishing (EPA 2017).

BBM is on the National Priorities List, and EPA is currently performing a remedial investigation (RI) at the site. The draft RI report is expected to be completed in 2018.

In 2007, EPA completed a time-critical removal action (TCRA) at the Site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings that were removed were consolidated with the main tailings pile on site to form a repository. The repository cover was constructed with tailings/waste material which analytical results showed to be below the 2007 Removal Action Objective of 23 milligrams per kilogram (mg/kg) for mercury. Additionally, mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil/tailings that were determined to have low mercury concentrations.

Recent surface water and sediment sampling by the Oregon Department of Environmental Quality and EPA indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment are the dominant source of mercury migrating to Garoutte Creek. Erosion of tailings and mercury-impacted soil into the Furnace Creek and re-suspension of mercury impacted channel bottom sediments into the water column are the two primary mechanisms for transport of particulate mercury from source areas within the Furnace Creek catchment to Garoutte Creek. Furnace Creek was not included in the scope of the 2007 TCRA.

To reduce the release of mercury to surface water, EPA decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA is to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFW watershed.

EPA's remedial program completed an engineering evaluation / cost analysis (EE/CA; CDM Smith 2016), and the recommended removal alternative is the excavation of mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel. The excavated material will be added to the existing on-site repository from the 2007 TCRA, and then the expanded repository will be covered with a new cap composed of clean borrow soil from a to-be-determined borrow source. Following the removal of contaminated sediment and tailings in the creek channel, Furnace Creek will be restored.

The NTCRA will be completed in accordance with a Draft Implementation Plan (CDM 2018b). Target preliminary removal action objectives (PRAOs) were outlined in a Field Decision Criteria Memo dated April 11, 2018 (CDM 2018a). This SSSP outlines the sampling and analytical procedures to be performed by START to support the NTCRA.

References:

CDM Smith, April 11, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA.

_____, February 2018b, Draft Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

_____, July 22, 2016, Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

U.S. Environmental Protection Agency (EPA), 2017, First Amendment to the Action Memorandum, including a Request for Exemption from, the 12-Month and $2 Million Statutory Limits on Removal Actions and an Increase in the Project Cost Ceiling for a Non-Time-Critical Removal Action for the Furnace Creek Area at Operable Unit 1 of the Black Butte Mine Superfund Site, Lane County, Oregon (SEMS IDNO.OR0000515759), September 13, 2017.

6. Conceptual Site Model

Example: Contaminant: Mercury
Transport Mechanism: vapor moving on air currents
Receptors: people living in the house

Contaminants: Mercury vapors, airborne arsenic and mercury salt particulates, and/or nuisance dust are the primary airborne contaminants of concern.

Transport Mechanisms: Inhalation and/or ingestion of contaminants in air currents.

Receptors: Removal action site workers and hikers / site visitors.

7. Decision Statement

Examples: 1) Determine whether surface contamination exceeds the established action level;
2) Determine appropriate disposal options for contaminated materials.

The decision(s) to be made from this investigation is/are to:

Determine whether mercury vapors, airborne arsenic and mercury salt particulates, and/or nuisance dust in air currents exceed the established action level(s) during the soil excavation and repository construction.

8. Action Level

State the analyte, concentration, and units for each selected action level. Describe the rationale for choosing each action level and its source (i.e. MTCA, PRG, ATSDR, etc.) Example: The action level for total mercury in soil is 6.7 mg/kg (from Regional Screening Level residential).

Air and Dust Monitoring during Excavation
Table 1 presents a summary of exposure limits (Occupational Safety and Health Administration [OSHA] permissible exposure limits [PELs] and National Institute of Occupational Safety and Health [NIOSH] recommended exposure limits [RELs]) for arsenic, mercury, and nuisance dust.

The Site-specific, on-Site dust action level is 300 micrograms per cubic meter (μg/m^3) sustained for 10 minutes. This is an on-Site dust action level for worker protection. The assumptions and calculations for this action level are included in Table 1. This dust action level is based on the maximum concentrations of arsenic and mercury detected at the Site (during the recent October 2017 sampling event results presented in the Recommended Field Decision Criteria Memo [CDM Smith 2018a]), the lowest available exposure limit, and a safety factor of 3. This Site-specific value provides an action level to be used with daily dust monitoring with the DustTrack and personal DataRAM (PDR) instruments that should be protective of human health exposure for any arsenic and mercury, based on the assumptions outlined above. While based on 8-hour time-weighted average (TWA) exposure limits, to be conservative and more protective of worker health, this action level will be triggered if dust readings exceed 300 μg/m^3 for 10 minutes.

The Site-specific mercury vapor action level is 10 μg/m^3 sustained for 10 minutes. In addition to dust monitoring, ambient mercury vapors will be routinely monitored in work zones on a daily basis with either a Lumex or Jerome mercury vapor analyzer (MVA). This level is based on the Agency for Toxic Substances and Disease Registry (ATSDR) action level for isolation in a residential setting.

II. Data Acquisition and Measurement Objectives

9. Site Diagram and Sampling Areas

A Sampling Area is an area within in which a specific action will be performed.
Examples : 1) Each drum on the site is a Sampling Area;
2) Each section of sidewalk in front of the residence is a Sampling Area;
3) Each sampling grid section is a Sampling Area.

Three air stations will be established and maintained throughout removal activities (Figure 2). One will be located near the command post (AS01), one will be located near the repository (AS02), and one will be located near the excavation activities in Furnace Creek (AS03).

It is expected that the air stations near the command post and repository will be stationary for the duration of the removal action. Air station AS03 (AS03) will be moved periodically so that it can monitor excavation activities.

Each air station will have a DustTrack that is attached to Viper. Additionally, AS03 near excavation activities will include an MVA.

PDRs may also be worn by Site workers conducting earth-moving activities or potentially exposed to dust generated by earth-moving activities.

Additionally, personal samples for airborne metals may be collected from site personnel.

10. The Decision Rules

These can be written as logical If…, Then.. statements. Describe how the decisions will be made and how to address results falling within the error range of the action level. Examples: 1) In the Old Furnace Sampling Area, the soil in the area around the furnace structure will be excavated until sample analysis with XRF shows no mercury concentrations in surface soil above the lower limit of the error associated with the action level, 18.4 mg/kg. 2) If the concentrations of contaminants in a SA are less than the lower limit of the error associated with the action level, then the area may be characterized as not posing an unacceptable risk to human health or the environment and may be dismissed from additional RP activities. The area may be referred to other Federal, State or Local government agencies.

The following statement(s) describe the decision rules to apply to this investigation:

If the mercury vapors, airborne arsenic and mercury salt particulates, and/or nuisance dust exceed action levels during field activities, engineering or other controls may be used to reduce the concentrations until the results are less than the action levels, or the level of personal protective equipment may be upgraded.

11. Information Needed for the Decision Rule

What information needs to be collected to make the decisions – this includes non-sampling info as well: action levels, climate history, direction of water flow, etc. Examples: Current and future on-site and off-site land use; wind direction, humidity and ambient temperature; contaminant concentrations in surface soil.

The following inputs to the decision are necessary to interpret the analytical results:

Field instrument results from the DustTracks, Lumex and Jerome MVAs, and/or PDRs.

12. Sampling and Analysis

For each SA, describe:

1. *sampling pattern (random, targeted, scheme for composite)*
2. *number of samples, how many to be collected from where, and why*
3. *sample type (grab, composite)*
4. *matrix (air, water, soil)*
5. *analytes and analytical methods*
6. *name and locations of off-site laboratories, if applicable.*

Dust Monitoring

DustTrack airborne particulate monitors will be stationed on a daily basis at the three air station locations (Section 9 and Figure 2) to monitor for dust emissions. Air stations AS01 (command post) and AS02 (repository) are expected to remain stationary for the duration of the removal action, unless there is a reason to move them. The specific monitoring location of AS03 will change throughout the removal action, depending on the location of excavation activities. Additionally, PDRs may be used periodically to measure dust exposure levels to Site workers.

DustTracks will be connected with the Viper telemetry system so that results can be monitored remotely in real time.

1. Sampling Pattern: Targeted; subject to change based on field conditions.
2. Number of Samples: Approximately 3 DustTracks and/or a PDR will be deployed daily.
3. Sample Type: TWA .
4. Matrix: Air.
5. Analytes: Airborne particulates and nuisance dust.
6. Off-site laboratory is not applicable (N/A).

Ambient Mercury Vapor

Throughout the removal action, START will periodically use a Lumex or Jerome MVA to screen for mercury vapors at various areas around the Site, including near excavation/construction activities, support zones, and residences. Additionally, a Lumex or Jerome MVA will be stationed at AS03 near excavation activities.

1. Sampling Pattern: Targeted, depending on field activities; one MVA will be co-located with a DustTrack at AS03.
2. Number of Samples: Not applicable; periodic field screening.
3. Sample Type: Grab for periodic screening (on-demand; 10 second averages). Continuous for AS03.
4. Matrix: Air.
5. Analytes: Mercury vapors (air screening with Lumex or Jerome MVA).
6. Off-site laboratory is N/A.

Personal Air Sampling

During the first few weeks of excavation and construction activities, personal air samples will be collected from the breathing zone of Site workers for the analysis of arsenic and mercury. These results will be compared to the action levels in Section 8 as well as the results of dust monitoring with the DustTracks and/or PDR. The laboratory results will be used to determine if field screening for dust and mercury vapors will be sufficient to monitor for potential exposures to Site workers.

1. Sampling Pattern: Targeted; subject to change based on field conditions.
2. Number of Samples: As many as 20.
3. Sample Type: TWA (personal air samplers affixed to workers).
4. Matrix: Air.
5. Analytes: Mercury vapors (air sampling with NIOSH Method 6009), mercuric salt particulates (air sampling with OSHA Method ID-145) and arsenic particulates (air sampling with NIOSH Method 7303 or 7900).
6. Air sample (filter cassettes and sorbent tubes) analyses will be performed by TestAmerica Laboratory in Phoenix, Arizona.

13. Applicability of Data (place an X in front of the data categories needed, explain with comments)

Do the decisions to be made from the data require that the analytical data be:
1) definitive data, 2) screening data (with definitive confirmation) or 3) screening data (without definitive confirmation)?

__X_ ***A) Definitive data*** *is analytical data of sufficient quality for final decision-making. To produce definitive data on-site or off-site, the field or lab analysis will have passed full Quality Control (QC) requirements (continuing calibration checks, Method Detection Limit (MDL) study, field duplicate samples, field blank, matrix spikes, lab duplicate samples, and other method-specific QC such as surrogates) AND the analyst will have passed a Precision and Recovery (PAR) study AND the instrument will have a valid Performance Evaluation sample on file. This category of data is suitable for:* ***1) enforcement purposes, 2) determination of extent of contamination, 3) disposal, 4) RP verification or 5) cleanup confirmation.***
Comments: All fixed laboratory analyses will provide definitive data.

__X_ ***B) Screening data with definitive confirmation*** *is analytical data that may be used* ***to support preliminary or intermediate decision-making*** *until confirmed by definitive data. However, even after confirmation, this data is often not as precise as definitive data. To produce this category of data, the analyst will have passed a PAR study to determine analytical error AND 10% of the samples are split and analyzed by a method that produced definitive data with a minimum of three samples above the action level and three samples below it.*
Comments: Field analyses that are confirmed at a fixed laboratory will provide screening data with definitive confirmation.

__X_ ***C) Screening data*** *is analytical data which has not been confirmed by definitive data. The QC requirements are limited to an MDL study and continuing calibration checks. This data can be used for making decisions:* ***1) in emergencies, 2) for health and safety screening, 3) to supplement other analytical data, 4) to determine where to collect samples, 5) for waste profiling, and 6) for preliminary identification of pollutants****. This data is not of sufficient quality for final decision-making.* Comments: Field analyses that are not confirmed at a fixed laboratory will provide screening data.

14. Special Sampling or Analysis Directions

Describe any special directions for the planned sampling and analysis such as additional quality controls or sample preparation issues. Examples: 1) XRF and Lumex for sediment will be calibrated before each day of use and checked with a second source standard. 2) A field blank will be analyzed with each calibration to confirm the concentration of non-detection. 3) A Method Detection Limit determination will be performed prior to the start of analysis so that the lower quantitation limit can be determined. 4) If particle size is too large for accurate analyses, the samples will be ground prior to analysis. If the sample contains too much moisture for accurate analyses, the sample will be decanted and air dried prior to analysis.

In order to account for both mercury vapors and airborne mercuric salt particulates, a pre-filter will be included with the mercury vapor sorbent tube during air sampling. The pre-filter will be analyzed for mercury particulates (i.e., mercuric salts) using OSHA Method ID-145, and the sorbent tube will be analyzed for mercury vapors (i.e., elemental mercury) using NIOSH Method 6009.

15. Method Requirements

[Describe the restrictions to be considered in choosing an analytical method due to the need to meet specific regulations, policies, ARARs, and other analytical needs. Examples: 1) Methods must meet USEPA Drinking Water Program requirements. 2) Methods must achieve lower quantitation limits of less than 1/10 the action levels.3) Methods must be performed exactly as written without modification by the analytical laboratory.]

Methods must achieve quantitation limits that are the same or lower than the action levels and exposure limits listed in Table 1.

16. Sample Collection Information

[Describe any activities that will be performed related to sample collection]

The applicable sample collection Standard Operating Procedures (SOPs) or methods will be followed and include:
Field Activity Logbook SOP
Sample Packaging and Shipping SOP
Sampling and Field Equipment Decontamination SOP
Instrument Quick Start Guides (QSG): DustTrack, Lumex, PDR
Site Control Procedures for Potentially Contaminated Sites, Surface and Shallow Subsurface Soil Sampling
NIOSH Air Sampling Methods 6009 (Mercury Vapor) and 7900 (Arsenic Particulates)
OSHA Sampling Method ID-145 (Mercury Particulates)

17. Optimization of Sampling Plan (Maximizing Data Quality While Minimizing Time and Cost)

[Describe what choices were made to reduce cost of sampling while meeting the needed level of data quality. Example: The XRF will be used in situ whenever possible to achieve accurate results. Reproducibility and accuracy of in situ XRF analyses will be checked by collecting, air drying, analyzing and comparing five in situ samples at the start of sampling. Where interferences are suspected, steps will be taken to eliminate the interferences by mechanisms such as drying, grinding or sieving the samples or analyzing them using the Lumex with soil attachment.]

The Lumex MVA will be used to screen for mercury vapors on Site, while only a limited number of mercury vapor samples will be submitted to the fixed laboratory to reduce analytical costs.

The results of personal air sampling for arsenic and mercury will be compared to field screening data (e.g., DustTracks, PDR, and Lumex MVA) to determine whether the field screening techniques will be sufficient to monitor for worker health and safety.

The format for sample number identification is summarized in Table 2. Sample collection and analysis information is summarized in Table 3.

Table 1
Dust Action Levels Worksheet
Black Butte Mine Site Removal Action

Compound	Maximum Concentration in Soil (mg/kg)	Maximum Concentration in Soil (%)	OSHA PEL		NIOSH REL		Exposure Limit Used for Calculation (mg/m^3)	Safety Factor	Dust Action Level for Compound (mg/m^3)	Notes
			TWA (mg/m^3)	Ceiling (mg/m^3)	TWA (mg/m^3)	Ceiling or Short Term (mg/m^3)				
Contaminant Exposure Limits and Dust Calculations										
Arsenic[1,2]	1,088	0.1088	0.01	N/A	N/A	0.002	0.002	3	0.6	[2] Maximum arsenic concentation value reported at XRF-192
Mercury[1,3]										
Mercury compounds (except organo alkyls)	10,391	1.0391	0.1	N/A	0.05	0.1	0.05	3	1.6	[3] Maximum mercury concentration value reported at XRF-39
Mercury as organo alkyl	10,391	1.0391	0.01	0.04	0.01	0.03	0.01	3	0.3	[3] Maximum mercury concentration value reported at XRF-39
Nuisance Dust:										
respirable	1,000,000	100	5				5	3	1.7	
total	1,000,000	100	15				15	3	5.0	
Site Action Levels for Dust (based on mercury as ogano alkyl and REL/PEL)								**Lowest compound action level:**	**0.3**	**Action Level to Upgrade to Level C**

NOTES:
[1] Maximum concentration values from Table 1 - Furnace Creek FPXRF Screening Dataset, of Appendix B - Furnace Creek Non-Time-Critical Removal Action - Recommended Field Decision Criteria
[2] Maximum arsenic concentation value reported at XRF-192
[3] Maximum mercury concentration value reported at XRF-39

Key:

%	= percent
mg/kg	= milligrams per kilogram
mg/m^3	= milligrams per cubic meter
NIOSH	= National Institute of Occupational Safety and Health
OSHA	= Occupational Safety and Health Administration
PEL	= permissible exposure limit
REL	= recommended expsoure limit
TWA	= time-weighted average

Table 2
SAMPLE CODING

Project Name: Black Butte Mine – Air Monitoring **Site ID:** 10EK

SAMPLE NUMBER (1)

Digits	Description	Code (Example)
1,2,3,4	Year and Month Code	1805 (YYMM)
5,6,7,8	Consecutive Sample Number (grouped by SA as appropriate)	0501 (First sample of SA)

SAMPLE NAME / LOCATION ID (2)
(Optional)

1,2	Sampling Area	FC – Furnace Creek Removal Area BS – Borrow Source RC – Repository Cover
3,4	Consecutive Sample Number	01 – First sample of Sampling Area
5,6	Matrix Code	AR – Air MV – Mercury Vapor QC – Quality Control

Notes:
(1) The Sample Number is a unique, 8-digit number assigned to each sample.
(2) The Sample Name or Location ID is an optional identifier that can be used to further describe each sample or sample location.

Table 3. Sampling and Analysis

Data Quality	Sampling Area	Matrix	Sampling Pattern	Sample Type	Data Quality	Number of Field Samples	Analyte or Parameter	Method Number	Action Level	Method Quant. Limit	#/type of Sample Containers per Sample	Preservative	Hold Time	Field QC
Field Screening	All Decision Areas	Air	Targeted	Grab and Continuous	Screening	Daily	Mercury	Lumex QSG	10 μg/m³ (NIOSH REL)	0.002 μg/m³	N/A	N/A	N/A	N/A
Field Screening	All Decision Areas	Dust	Targeted	TWA	Screening	Daily	Dust	DustTrack and PDR QSG	300 μg/m³	0.1 μg/m³ (DustTrack) 1.0 μg/m³ (PDR)	N/A	N/A	N/A	N/A
Lab Analysis	Excavation Areas	Air	Targeted	TWA	Definitive	20	Arsenic	NIOSH 7900	2 μg/m³ (NIOSH REL)	1.5 μg/m³	0.8 2 μm MCE cassette	Refrigerated (≤ 6º C)	Indefinitely if refrigerated	Duplicate Blank
Lab Analysis	Excavation Areas	Air	Targeted	TWA	Definitive	20	Mercury	NIOSH 6009 (vapor) OSHA ID-145 (particulates)	2 μg/m³ (NIOSH REL)	2 μg/m³ (NIOSH 6009) 2.5 μg/m³ (OSHA ID-145)	SKC 226-17-A tubes with prefilters	≤ 6º C	30 days	Duplicate Blank

Table 4. Common Sample Handling Information

Analysis Type	Sub Analysis	Matrix	Analytical Method	Container Type	Minimum Volume	Preservative	Temperature/ Storage	Hold Time	Source
Metals	Metals Not including Mercury or Hexavalent chromium. Includes TAL, PP, RCRA lists)	Solid	EPA 6000 / 7000 Series	Glass Jar	200 g	n/a	None	6 months	SW-846 ch. 3
		Aqueous	EPA 6000 / 7000 Series	PTFE or HDPE	600 mL	HNO_3 to pH < 2	Not listed	6 months	SW-846 ch. 3
	Mercury	Solid	EPA 7471B	Glass Jar	200 g	n/a	< 6° C	28 days	SW-846 ch. 3
		Aqueous	EPA 7470A	PTFE or HDPE	400 mL	HNO_3 to pH < 2	Not listed	28 days	SW-846 ch. 3
	Hexavalent Chromium, (Hexachrome, Cr+6)	Solid	Lab-specific soil extraction modification, EPA 7196A	Glass Jar	100 g	n/a	< 6° C	28 days to extraction	SW-846 ch. 3
		Aqueous	EPA 218.6 (Drinking Water)	PTFE or HDPE	400 mL	n/a	< 6° C	24 hours	SW-846 ch. 3
	XRF	Solid (in situ; on the ground surface)	6200	none	n/a	none	none	Analyze Immediately	n/a
		Solid (ex situ)	6200	plastic bag	200 g	none	none	6 months	n/a
VOCs	VOCs / BTEX	Solid	EPA 5035 / 8260B	*	*	*	*	2 days to lab / 14 days	SW-846 ch. 4
		Aqueous	EPA 8260B	Amber Vial with Septa Lid	2 x 40 mL	HCl to pH< 2	< 6° C (headspace free)	14 days	SW-846 ch. 4
SVOCs	SVOCs / PAHs	Solid	EPA 8270D	Glass Jar	8 ounces	n/a	< 6° C	14 days	SW-846 ch. 4
		Aqueous	EPA 8270D	Amber Glass	2 x 1 L	n/a	< 6° C	7 days	SW-846 ch. 4
PCBs and Dioxins/Furans	PCBs	Solid	EPA 8082	Glass Jar	8 ounces	n/a	< 6° C	none	SW-846 ch. 4
		Aqueous	EPA 8082	Amber Glass	2 x 1 L	n/a	< 6° C	none	SW-846 ch. 4
	Dioxins/Furans	Solid	EPA 8280 or 8290	Glass Jar	8 ounces	n/a	< 6° C	none	SW-846 ch. 4
		Aqueous	EPA 8280 or 8290	Amber Glass	2 x 1 L	n/a	< 6° C	none	SW-846 ch. 4
Pesticides and Herbicides	Chlorinated Pesticides	Solid	EPA 8081	Glass Jar	8 ounces	n/a	< 6° C	14 days	SW-846 ch. 4
		Aqueous	EPA 8081	Amber Glass	2 x 1 L	n/a	< 6° C	7 days	SW-846 ch. 4
	Chlorinated Herbicides	Solid	EPA 8151	Glass Jar	8 ounces	n/a	< 6° C	14 days	SW-846 ch. 4
		Aqueous	EPA 8151	Amber Glass	2 x 1 L	n/a	< 6° C	7 days	SW-846 ch. 4
NWTPH	Gasoline-Range Organics	Solid	TPHs/NWTPH-Gx	Amber Glass Jar with Septa Lid	4 ounces	n/a	< 6° C (headspace free)	14 days	Method
		Aqueous	TPHs/NWTPH-Gx	Amber Vial with Septa Lid	2 x 40 mL	pH < 2 with HCl	< 6° C (headspace free)	7 days unpreserved 14 days preserved	Method
	Diesel-Range Organics	Solid	3510, 3540/3550, 8000	Glass Jar	8 ounces	n/a	< 6° C	14 days	Method

Analysis Type	Sub Analysis	Matrix	Analytical Method	Container Type	Minimum Volume	Preservative	Temperature/ Storage	Hold Time	Source
		Aqueous	3510, 3540/3550, 8000	Glass Amber	2 x 1 L	pH < 2 with HCl	$\leq$ 6° C	7 days unpreserved 14 days preserved	Method
Geotechnical	Particle Size Analysis	Solid	ASTM D-422	Glass Jar or Plastic Bag	2 x 8 ounce	none	n/a	n/a	Method
Miscellaneous	pH	Solid	EPA 9045	Glass Jar	8 ounces	n/a	n/a	Analyze Immediately	SW-846 ch. 3
		Aqueous	EPA 9040C	PTFE	25 mL	n/a	n/a	Analyze Immediately	SW-846 ch. 3
	Total Organic Carbon (TOC)	Solid	SW-846 9060	Glass Jar	100 mL	n/a	$\leq$ 6° C	28 days	SW-846
		Aqueous	EPA 415.1	PTFE or HDPE	200 mL	store in dark HCL or H_2SO_4 to pH <2	$\leq$ 6° C	7 days unpreserved 28 days preserved	Method
	Cyanide	Solid	SW-846 9013	Glass Jar	5 g	n/a	$\leq$ 6° C	14 days	SW-846 ch. 3
		Aqueous	SW-846 9010C	PTFE or HDPE	500 mL	NaOH to pH > 12	$\leq$ 6° C	14 days	SW-846 ch. 3
	Conductivity	Aqueous	EPA 120.1	PTFE or HDPE	100 mL	n/a	n/a	Analyze Immediately	Method
	Hardness	Aqueous	EPA 130.1	PTFE or HDPE	1 x 1 L	HNO3 to pH<2	$\leq$ 6° C	28 days	Method
	Flash Point	Aqueous	EPA 1010A or 1020B	Glass Jar	2 x 250 mL	n/a	$\leq$ 6° C	n/a	Method
	Total Suspended Solids	Aqueous	EPA 160.2	PTFE or HDPE	100 mL	n/a	$\leq$ 6° C	7 days	Method
	Total Dissolved Solids	Aqueous	EPA 160.1	PTFE or HDPE	100 mL	n/a	$\leq$ 6° C	7 days	Method
	Nitrate/nitrite	Aqueous	EPA 353.2	PTFE or HDPE	1 x 250 mL	H_2SO_4 to pH <2	$\leq$ 6° C	28 days	Method
	Nitrate	Aqueous	SW-846 9210A	PTFE or HDPE	1,000 mL	n/a	$\leq$ 6° C	28 days	SW-846 ch. 3
	Nitrite	Aqueous	SW-846 9216	PTFE or HDPE	25 mL	n/a	$\leq$ 6° C	48 hours	SW-846 ch. 3, Method
	Fluoride	Aqueous	SW-846 9214	PTFE or HDPE	300 mL	n/a	$\leq$ 6° C	28 days	SW-846 ch. 3
	Chloride	Aqueous	SW-846 9250	PTFE or HDPE	50 mL	n/a	$\leq$ 6° C	28 days	SW-846 ch. 3
	Sulfate	Aqueous	SW-846 9035	PTFE or HDPE	50 mL	n/a	$\leq$ 6° C	28 days	SW-846 ch. 3
	Sulfide	Solid	SW-846 9215	Glass Jar	1 x 4 ounces	Fill sample surface with 2N zinc acetate until moistened.	$\leq$ 6° C (headspace free)	7 days	SW-846 ch. 3
		Aqueous	SW-846 9031	PTFE or HDPE	100 mL	4 drops 2N zinc acetate/100 mL sample; NaOH to pH>9.	$\leq$ 6° C (headspace free)	7 days	SW-846 ch. 3

Key:

*	= See individual methods. We typically collect 3xEnCore-type samplers and 1x40 mL VOA vial per sample, keep at $\leq$ 6ºC with no chemical preservative, and they must be at the lab within 48 hours of collection.				
C	= Celsius	HNO_3	= nitric acid	SVOCs	= semivolatile organic compounds
Cr	= chromium	L	= liter	SW-846	= EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
EPA	= Environmental Protection Agency	mL	= milliliter	TAL	= Target Analyte List
g	=grams	n/a	= not applicable	TPH	= total petroleum hydrocarbons
H2SO4	= sulfuric acid	NaOH	= sodium hydroxide	VOA	= Volatile Organic Analysis
HCL	= hydrochloric acid	PCBs	= polychlorinated biphenyls	VOCs	= Volatile Organic Compounds
HDPE	= high-density polyethylene	PTFE	= polytetrafluoroethylene		
Hg	= mercury	RCRA	= Resource Conservation and Recovery Act		

III. Assessment and Response

A Sample Plan Alteration Form (SPAF) will be used to describe project discrepancies (if any) that occur between planned project activities listed in the final SSSP and actual project work. The completed SPAF will be approved by the OSC and QAC and appended to the original SSSP.

A Field Sampling Form (FSF) may be used to capture the sampling and analysis scheme for emergency responses in the field and then the FSF pages can be inserted into the appropriate areas of the final SSSP.

Corrective actions will be assessed by the sampling team and others involved in the sampling and a corrective action report describing the problem, solution, and recommendations will be forwarded to the OSC and the EMP QAC.

IV. Data Validation and Usability

The sample collection data will be entered into Scribe and Scribe will be used to print lab Chains of Custody. Results of field and lab analyses will be entered into Scribe as they are received and uploaded to Scibe.net when the sampling and analysis has been completed.

18. Data Validation or Verification will be performed by:

EMP's general recommendation on validation is that a minimum of CLP-equivalent stage IIA verification and validation be performed for every SSSP involving laboratory analyses. However, stage IIB is preferred if the lab can provide it. Dioxins should be validated at CLP-equivalent stage 4.

	Data Verification and Validation Stages						
Performed by:	I	IIA	IIB	III	IV	Verification	Other:
E and E QA Reviewer			100% Fixed Lab		10% Fixed Lab		
EPA Region 10 QA Office							
MEL staff							
Other:							

The following qualifiers shall be used in data validation:

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

JH - The result is an estimated quantity, but the result may be biased high.

JL - The result is an estimated quantity, but the result may be biased low.

JK - The result is an estimated quantity, but the result may have an unknown bias.

JQ - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).

N -

The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

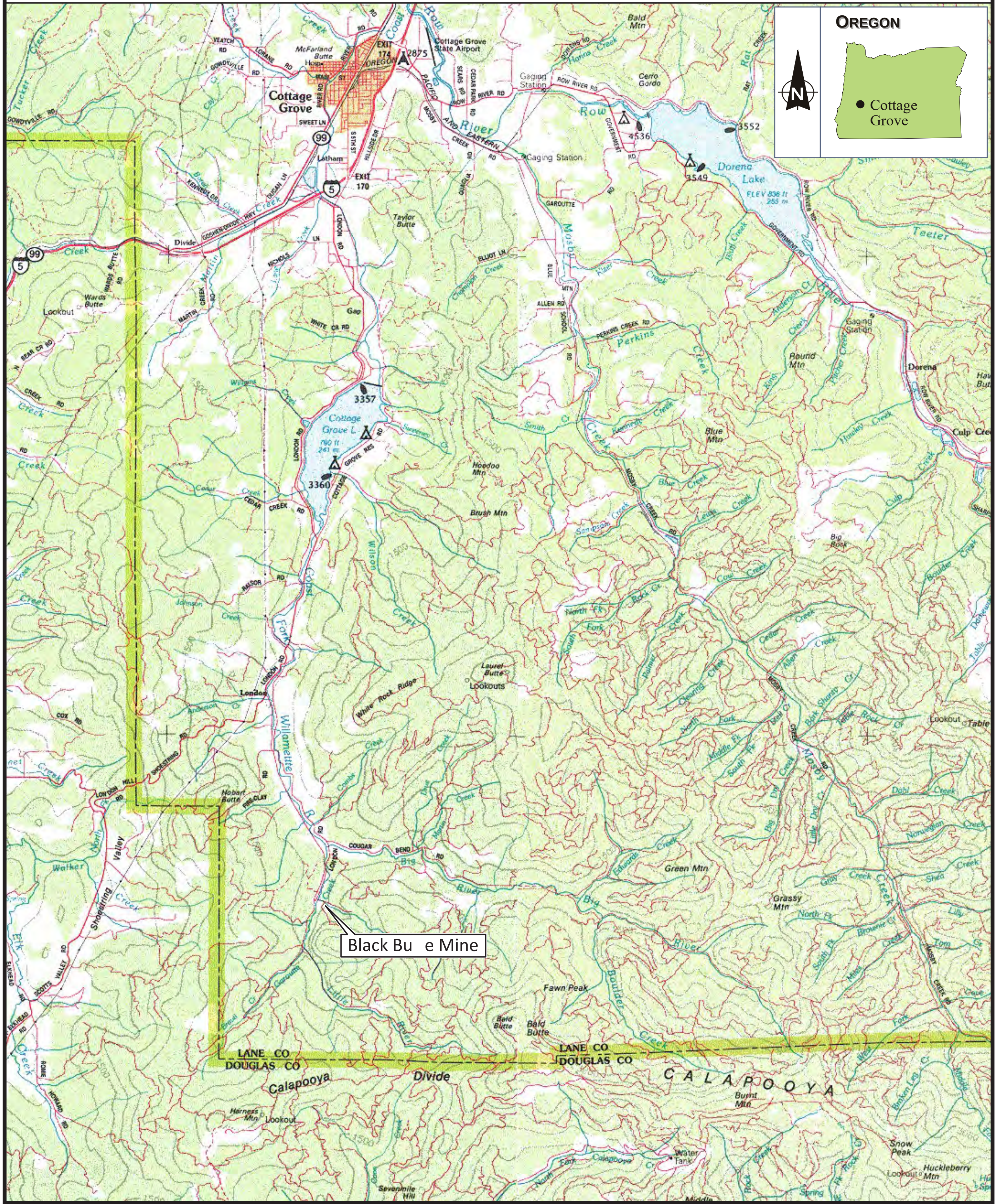
NJ - The analyte has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the sample.

UJ - The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R - The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

C - The target Pesticide or Aroclor analyte identification has been confirmed by Gas Chromatograph/ Mass Spectrometer (GC/MS).

Source: DeLorme 1991, Scale 1:150,000.



ecology and environment, inc.
Global Environmental Specialists
Seattle, Washington

BLACK BUTTE MINE
Lane County, Oregon

Figure 1
SITE LOCATION MAP

Date:	Drawn by:	
2/23/18	AES	10:START-IV\TO25T1SS1\fig 1

M:\Portland\Black_Butte\Maps\MXDs\Site_Features.mxd

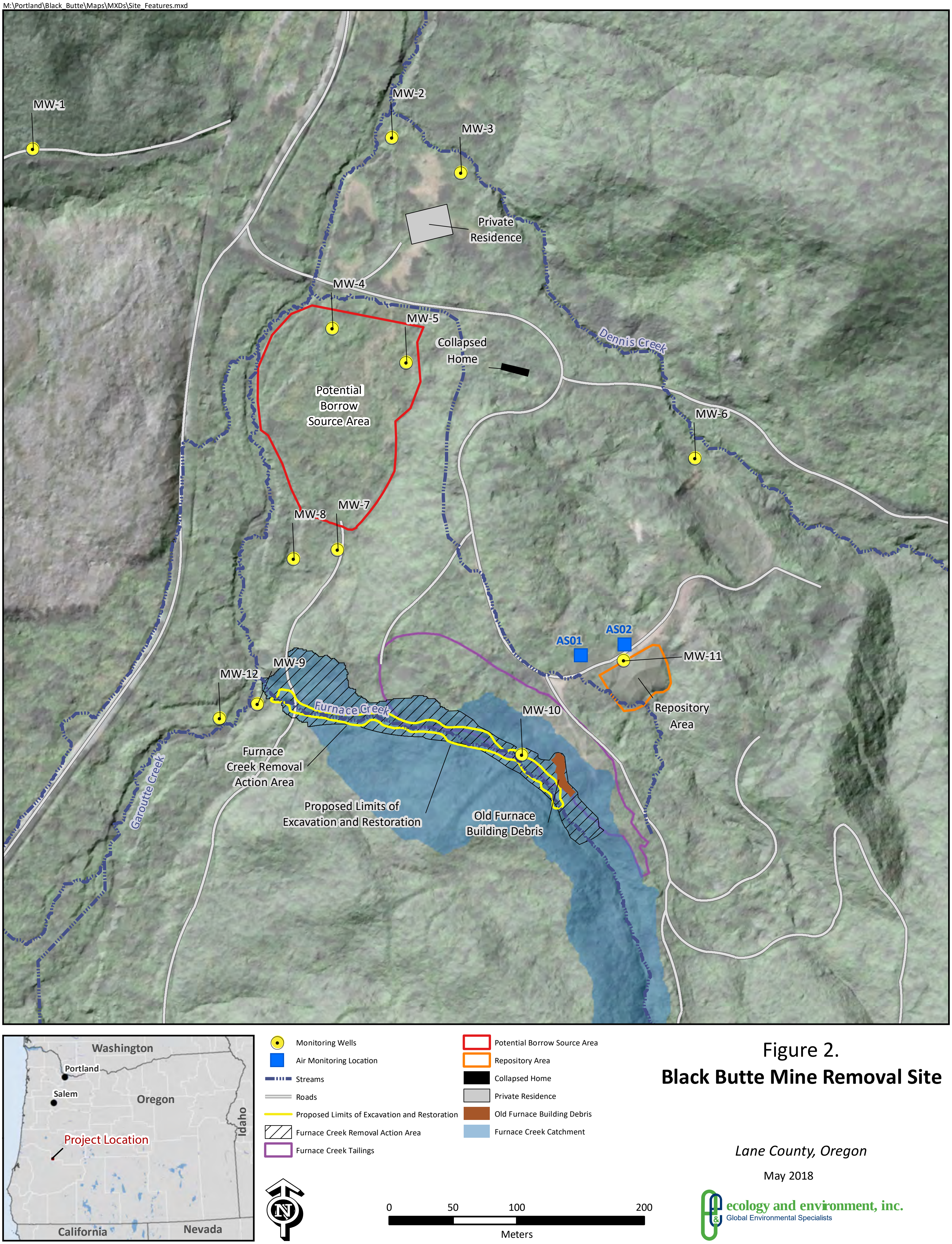


Figure 2.
Black Butte Mine Removal Site

Lane County, Oregon

May 2018

ecology and environment, inc.
Global Environmental Specialists

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

June 26, 2018

Randy Nattis, On-Scene Coordinator
United States Environmental Protection Agency
805 SW Broadway, Suite 500
Portland, Oregon 97205

Re: Final Site-Specific Sampling Plan
Black Butte Mine / Furnace Creek Non-Time Critical Removal Action (Soil Excavation)
Contract Number EP-S7-13-07, Task Order Number 25

Dear Mr. Nattis:

Enclosed please find the final Soil Excavation Site-Specific Sampling Plan (SSSP) for the non-time critical removal action of the Furnace Creek area of the Black Butte Mine Site, located near Cottage Grove in Lane County, Oregon.

This SSSP is based on the initial SSSP that was submitted on May 21, 2018, and it includes the results of the field analytical correlation study and other updates to the sampling approach based on field conditions.

If you have any question regarding this submittal, please call me at (206) 624-9537.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Steve Hall

Steven G. Hall
START-IV Removal Team Leader

Enclosure

cc: Kathy Parker, OSC, QA Coordinator, EPA Region 10, Seattle, Washington
Bryan Ciecko, START PM, E & E, Portland, Oregon

This page intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY MANAGEMENT PROGRAM

Site Specific Sampling Plan

Project Name: Black Butte Mine – Soil Excavation (Final)____ Site ID: 10EK_____

Author: B. Ciecko / Steve Hall Company: Ecology & Environment, Inc. Date Completed: _6/26/2018____

This Site Specific Sampling Plan (SSSP) is prepared and used in conjunction with the Quality Assurance Plan (QAP) for the Emergency Management Program for collecting samples during this Removal Program project. The information contained herein is based on the information available at the time of preparation. As better information becomes available, this SSSP will be adjusted.

When inadequate time is available for preparing the SSSP in advance of the sampling event, a Field Sampling Form may be prepared on-site immediately prior to sampling. This full length version of the SSSP is written after the sampling event and the completed Field Sampling Form attached to it.

1. Approvals

Name, Title	Telephone, Email, Address	Signature
Randy Nattis **On-Scene Coordinator**	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	
Kathy Parker **EMP Quality Assurance Coordinator**	206-553-0062, parker.kathy@epa.gov USEPA , M/S: ECL-133, 1200 Sixth Ave. Suite 900, Seattle, WA 98101	

I. Project Management and Organization

2. Personnel and Roles involved in the project:

Name	Telephone, Email, Company, Address	Project Role	Data Recipient
Randy Nattis	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	On Scene Coordinator	Yes
Bryan Ciecko	503-248-5600 x4602, bciecko@ene.com, 333 SW 5th Avenue, Suite 600, Portland, OR 97204	Author of SSSP, START Project Manager	Yes
Steve Hall	206-920-1739, sghall@ene.com E&E, 2101 Third Ave Suite 1700 Seattle, WA 98104	START Removal Team Leader	Yes
Kathy Parker	206 553-0062, parker.kathy@epa.gov USEPA , M/S: ECL-133, 1200 Sixth Ave. Suite 900, Seattle, WA 98101	EMP Quality Assurance Coordinator	No
Mark Woodke	206-624-9537, mwoodke@ene.com, E & E 720 Third Ave, Suite 1700 Seattle, WA 98104	START Quality Assurance Reviewer	Yes

Jason Cristino	874-324-3309, jcristino@emt.com, EMT Laboratory 8100 N. Austin Avenue, Morton Grove, IL 60053-3203	Laboratory contact	No

3. Physical Description and Site Contact Information:

Site Name	Black Butte Mine	
Site Location	The site is located approximately 10 miles south of Cottage Grove in Lane County, Oregon (Figure 1).	
Property Size	The Furnace Creek removal action area is approximately 2 acres (Figure 2).	
Site Contact	Randy Nattis	**Phone Number:** 503-628-9419
Nearest Residents	Approximately ¼ mile	**Direction:** Northwest
Primary Land Uses Surrounding the Site	Forest/timber lands	

4. The proposed schedule of project work follows:

Activity	Estimated Start Date	Estimated Completion Date	Comments
SSSP Review/ Approval	May 8, 2018	May 21, 2018	The first SSSP was prepared and used at the beginning of field work.
Final SSSP Review/ Approval	June 26, 2018	June 29, 2018	The Final SSSP has been updated to reflect changes in the sampling approach due to field conditions.
Mobilize to / Demobilize from Site	May 21 2018	September 21, 2018	
Sample Collection	May 21, 2018	September 21, 2018	
Laboratory Sample Receipt	May 25 or 26, 2018	September 21, 2018	May need Saturday receipt on first batch of samples (5/26/18)
Laboratory Analysis	May 28, 2018	September 28, 2018	1-week TAT on first batch of samples, standard TAT on subsequent samples
Data Validation	June 1, 2018	October 1, 2018	

5. Historical and Background Information

Describe briefly what you know about the site that is relevant to sampling and analysis for this investigation.

The Black Butte Mine (BBM) is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River basin, approximately ten miles south of Cottage Grove, Oregon (Figure 1). The BBM is located on the northwest flank of Black Butte. The landowner is The Land and Timber Company, which has used the property surrounding the site for logging.

The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Ore Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits (Figure 2).

Dennis Creek borders the northeast side of the site and flows westward into Garoutte Creek, approximately 0.25 miles downstream of BBM. Furnace Creek, an intermittent stream, borders the southwest side of the site and also flows into Garoutte Creek. Furnace Creek is adjacent to the Old Ore Furnace Area, and mill tailings are located in the creek channel and drainage basin. Garoutte Creek flows northward approximately six miles to the Coast Fork Willamette River, which empties into Cottage Grove Reservoir, a reservoir used extensively for recreational activities including contact recreation (i.e. swimming, canoeing, and scuba diving) and fishing (EPA 2017).

BBM is on the National Priorities List, and EPA is currently performing a remedial investigation (RI) at the site. The draft RI report is expected to be completed in 2018.

In 2007, EPA completed a time-critical removal action (TCRA) at the Site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury-contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings that were removed were consolidated with the main tailings pile on site to form a repository. The repository cover was constructed with tailings/waste material which analytical results showed to be below the 2007 Removal Action Objective of 23 milligrams per kilogram (mg/kg) for mercury. Additionally, mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil/tailings that were determined to have low mercury concentrations.

Recent surface water and sediment sampling by the Oregon Department of Environmental Quality and EPA indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment are the dominant source of mercury migrating to Garoutte Creek. Erosion of tailings and mercury-impacted soil into the Furnace Creek and re-suspension of mercury impacted channel bottom sediments into the water column are the two primary mechanisms for transport of particulate mercury from source areas within the Furnace Creek catchment to Garoutte Creek. Furnace Creek was not included in the scope of the 2007 TCRA.

To reduce the release of mercury to surface water, EPA decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA is to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFW watershed.

EPA's remedial program completed an engineering evaluation / cost analysis (EE/CA; CDM Smith 2016), and the recommended removal alternative is the excavation of mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel. The excavated material will be added to the existing on-site repository from the 2007 TCRA, and then the expanded repository will be covered with a new cap composed of clean borrow soil from a to-be-determined borrow source. Following the removal of contaminated sediment and tailings in the creek channel, Furnace Creek will be restored.

The NTCRA will be completed in accordance with a Final Implementation Plan (CDM Smith 2018b). Target preliminary removal action objectives (PRAOs) were outlined in a Field Decision Criteria Memo dated April 11, 2018 (CDM Smith 2018a). This SSSP outlines the sampling and analytical procedures to be performed by START to support the NTCRA.

References:

CDM Smith, April 11, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA.

_____, April 2018b, Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

_____, July 22, 2016, Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

U.S. Environmental Protection Agency (EPA), 2017, First Amendment to the Action Memorandum, including a Request for Exemption from, the 12-Month and $2 Million Statutory Limits on Removal Actions and an Increase in the Project Cost Ceiling for a Non-Time-Critical Removal Action for the Furnace Creek Area at Operable Unit 1 of the Black Butte Mine Superfund Site, Lane County, Oregon (SEMS IDNO.OR0000515759), September 13, 2017.

6. Conceptual Site Model

Example: Contaminant: Mercury
Transport Mechanism: vapor moving on air currents
Receptors: people living in the house

Contaminants: Mercury and arsenic in the Furnace Creek catchment.

Transport Mechanisms: erosion and dissolution of tailings/calcines into surface water in Furnace Creek to Garoutte Creek and Cottage Grove Reservoir; mercury vapors in air.

Receptors: aquatic invertebrates in Garoutte Creek and Cottage Grove Reservoir, fish, and nearby residents, consumption of fish or surface water from Cottage Grove Reservoir; direct contact to contaminated tailings or inhalation of mercury vapors by hikers / site visitors.

7. Decision Statement

Examples: 1) Determine whether surface contamination exceeds the established action level;
2) Determine appropriate disposal options for contaminated materials.

The decision(s) to be made from this investigation is/are to:

Determine the correlation between mercury and arsenic concentrations in soil using the field portable x-ray fluorescence (XRF; mercury and arsenic) and Lumex (mercury only) instruments.

Determine the correlation between mercury and arsenic concentrations in soil using field analytical methods (XRF and Lumex) and off-site laboratory analyses.

Determine whether there is a direct correlation between arsenic and mercury concentrations in site soils and tailings

Determine when sufficient soil/sediment have been removed to achieve the PRAOs for mercury and arsenic.

Determine acceptable fill material based on guidelines from the Implementation Plan (CDM Smith, 2018b) and Memo (CDM Smith 2018a).

8. Action Level

State the analyte, concentration, and units for each selected action level. Describe the rationale for choosing each action level and its source (i.e. MTCA, PRG, ATSDR, etc.) Example: The action level for total mercury in soil is 6.7 mg/kg (from Regional Screening Level residential).

Per the Field Decision Criteria Memo (CDM Smith 2018a), removal decisions will be guided by existing analytical data and visual observations. The tailings at BBM can generally be identified visually. For areas with soil mixed with mine-waste material, visual identification is less reliable and will be supplemented with field analytical techniques (XRF and/or Lumex).

The Field Decision Criteria Memo established mercury and arsenic criteria for the removal of tailings and contaminated soil/sediment and for soil from borrow source(s) to be used as fill and cover material. These criteria are outlined in Table 1:

Table 1. Field Decision Criteria for Mercury and Arsenic

Criteria Type	Mercury (mg/kg)	Arsenic (mg/kg)
Target Removal Criteria	20	100
Criteria for On-site Borrow Material	7	30
Criteria for Off-site Borrow Material	2	20

Key: mg/kg = milligrams per kilogram

These site action levels and field and off-site laboratory reporting limits are included in Attachment A.

II. Data Acquisition and Measurement Objectives

9. Site Diagram and Sampling Areas

A Sampling Area is an area within in which a specific action will be performed.
Examples : 1) Each drum on the site is a Sampling Area;
2) Each section of sidewalk in front of the residence is a Sampling Area;
3) Each sampling grid section is a Sampling Area.

Figure 2 shows site features and sampling areas.
The site includes the following sampling areas:

- Furnace Creek Removal Action Area
  - During the removal action the Furnace Creek channel will be subdivided by 19 transect lines spaced approximately 50 feet apart (e.g., STA 0+00 to STA 9+00). Each of the 50-foot creek channel sections (e.g., 0+00 to 0+50, 0+50 to 1+00, etc.) will then be subdivided into three Decision Units (DUs) for post-excavation confirmation sampling. The three DUs per channel section will include the left bank (LB), right bank (RB), and floor (FL) of the channel. With approximately 18 fifty-foot sections and three DUs per section, there will be approximately 54 DUs in the creek channel.
- Borrow Source Area(s)
- Repository Area

10. The Decision Rules

These can be written as logical If…, Then.. statements. Describe how the decisions will be made and how to address results falling within the error range of the action level. Examples: 1) In the Old Furnace Sampling Area, the soil in the area around the furnace structure will be excavated until sample analysis with XRF shows no mercury concentrations in surface soil above the lower limit of the error associated with the action level, 18.4 mg/kg. 2) If the concentrations of contaminants in a SA are less than the lower limit of the error associated with the action level, then the area may be characterized as not posing an unacceptable risk to human health or the environment and may be dismissed from additional RP activities. The area may be referred to other Federal, State or Local government agencies.

The following statement(s) describe the decision rules to apply to this investigation:

1. The XRF will be utilized to verify that tailings from Furnace Creek have been removed to acceptable levels. If XRF results indicate concentrations below 20 mg/kg for mercury and 100 mg/kg for arsenic, excavation will be considered complete. If XRF results are above those levels for mercury and/or arsenic, excavation shall continue to the extent practicable, or tailings and waste material may be left and covered in place in accordance with the Final Implementation Plan (CDM Smith 2018b).

2. For the On-Site Borrow Source Area(s), if sample results indicate concentrations generally below 7 mg/kg for mercury and 30 mg/kg for arsenic, and if the properties listed in Section 8 and Attachment B are within the specified criteria, the material will be considered suitable as a borrow source.

3. For Off-Site Borrow Source(s), if sample results indicate concentrations generally below 2 mg/kg for mercury and 20 mg/kg for arsenic, and if the other properties listed in Section 8 and Attachment B are within the specified criteria, the material will be considered suitable as a borrow source.

11. Information Needed for the Decision Rule

What information needs to be collected to make the decisions – this includes non-sampling info as well: action levels, climate history, direction of water flow, etc. Examples: Current and future on-site and off-site land use; wind direction, humidity and ambient temperature; contaminant concentrations in surface soil.

The following inputs to the decision are necessary to interpret the analytical results:

Prior to using XRF and/or Lumex data to guide removal decisions, a correlation study was performed by analyzing site tailings, sediment, and soil samples in the field with both the XRF and the Lumex (in soil mode) and at an off-site laboratory. The samples collected and analyzed covered the range of expected mercury and arsenic concentrations at the site.

12. Sampling and Analysis

For each SA, describe:

1. *sampling pattern (random, targeted, scheme for composite)*
2. *number of samples, how many to be collected from where, and why*
3. *sample type (grab, composite)*
4. *matrix (air, water, soil)*
5. *analytes and analytical methods*
6. *name and locations of off-site laboratories, if applicable.*

A. Correlation Study

Prior to initiation of the NTCRA, START performed a correlation study to compare the results from XRF, Lumex, and off-site laboratory analyses. Field work for the correlation study was performed during the week of May 21, 2018. The results were compared to evaluate the correlation between the three types of analyses and also to confirm to what degree mercury and arsenic concentrations were correlated in the site materials.

Number of Samples

As many as 120 grab samples of tailings, soil, and sediment were collected from the three site work areas (Furnace Creek, repository, and borrow source) and analyzed on site for mercury and arsenic. Samples collected from the Furnace Creek removal action area represented the expected high end of the concentration range, samples collected from the repository area (which was capped with low concentration tailings) represented the expected middle range of mercury concentrations, and samples collected from a potential borrow source area represented the expected low end of the concentration range.

All of the samples (between 80 to 120) were collected from the three areas and analyzed on site for mercury and arsenic with the XRF. A subset of those samples (between 60 to 80) were also analyzed on site for mercury with the Lumex. Forty of the samples analyzed by both XRF and Lumex were submitted to the off-site laboratory for mercury and arsenic analyses. The numbers of samples to be collected by site work area and analysis type are detailed in Table 2.

Table 2: Numbers of Samples for Correlation Study

Site Work Area	Field XRF	Field Lumex	Off-Site Lab
Borrow source (expected low range)	20 - 30	15 - 20	10
Repository cover (expected middle range)	20 - 30	15 - 20	10
Furnace Creek (expected high range)	40 - 60	30 - 40	20
Total	**80 - 120**	**60 - 80**	**40**

Sampling Locations and Frequency

Sample locations in the three site areas were selected in accordance with the following guidelines. Sample locations and frequency were modified by the On-Scene Coordinator (OSC) or START field team leader depending on site conditions.

Furnace Creek: The XRF samples within the NTCRA footprint were collected throughout the removal action area and was not focused in any one area. No specific sampling locations or spacing were necessary for the correlation study; however, samples locations were targeted towards areas of red soils which are indicative of tailings.

Repository: Samples were collected from the surface. The locations were generally evenly spaced across the existing cover at a rate of approximately 1 sample per 1,000 square feet (ft^2).

Borrow Source(s): Sample locations and frequency depended on the size of any potential borrow sources identified at the site. Subsurface soils samples were co-located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet below ground surface (bgs). Additional details for borrow source characterization are provided in Section 12B below.

Sampling Methodology
Each sample was collected using a dedicated plastic spoon or scoop and placed into a zip-top bag. Surface detritus was removed exposing mineral soil, and sufficient sample was retained for analysis by XRF, Lumex, and fixed laboratory (at least 4 to 6 ounces). The material was homogenized inside the bag, and gravel and organic material was discarded.

XRF Field Analyses
Once each sample was prepared, it was analyzed with the XRF following the procedures of EPA Method 6200 (Attachment C). All samples were retained for further analysis with the Lumex and/or fixed laboratory.

Lumex Field Analyses
A subset of the samples collected for XRF analysis was split for field analysis using the Lumex (soil mode). The number of samples from each site work area conformed with Table 2, and samples were selected to represent the range of target concentrations identified by XRF. Analysis using the Lumex followed the "Standard Operating Procedures for Mercury In Soils and Solutions Using the Lumex RA-915+ Method 7473" guidance document included as Attachment D.

Off-Site Laboratory
As many as 40 samples were submitted for fixed lab analysis of total mercury and total arsenic via EPA SW-846 Methods 7471B and 6010C. These samples were a subset of those analyzed using the Lumex and were selected to represent the full range of concentrations identified by the Lumex.

Results
The results of the correlation study are provided in the attached memorandum (Attachment E), and the results are summarized below.

- Arsenic: The XRF/laboratory data correlation (r) was 0.9355, and the XRF can be used for any predicted arsenic value greater than 9 mg/kg.

- Mercury: Above 20 mg/kg, the XRF/laboratory data correlation (r) was 0.9675, and below 20 mg/kg, the Lumex/laboratory data correlation (r) was 0.9424. To optimize field analyses for mercury, samples will be initially be analyzed by XRF. If the ex situ XRF concentration for mercury in a sample is less than 30 mg/kg, and if an accurate mercury concentration less than 30 mg/kg is needed for that sample, then the sample will be further analyzed with the Lumex. Note that 30 mg/kg is used for this decision point to account for the standard error in the XRF correlation.

B. Borrow Source Characterization

Initial Characterization / Correlation Study – On-Site Borrow Source
In addition to providing data for the correlation study discussed in Section 12A above, samples collected from potential borrow source(s) will help characterize the suitability of the material for use as fill and cover during the NTCRA. In addition to surface samples, subsurface samples will be collected to help determine the depth of the borrow source so that a volume can be extrapolated. Subsurface soils samples will be co-located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet bgs. It is anticipated that the Emergency Response and Rapid Services (ERRS) contractor will assist with collecting the subsurface soil samples through the use of heavy equipment.

Off-Site Borrow Sources
If use of material from an off-site source is necessary to achieve removal action objectives, then representative samples will be collected and screened with the XRF and/or Lumex. If the samples pass the suitability criteria in Table 1, then samples will be collected for additional laboratory testing as described in the next section.

<u>Analytical Testing</u>
As described in Table 2, between 20-30 borrow source samples will be analyzed by XRF, between 15-20 will be analyzed with the Lumex, and as many as 10 will be submitted to the off-site laboratory for mercury and arsenic analysis. These results will be compared to the criteria in Table 1.

Additionally, at least one 20-point composite sample from the potential borrow source will be submitted for the parameters outlined in Attachment B (Section 2.2.4.1 of the Final Implementation Plan; CDM Smith 2018b). The results of all analyses on potential borrow source materials will be compared to the criteria in Table 1 and Attachment B to determine if the material is suitable as borrow material.

<u>Further Borrow Source Confirmation</u>
Once a suitable borrow source or borrow sources have been identified, further characterization may be necessary depending on the amount of material needed. For mercury and arsenic, confirmation samples may be collected at an approximate rate of at least one sample per 1,000 cubic yards of on-site or off-site material. All samples will be analyzed by XRF. Confirmation of the XRF results will be performed at a rate of 20% by Lumex for mercury and 10% to be submitted for mercury and arsenic testing at the off-site laboratory.

C. <u>Removal Phase</u>
Initially, the removal will be guided by visual evidence of tailings. Previous investigations at the site have noted that the tailings have a distinctive and easy to identify red color.

Once suspected native soils are encountered (i.e., tailings that do not appear to be present any more based on an absence of visual evidence), the XRF may be utilized for *in situ* (i.e., directly on the ground surface) analysis of mercury and arsenic to provide an indication of whether sufficient material has been removed, or whether excavation should continue.

Once excavation is completed in each 50-foot section of the Furnace Creek channel, three post-excavation composite confirmation samples will be collected with one each from the left bank (LB) side wall, right bank (RB) side wall, and floor (FL). Each five-point composite sample will be collected from the surface of the excavated area into a zip-top plastic bag for XRF analysis for mercury and arsenic. Sample procedures for XRF during the removal phase will be identical to those discussed in the Correlation Study above. If an area of the excavation is unsafe to enter because of depth, steepness of slope, and/or soil type, then composite samples will be collected from freshly excavated material in the excavator bucket.

Per the results of the correlation study, if the ex situ XRF result for any sample indicates a mercury concentration of less than 30 mg/kg, and if a more accurate mercury concentration below 30 mg/kg is required, then that sample will also be analyzed for mercury by the Lumex.

Additionally, between 10% to 20% of the post-excavation confirmation samples analyzed by XRF and/or Lumex will be retained and submitted to the off-site laboratory for total mercury and total arsenic concentrations via EPA methods 7471B and 6010C.

D. Repository Screening
To ensure that the tailings and waste materials that are placed in the repository do not exceed 2,000 mg/kg as specified in the Final Implementation Plan (CDM Smith 2018b), a composite sample will be collected from the repository and analyzed by XRF every morning. The sample will be a 5-point composite collected from the area of the repository that received the waste the day before. Sampling and field analytical procedures will be performed as described above.

During the removal action, ERRS began to segregate "cleaner" overburden material separately from the tailings and more highly contaminated waste materials placed in the in the main repository. This cleaner overburden will be used as part of the repository cover. When cleaner overburden material is excavated and hauled to the stockpile area, a daily composite sample will also be collected and analyzed by XRF.

E. <u>Sample Retention and Disposal</u>
All samples collected for field XRF analyses will be retained for further analysis with the Lumex and/or fixed laboratory, if necessary. Samples may eventually be disposed of on site in the repository with the approval of the OSC.

13. Applicability of Data (place an X in front of the data categories needed, explain with comments)

Do the decisions to be made from the data require that the analytical data be:
1) definitive data, 2) screening data (with definitive confirmation) or 3) screening data (without definitive confirmation)?

__X_***A) Definitive data*** *is analytical data of sufficient quality for final decision-making. To produce definitive data on-site or off-site, the field or lab analysis will have passed full Quality Control (QC) requirements (continuing calibration checks, Method Detection Limit (MDL) study, field duplicate samples, field blank, matrix spikes, lab duplicate samples, and other method-specific QC such as surrogates) AND the analyst will have passed a Precision and Recovery (PAR) study AND the instrument will have a valid Performance Evaluation sample on file. This category of data is suitable for:* ***1) enforcement purposes, 2) determination of extent of contamination, 3) disposal, 4) RP verification or 5) cleanup confirmation.***
Comments: All fixed laboratory analyses will provide definitive data.

__X_***B) Screening data with definitive confirmation*** *is analytical data that may be used* ***to support preliminary or intermediate decision-making*** *until confirmed by definitive data. However, even after confirmation, this data is often not as precise as definitive data. To produce this category of data, the analyst will have passed a PAR study to determine analytical error AND 10% of the samples are split and analyzed by a method that produced definitive data with a minimum of three samples above the action level and three samples below it.*
Comments: Field analyses that are confirmed at a fixed laboratory will provide screening data with definitive confirmation.

__X_***C) Screening data*** *is analytical data which has not been confirmed by definitive data. The QC requirements are limited to an MDL study and continuing calibration checks. This data can be used for making decisions:* ***1) in emergencies, 2) for health and safety screening, 3) to supplement other analytical data, 4) to determine where to collect samples, 5) for waste profiling, and 6) for preliminary identification of pollutants****. This data is not of sufficient quality for final decision-making.*
Comments: Field analyses that are not confirmed at a fixed laboratory will provide screening data.

14. Special Sampling or Analysis Directions

Describe any special directions for the planned sampling and analysis such as additional quality controls or sample preparation issues. Examples: 1) XRF and Lumex for sediment will be calibrated before each day of use and checked with a second source standard. 2) A field blank will be analyzed with each calibration to confirm the concentration of non-detection. 3) A Method Detection Limit determination will be performed prior to the start of analysis so that the lower quantitation limit can be determined. 4) If particle size is too large for accurate analyses, the samples will be ground prior to analysis. If the sample contains too much moisture for accurate analyses, the sample will be decanted and air dried prior to analysis.

One week turnaround time will be requested for samples collected as part of the correlation study.

Mercury and arsenic will be analyzed using method 7471B and 6010C, respectively, for lab analysis; method 6200 for XRF analysis and SOP304a, Mercury In Soil By Lumex RA-915+ (Attachment D) for Lumex analysis of mercury.

XRF and Lumex will be calibrated at prior to use each day of use and checked with a second source standard.

For Lumex and XRF, a field blank will be analyzed with each calibration to confirm the concentration of non-detection.

For the XRF and Lumex, a Method Detection Limit determination will be performed prior to the start of analysis so that the lower quantitation limit can be determined.

15. Method Requirements

[Describe the restrictions to be considered in choosing an analytical method due to the need to meet specific regulations, policies, ARARs, and other analytical needs. Examples: 1) Methods must meet USEPA Drinking Water Program requirements. 2) Methods must achieve lower quantitation limits of less than 1/10 the action levels.3) Methods must be performed exactly as written without modification by the analytical laboratory.]

If results of the correlation study indicate that the XRF and off-site laboratory data has a minimum correlation (r) of 0.7, then the XRF will be used to provide real time removal decisions during the NTCRA. If the XRF correlation does not meet the minimum method criteria for mercury, the Lumex will be relied upon to give near-real time mercury results to guide the removal.

16. Sample Collection Information

[Describe any activities that will be performed related to sample collection]

The applicable sample collection Standard Operating Procedures (SOPs) or methods will be followed and include:

Field Activity Logbook SOP
Sample Packaging and Shipping SOP
Sampling and Field Equipment Decontamination SOP
Instrument SOPs: Lumex, XRF
Other SOPs: Site Control Procedures for Potentially Contaminated Sites, Surface and Shallow Subsurface Soil Sampling

All SOP's are included as Attachment D.

17. Optimization of Sampling Plan (Maximizing Data Quality While Minimizing Time and Cost)

[Describe what choices were made to reduce cost of sampling while meeting the needed level of data quality. Example: The XRF will be used in situ whenever possible to achieve accurate results. Reproducibility and accuracy of in situ XRF analyses will be checked by collecting, air drying, analyzing and comparing five in situ samples at the start of sampling. Where interferences are suspected, steps will be taken to eliminate the interferences by mechanisms such as drying, grinding or sieving the samples or analyzing them using the Lumex with soil attachment.]

XRF and Lumex analyses will be performed when possible to provide faster results and to save on analytical laboratory costs.

The format for sample number identification is summarized in Table 3. Sample collection and analysis information is summarized in Table 4. Common sample handling information is presented in Table 5.

Table 3
SAMPLE CODING

Project Name: ___Black Butte Mine - Removal___________________ **Site ID:** _10EK__

SAMPLE NUMBER [1]

Digits	Description	Code (Example)
1,2,3,4	Year and Month Code	1805 (YYMM)
5,6,7,8	Consecutive Sample Number (grouped by SA as appropriate)	0001 (First sample of SA)

SAMPLE NAME / LOCATION ID [2]
(Optional)

1,2	Sampling Area	FC – Furnace Creek Removal Area BS – Borrow Source RC – Repository Cover AC – Adit Creek RS – Repository Screening LB – Left Bank RB – Right Bank FL – Floor
3,4	Consecutive Sample Number	01 – First sample of Sampling Area 150-200 – Furnace Creek post-excavation confirmation DU
5,6	Matrix Code	CC – Cleaner Cover (Repository Screening) SB – Subsurface Soil SS – Surface Soil QC – Quality Control
7,8	Depth (Optional)	01 (feet below ground surface)

Notes:
(1) The Sample Number is a unique, 8-digit number assigned to each sample.
(2) The Sample Name or Location ID is an optional identifier that can be used to further describe each sample or sample location.

Table 4. Sampling and Analysis

Data Quality	Sampling Area	Matrix	Sampling Pattern	Sample Type	Data Quality	Number of Field Samples	Analyte or Parameter	Method Number	Action Level	Method Quant. Limit	#/type of Sample Containers per Sample	Preservative	Hold Time	Field QC
Field Analysis – Correlation	All Decision Areas	Soil	Targeted	Grab	Screening	Up to 120 Up to 80	Mercury and Arsenic Mercury	XRF EPA 6200 Quick Start Guide	N/A N/A	30 mg/kg 40 mg/kg 0.5 ug/kg	1x2-oz glass jar	$\leq$ 6ºC	N/A	Up to 6 Field Duplicates and 6 Blank Spikes* Up to 4 Field Duplicates and 4 Blank Spikes*
Lab Analysis - Correlation	All Decision Areas	Soil	Targeted	Grab	Definitive	40	Arsenic Mercury	EPA 6010C EPA 7471	See Attachment A	5 mg/kg 0.5 mg/kg	1x2-oz glass jar	$\leq$ 6ºC	6 months 28 days	2 Field Duplicates and 2 MS/DUPs
Lab Analysis	Borrow Source Characterization	Soil	Targeted	20-point composite	Definitive	2	Attachment B Parameters	See Attachment B	See Attachment B	Generally 0 (units vary per method)	TBD	TBD	TBD	1 Field Duplicate and 1 MS/MSD/ DUP (per method)
Lab Analysis	Borrow Source Confirmation	Soil	Targeted	Grab	Definitive	5	Arsenic Mercury	EPA 6010C EPA 7471	See Attachment A	5 mg/kg 0.5 mg/kg	1x2-oz glass jar	$\leq$ 6ºC	6 months 28 days	1 Field Duplicate and 1 MS/DUP
Lab Analysis	Removal Confirmation	Soil	Targeted	5-point composite	Definitive	20	Arsenic Mercury	EPA 6010C EPA 7471	See Attachment A	5 mg/kg 0.5 mg/kg	1x2-oz glass jar	$\leq$ 6ºC	6 months 28 days	

*- NIST Standard Reference Materials will be used for field method blank spike analyses when available at a minimum frequency of 5% of the total samples.

Table 5. Common Sample Handling Information

Analysis Type	Sub Analysis	Matrix	Analytical Method	Container Type	Minimum Volume	Preservative	Temperature/ Storage	Hold Time	Source
Metals	Metals Not including Mercury or Hexavalent chromium. Includes TAL, PP, RCRA lists)	Solid	EPA 6000 / 7000 Series	Glass Jar	200 g	n/a	None	6 months	SW-846 ch. 3
		Aqueous	EPA 6000 / 7000 Series	PTFE or HDPE	600 mL	HNO_3 to pH < 2	Not listed	6 months	SW-846 ch. 3
	Mercury	Solid	EPA 7471B	Glass Jar	200 g	n/a	≤ 6º C	28 days	SW-846 ch. 3
		Aqueous	EPA 7470A	PTFE or HDPE	400 mL	HNO_3 to pH < 2	Not listed	28 days	SW-846 ch. 3
	Hexavalent Chromium, (Hexachrome, Cr+6)	Solid	Lab-specific soil extraction modification, EPA 7196A	Glass Jar	100 g	n/a	≤ 6º C	28 days to extraction	SW-846 ch. 3
		Aqueous	EPA 218.6 (Drinking Water)	PTFE or HDPE	400 mL	n/a	≤ 6º C	24 hours	SW-846 ch. 3
	XRF	Solid (in situ; on the ground surface)	6200	none	n/a	none	none	Analyze Immediately	n/a
		Solid (ex situ)	6200	plastic bag	200 g	none	none	6 months	n/a
VOCs	VOCs / BTEX	Solid	EPA 5035 / 8260B	*	*	*	*	2 days to lab / 14 days	SW-846 ch. 4
		Aqueous	EPA 8260B	Amber Vial with Septa Lid	2 x 40 mL	HCl to pH< 2	≤ 6º C (headspace free)	14 days	SW-846 ch. 4
SVOCs	SVOCs / PAHs	Solid	EPA 8270D	Glass Jar	8 ounces	n/a	≤ 6º C	14 days	SW-846 ch. 4
		Aqueous	EPA 8270D	Amber Glass	2 x 1 L	n/a	≤ 6º C	7 days	SW-846 ch. 4
PCBs and Dioxins/Furans	PCBs	Solid	EPA 8082	Glass Jar	8 ounces	n/a	≤ 6º C	none	SW-846 ch. 4
		Aqueous	EPA 8082	Amber Glass	2 x 1 L	n/a	≤ 6º C	none	SW-846 ch. 4
	Dioxins/Furans	Solid	EPA 8280 or 8290	Glass Jar	8 ounces	n/a	≤ 6º C	none	SW-846 ch. 4
		Aqueous	EPA 8280 or 8290	Amber Glass	2 x 1 L	n/a	≤ 6º C	none	SW-846 ch. 4
Pesticides and Herbicides	Chlorinated Pesticides	Solid	EPA 8081	Glass Jar	8 ounces	n/a	≤ 6º C	14 days	SW-846 ch. 4
		Aqueous	EPA 8081	Amber Glass	2 x 1 L	n/a	≤ 6º C	7 days	SW-846 ch. 4
	Chlorinated Herbicides	Solid	EPA 8151	Glass Jar	8 ounces	n/a	≤ 6º C	14 days	SW-846 ch. 4
		Aqueous	EPA 8151	Amber Glass	2 x 1 L	n/a	≤ 6º C	7 days	SW-846 ch. 4
NWTPH	Gasoline-Range Organics	Solid	TPHs/NWTPH-Gx	Amber Glass Jar with Septa Lid	4 ounces	n/a	≤ 6º C (headspace free)	14 days	Method
		Aqueous	TPHs/NWTPH-Gx	Amber Vial with Septa Lid	2 x 40 mL	pH < 2 with HCl	≤ 6º C (headspace free)	7 days unpreserved 14 days preserved	Method
	Diesel-Range Organics	Solid	3510, 3540/3550, 8000	Glass Jar	8 ounces	n/a	≤ 6º C	14 days	Method

Analysis Type	Sub Analysis	Matrix	Analytical Method	Container Type	Minimum Volume	Preservative	Temperature/ Storage	Hold Time	Source
		Aqueous	3510, 3540/3550, 8000	Glass Amber	2 x 1 L	pH < 2 with HCl	≤ 6° C	7 days unpreserved 14 days preserved	Method
Geotechnical	Particle Size Analysis	Solid	ASTM D-422	Glass Jar or Plastic Bag	2 x 8 ounce	none	n/a	n/a	Method
Miscellaneous	pH	Solid	EPA 9045	Glass Jar	8 ounces	n/a	n/a	Analyze Immediately	SW-846 ch. 3
		Aqueous	EPA 9040C	PTFE	25 mL	n/a	n/a	Analyze Immediately	SW-846 ch. 3
	Total Organic Carbon (TOC)	Solid	SW-846 9060	Glass Jar	100 mL	n/a	≤ 6° C	28 days	SW-846
		Aqueous	EPA 415.1	PTFE or HDPE	200 mL	store in dark HCL or H_2SO_4 to pH <2	≤ 6° C	7 days unpreserved 28 days preserved	Method
	Cyanide	Solid	SW-846 9013	Glass Jar	5 g	n/a	≤ 6° C	14 days	SW-846 ch. 3
		Aqueous	SW-846 9010C	PTFE or HDPE	500 mL	NaOH to pH > 12	≤ 6° C	14 days	SW-846 ch. 3
	Conductivity	Aqueous	EPA 120.1	PTFE or HDPE	100 mL	n/a	n/a	Analyze Immediately	Method
	Hardness	Aqueous	EPA 130.1	PTFE or HDPE	1 x 1 L	HNO3 to pH<2	≤ 6° C	28 days	Method
	Flash Point	Aqueous	EPA 1010A or 1020B	Glass Jar	2 x 250 mL	n/a	≤ 6° C	n/a	Method
	Total Suspended Solids	Aqueous	EPA 160.2	PTFE or HDPE	100 mL	n/a	≤ 6° C	7 days	Method
	Total Dissolved Solids	Aqueous	EPA 160.1	PTFE or HDPE	100 mL	n/a	≤ 6° C	7 days	Method
	Nitrate/nitrite	Aqueous	EPA 353.2	PTFE or HDPE	1 x 250 mL	H_2SO_4 to pH <2	≤ 6° C	28 days	Method
	Nitrate	Aqueous	SW-846 9210A	PTFE or HDPE	1,000 mL	n/a	≤ 6° C	28 days	SW-846 ch. 3
	Nitrite	Aqueous	SW-846 9216	PTFE or HDPE	25 mL	n/a	≤ 6° C	48 hours	SW-846 ch. 3, Method
	Fluoride	Aqueous	SW-846 9214	PTFE or HDPE	300 mL	n/a	≤ 6° C	28 days	SW-846 ch. 3
	Chloride	Aqueous	SW-846 9250	PTFE or HDPE	50 mL	n/a	≤ 6° C	28 days	SW-846 ch. 3
	Sulfate	Aqueous	SW-846 9035	PTFE or HDPE	50 mL	n/a	≤ 6° C	28 days	SW-846 ch. 3
	Sulfide	Solid	SW-846 9215	Glass Jar	1 x 4 ounces	Fill sample surface with 2N zinc acetate until moistened.	≤ 6° C (headspace free)	7 days	SW-846 ch. 3
		Aqueous	SW-846 9031	PTFE or HDPE	100 mL	4 drops 2N zinc acetate/100 mL sample; NaOH to pH>9.	≤ 6° C (headspace free)	7 days	SW-846 ch. 3

Key:

* = See individual methods. We typically collect 3xEnCore-type samplers and 1x40 mL VOA vial per sample, keep at ≤ 6ºC with no chemical preservative, and they must be at the lab within 48 hours of collection.

C	= Celsius	HNO_3	= nitric acid	SVOCs	= semivolatile organic compounds
Cr	= chromium	L	= liter	SW-846	= EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
EPA	= Environmental Protection Agency	mL	= milliliter	TAL	= Target Analyte List
g	=grams	n/a	= not applicable	TPH	= total petroleum hydrocarbons
H2SO4	= sulfuric acid	NaOH	= sodium hydroxide	VOA	= Volatile Organic Analysis
HCL	= hydrochloric acid	PCBs	= polychlorinated biphenyls	VOCs	= Volatile Organic Compounds
HDPE	= high-density polyethylene	PTFE	= polytetrafluoroethylene		
Hg	= mercury	RCRA	= Resource Conservation and Recovery Act		

III. Assessment and Response

A Sample Plan Alteration Form (SPAF) will be used to describe project discrepancies (if any) that occur between planned project activities listed in the final SSSP and actual project work. The completed SPAF will be approved by the OSC and QAC and appended to the original SSSP.

A Field Sampling Form (FSF) may be used to capture the sampling and analysis scheme for emergency responses in the field and then the FSF pages can be inserted into the appropriate areas of the final SSSP.

Corrective actions will be assessed by the sampling team and others involved in the sampling and a corrective action report describing the problem, solution, and recommendations will be forwarded to the OSC and the EMP QAC.

IV. Data Validation and Usability

The sample collection data will be entered into Scribe and Scribe will be used to print lab Chains of Custody. Results of field and lab analyses will be entered into Scribe as they are received and uploaded to Scibe.net when the sampling and analysis has been completed.

18. Data Validation or Verification will be performed by:

EMP's general recommendation on validation is that a minimum of CLP-equivalent stage IIA verification and validation be performed for every SSSP involving laboratory analyses. However, stage IIB is preferred if the lab can provide it. Dioxins should be validated at CLP-equivalent stage 4.

	Data Verification and Validation Stages						
Performed by:	I	IIA	IIB	III	IV	Verification	Other:
E and E QA Reviewer			100% Fixed Lab		10% Fixed Lab	100% Field Lab	
EPA Region 10 QA Office							
MEL staff							
Other:							

The following qualifiers shall be used in data validation:

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

JH - The result is an estimated quantity, but the result may be biased high.

JL - The result is an estimated quantity, but the result may be biased low.

JK - The result is an estimated quantity, but the result may have an unknown bias.

JQ - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).

N - The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”.

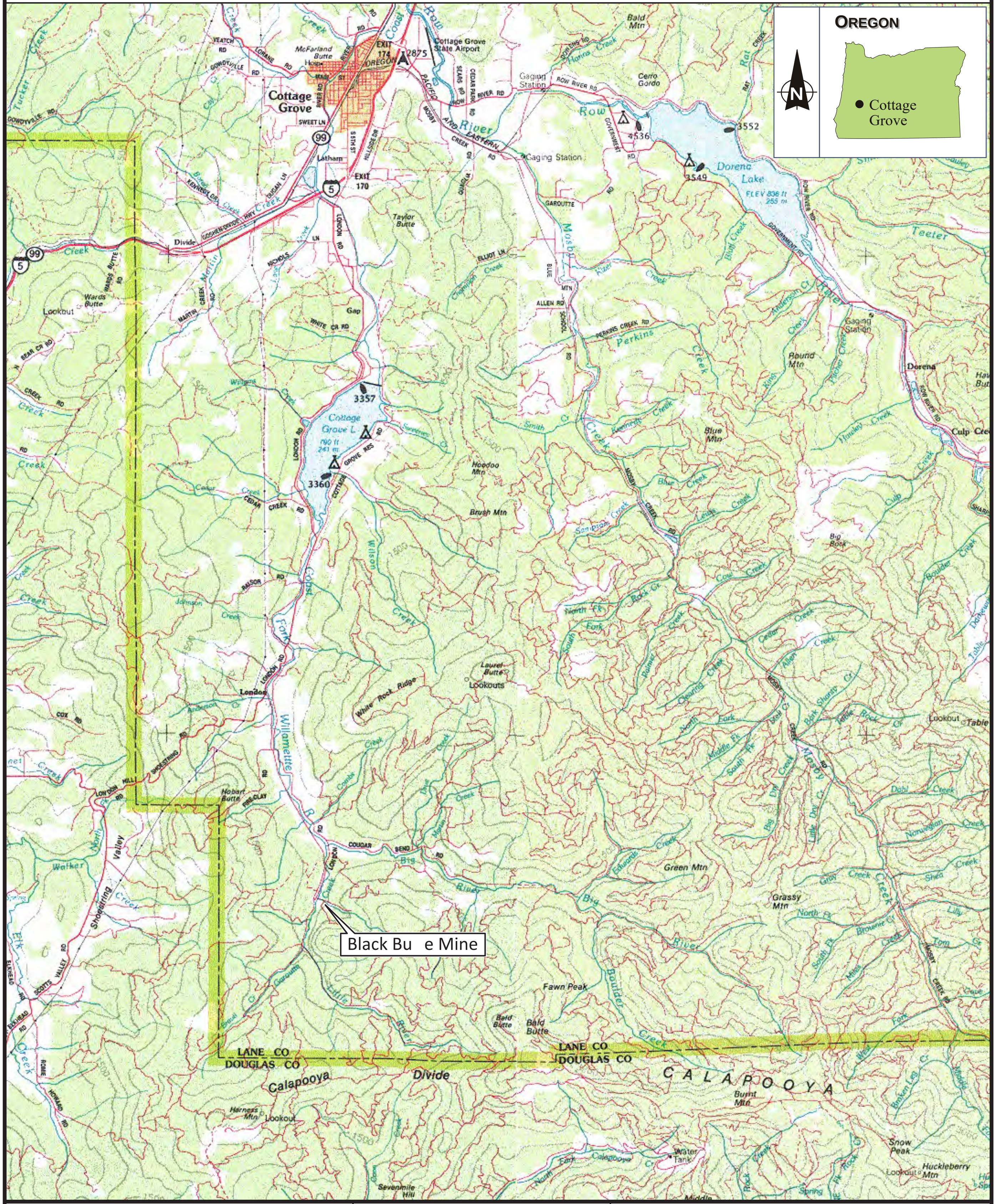
NJ - The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value is the estimated concentration in the sample.

UJ - The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R - The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

C - The target Pesticide or Aroclor analyte identification has been confirmed by Gas Chromatograph/ Mass Spectrometer (GC/MS).

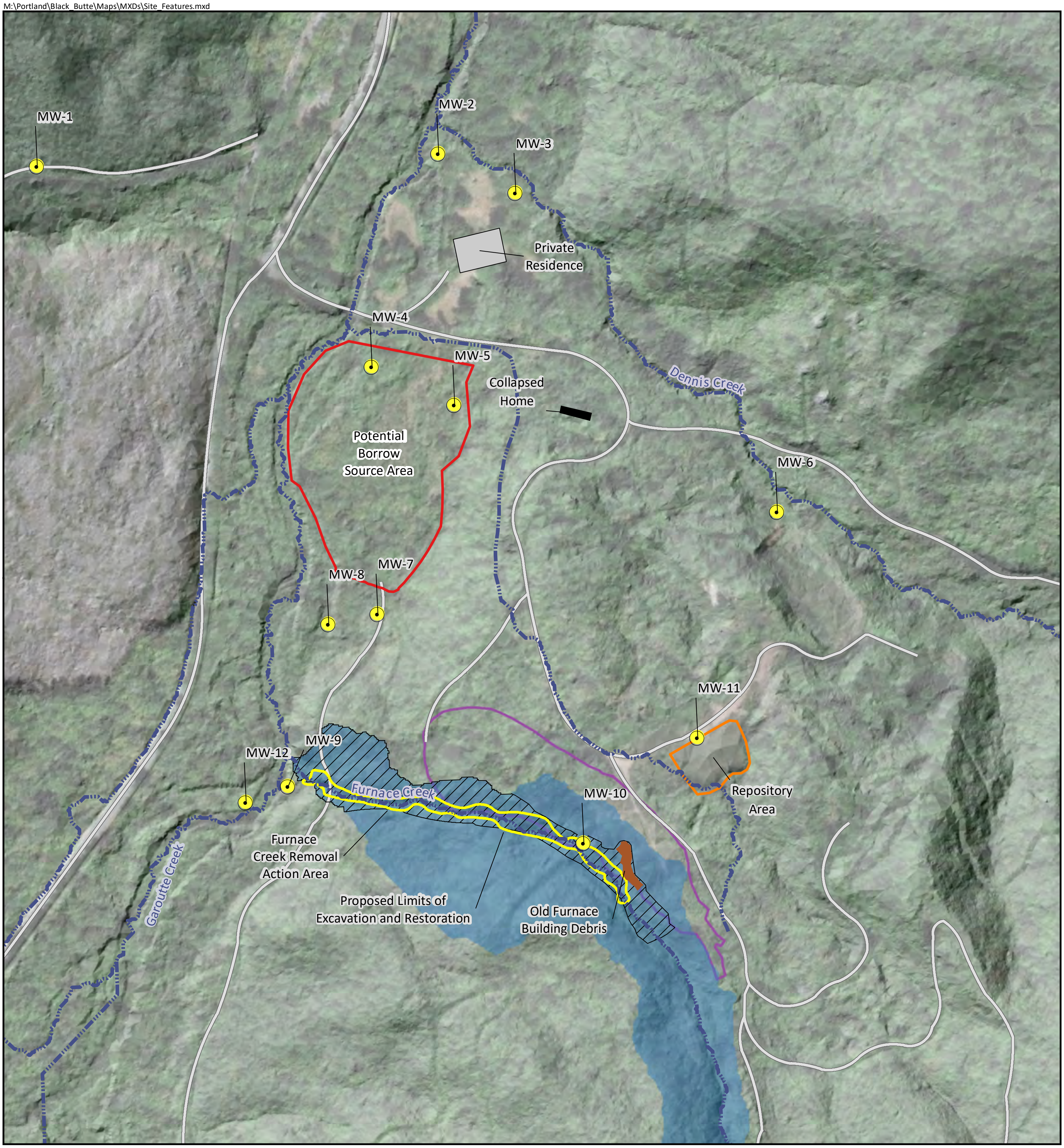
Source: DeLorme 1991, Scale 1:150,000.



ecology and environment, inc.
Global Environmental Specialists
Seattle, Washington

BLACK BUTTE MINE Lane County, Oregon	Figure 1 SITE LOCATION MAP		
	Date: 2/23/18	Drawn by: AES	10:START-IV\TO25T1SS1\fig 1

M:\Portland\Black_Butte\Maps\MXDs\Site_Features.mxd



Monitoring Wells
Streams
Roads
Proposed Limits of Excavation and Restoration
Furnace Creek Removal Action Area
Furnace Creek Tailings
Potential Borrow Source Area
Repository Area
Collapsed Home
Private Residence
Old Furnace Building Debris
Furnace Creek Catchment

N

0 50 100 200
Meters

Figure 2.
Black Butte Mine Removal Site

Lane County, Oregon

May 2018

ecology and environment, inc.
Global Environmental Specialists

ATTACHMENT A

REMOVAL CRITERIA AND REPORTING LIMITS

This page intentionally left blank.

Attachment A: Removal Criteria and Reporting Limits							
Primary Contaminants of Concern	Site Criteria (mg/kg)			Reporting Limits (mg/kg)			
	Target Removal Criteria	Criteria for On-site Borrow Material	Criteria for Off-site Borrow Material	XRF	Lumex	Off-Site lab	
						Method	Reporting Limit
Mercury	20	7	2	11	0.5	SW-846 7471B	0.02
Arsenic	100	30	20	5	N/A	SW-846 6020B	0.5

This page intentionally left blank.

ATTACHMENT B

SOIL COVER SUITABILITY CRITERIA

This page intentionally left blank.

Attachment B: Soil Cover Suitability Criteria and Methods

Property	Acceptance Criteria	Standard Procedure
Coarse Fragments	20 – 30%	American Society of Agronomy (ASA) Monograph No. 9, Part 1, Method 15-5
Maximum Rock Size (inches)	0 – 3	Measured Verification in Field
Soil Reactivity (pH)	pH 5.5 – 8.5	ASA Monograph No. 9, Part 2, Method 10-3.2
Electrical Conductivity (EC) (mmhos/cm)	0 - 8	ASA Monograph No. 9, Part 2, Method 10-3.3
Sodium Adsorption Ratio (SAR)	0 - 10	ASA Monograph No. 9, Part 2, Method 10-3.4.45
Organic Matter (OM) Content	3 – 20%	ASA Monograph No. 9, Part 1, Method 29-3
Saturation Percent	25 – 85%	U.S. Department of Agriculture (USDA) Handbook 60, Method 27a
Available Water Holding Capacity	> 0.1	Soil Science Society of America, Part 4

This page intentionally left blank.

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

To: Randy Nattis, On-Scene Coordinator, United States Environmental Protection Agency

From: Valeriy Bizyayev, Ecology and Environment, Inc.

CC: Bryan Ciecko, Ecology and Environment, Inc.
Mark Woodke, Ecology and Environment, Inc.
Steve Hall, Ecology and Environment, Inc.

Date: June 20, 2018

Re: Black Butte Mine XRF, Lumex and Lab Correlation Memorandum

---

Problem Statement and Memorandum Purpose

The Black Butte Mine is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River (CFWR) basin, approximately ten miles south of Cottage Grove, Oregon. The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits.

To reduce the release of mercury to surface water, United States Environmental Protection Agency (EPA) decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA is to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFWR watershed.

The NTCRA will be completed in accordance with a Final Implementation Plan[1]. Target preliminary removal action objectives were outlined in a Field Decision Criteria Memo dated April 11, 2018[2]. The SSSP[3] outlines the sampling and analytical procedures to be performed by the Superfund Technical Assessment and Response Team (START) to support the NTCRA.

---

[1] CDM Smith, April 2018b, Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

[2] CDM Smith, April 11, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA.

[3] Ecology and Environment, Inc., May 2018, Site Specific Sampling Plan (SSSP), Black Butte Mine- Soil Excavation, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington

In addition to providing sampling support to the NTCRA, START will implement the Field Analytical program to help guide field decisions. To assess the impact and success of the Field Analytical approach, a correlation study was performed to help guide the use of these to tools to support the site objectives.

This memorandum only covers instrumentation used for the correlation study. Any significant setting, manufacturer or site deviations invalidate the correlation and applicability of this memorandum. Instruments used include the Lumex 915+ mercury analyzer with Attachment RP-91C (Lumex) for solid samples and the Olympus Delta x-ray fluorescence (XRF) unit for arsenic and mercury analysis with Beams #1 and #2 set to 30 second run times and Beam #3 deactivated.

Field Analytical Study

Prior to initiation of the NTCRA, START performed a correlation study to compare the results from XRF, Lumex, and off-site laboratory analyses. Fieldwork for the correlation study was performed during the week of May 21, 2018. The results were compared to evaluate the correlation between the three types of analyses and to confirm to what degree mercury and arsenic concentrations are correlated in the site materials. This study will allow for quick turnaround times using field soil analysis and allow site NTCRA activities to progress while not waiting for results from a fixed laboratory.

Number of Samples

Table 1. Numbers of Samples for Correlation Study			
Site Work Area	**Field XRF**	**Field Lumex**	**Off-Site Lab**
Borrow sources	40	20	10
Repository cover	20	16	10
Furnace Creek	41	30	20
Total	**101**	**66**	**40**

Sampling Locations and Frequency

Sample locations in the three site areas were selected in accordance with the following guidelines.

Furnace Creek: The XRF samples within the NTCRA footprint were collected throughout the removal action area and were not focused in any one area. No specific sampling locations or spacing were necessary for the correlation study; however, samples locations were targeted towards areas of red soils which are indicative of tailings.

Repository Cover: Samples were collected from the surface. The locations were generally evenly spaced across the existing cover at a rate of approximately 1 sample per 1,000 square feet (ft^2).

Borrow Sources: Sample locations and frequency were dependent on the size of any potential borrow sources identified at the site. Subsurface soil samples were co-located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet below ground surface (bgs). Additional details for borrow source characterization are provided in the SSSP.

Sampling Methodology

Each sample was collected using a dedicated plastic spoon or scoop and placed into a zip-top bag. Surface detritus was removed exposing mineral soil, and sufficient sample was retained for analysis by XRF, Lumex, and fixed laboratory (at least 4 to 6 ounces). The material was homogenized inside the bag, and gravel and organic material was discarded.

XRF Field Analyses

Once each sample was prepared, it was analyzed for arsenic and mercury with the XRF following the procedures of EPA Method 6200. All samples were retained for further analysis with the Lumex and fixed laboratory. EPA Method 6200 was modified to decrease volatilization of mercury vapors from samples. Samples visibly saturated or wet were analyzed before drying and then a simple air-drying method of opening the bag for several hours was conducted. After drying, they were reanalyzed to check for variation and precision. Variation between post-drying analysis and pre-drying analysis results showed no significant variability among samples treated.

Lumex Field Analyses

A subset of the samples collected for XRF analysis were split for mercury field analysis using the Lumex (soil attachment). Samples were selected to represent the range of target concentrations identified by XRF analysis. Analysis using the Lumex followed the EPA's "Standard Operating Procedures for Mercury In Soils and Solutions Using the Lumex RA-915+ Method 7473".

Off-Site Laboratory

Forty samples were submitted for fixed lab analysis of total mercury and total arsenic via EPA SW-846 Methods 7471B and 6010C, respectively. These samples were a subset of those analyzed using the Lumex and were selected to represent the full range of concentrations identified by the Lumex.

Field Observations and Data

Sample Matrix

The sample matrix was mainly silty, sandy and gravel-like material. Colors varied from browns to reds. The samples did not visually have a presence of high biomass content or appear visually wet. To decrease result variability and increase precision, all samples were homogenized before analysis with the XRF and Lumex. Sample bias does likely exist as the sample size and amount was limited by what could fit into the sampling boat for the Lumex unit. XRF sample bias and matrix bias was reduced by homogenization.

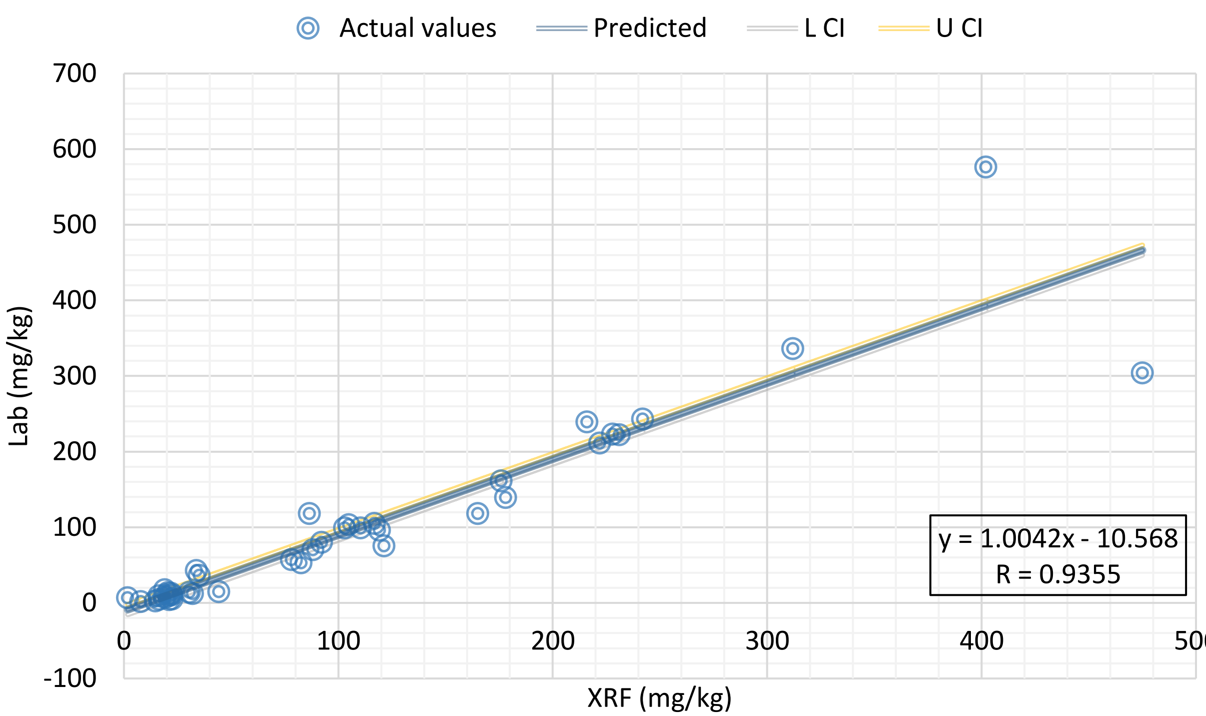
Data Integrity

All field procedures and data collection methods are held to the highest degree possible for field data quality and integrity. Field instrumentation can provide high quality data; however, there are still field variables that cannot be controlled to the same extent as at a fixed laboratory. Both Lumex and XRF instruments provide accurate results for field determination and guidance for the NTCRA in accordance with this memorandum.

Arsenic Correlation

Arsenic correlation was based on only the XRF results; all 40 samples analyzed by the fixed laboratory (Lab) were analyzed in the field by XRF. The correlation of the arsenic XRF data with the Lab data indicated a correlation coefficient value of 0.9355, meeting the screening level limit of $\geq$ 0.7, and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 6.51 milligrams per kilogram (mg/kg), indicating any Lab value produced by prediction using the XRF results will result in a value with an error of ± 6.51 mg/kg (Figure 1).

Figure 1. XRF vs. Lab arsenic values for all samples in correlation study. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 40).

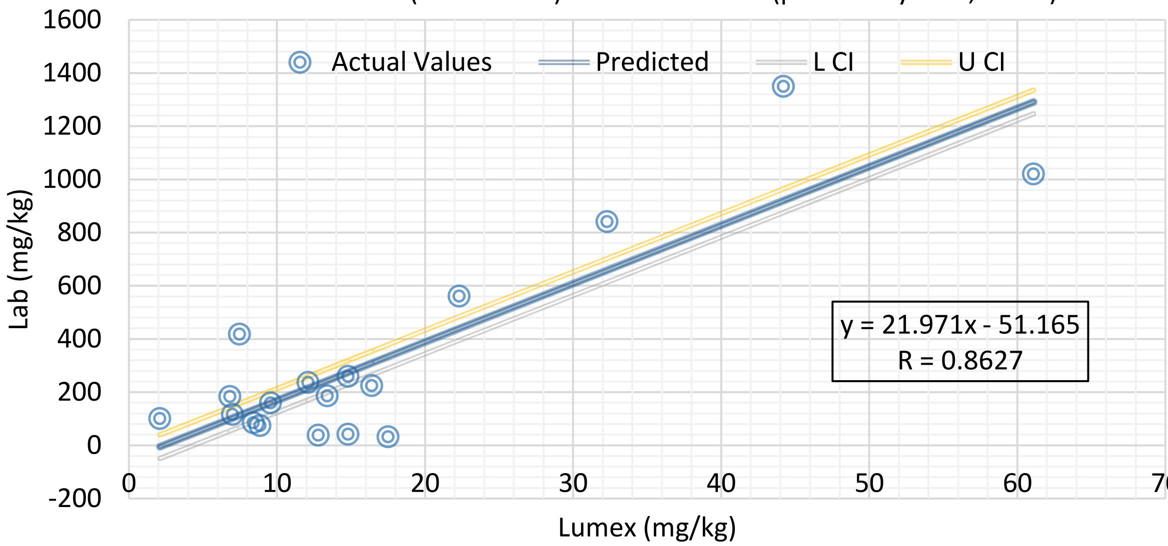


Mercury Correlation

Of the 40 samples sent for offsite analysis, all were analyzed by Lumex and XRF for mercury. For correlation purposes, the initial population of mercury data was split into two populations: one population is representative of samples with mercury laboratory values greater than 20 mg/kg, and the other is representative of mercury values less than 20 mg/kg. This was done to reflect the mercury action level established for the site and to provide greater confidence in results less than 20 mg/kg. Figures 2 through 5 present the correlations for mercury using the Lumex and XRF.

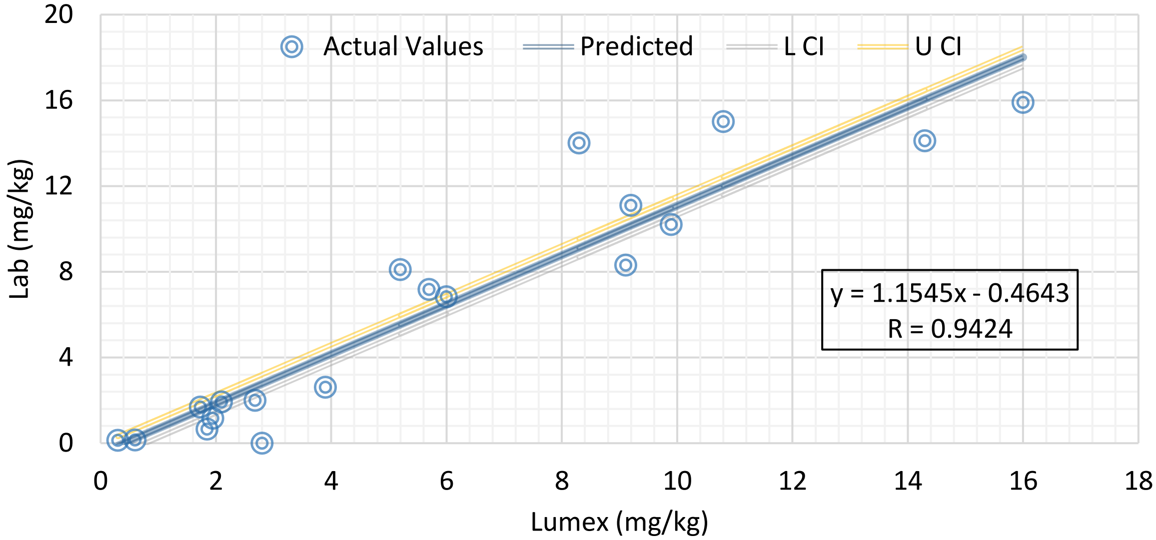
The correlation of the mercury Lumex data with the fixed laboratory values greater than ~20 mg/kg indicated a correlation coefficient value of 0.8627, meeting the screening level limit of $\geq$ 0.7 listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 44.5 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 44.5 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 2).

Figure 2. Lumex vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (LCI and UCI) calculate to 95% (probability 0.05, n= 18).



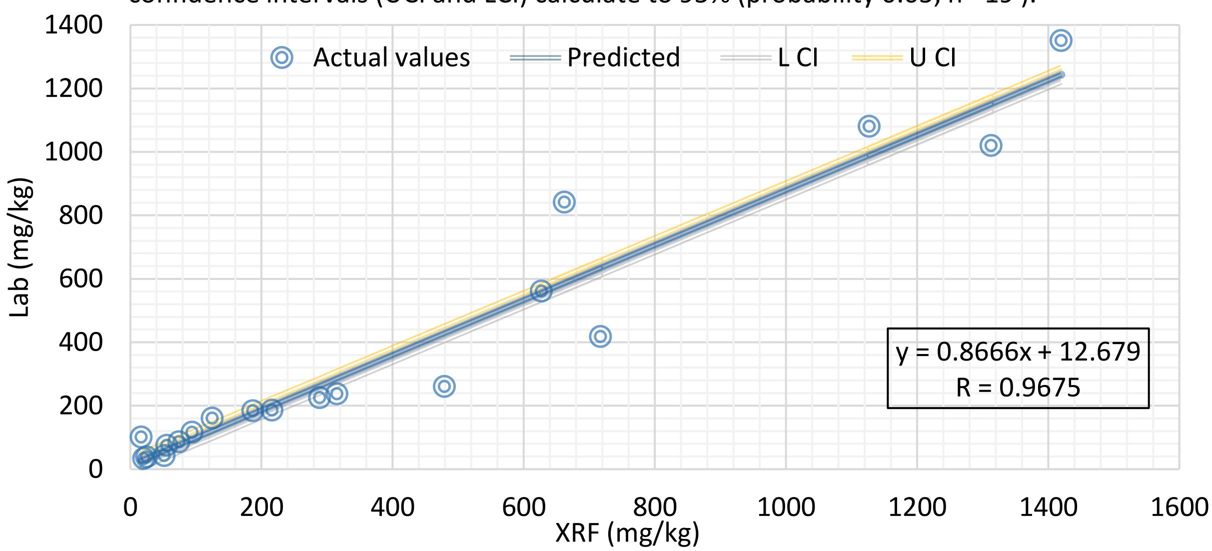
The correlation of the mercury Lumex data with the fixed laboratory values less than ~20 mg/kg indicated a correlation coefficient value of 0.9424, meeting the screening level limit of $\geq$ 0.7 and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 0.431 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 0.431 mg/kg. Two outliers were excluded from this sample population based on visual assessment of the data (Figure 3).

Figure 3. Lumex vs. Lab mercury values less than~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



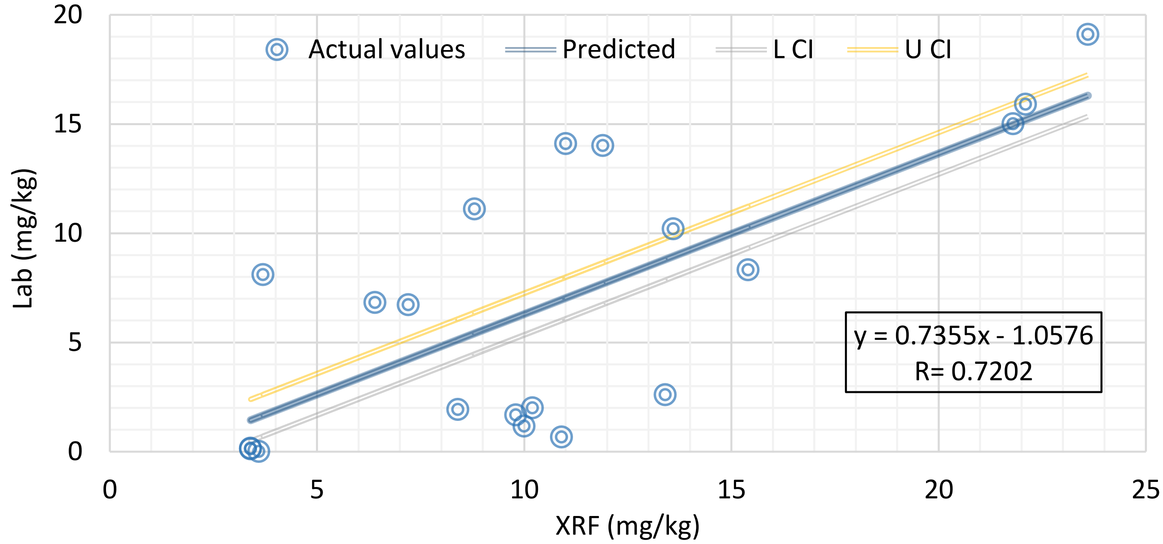
The correlation of the mercury XRF data with the fixed laboratory values greater than ~20 mg/kg data indicated a correlation coefficient value of 0.9675 exceeding the screening level limit of 0.7 and exceeding 0.9, potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for predicted fixed laboratory value is 23.2 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 23.2 mg/kg (Figure 4).

Figure 4. XRF vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



The correlation of the mercury XRF data with the fixed laboratory values less than ~20 mg/kg data indicated a correlation coefficient value of 0.7202, meeting the screening level limit of $\geq$ 0.7 but not exceeding 0.9, indicating the definitive level data criteria listed in EPA Method 6200 is not met. The standard error for a predicted fixed laboratory value is 0.953 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 0.953 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 5).

Figure 5. XRF vs. Lab mercury values less than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 20).



Conclusions and Recommendations

Arsenic

Based on the data, correlation with fixed laboratory results and history of the XRF instrument and its reliability of detecting arsenic, it is recommended that the field XRF instrument can be used to detect arsenic in soils without any correction in values. This can be implemented in accordance with EPA Method 6200, the SSSP, and following appropriate QA/QC parameters listed in the XRF Standard Operating Procedure and indicated on the XRF daily operations checklist.

Based on the regression analysis and XRF manufacturer's recommendations it is not recommended to use the XRF for detection of arsenic less than 9 mg/kg (Table 2).

Mercury

Based on the data, the XRF has a good correlation with fixed laboratory results for mercury in soils with concentrations greater than ~20 mg/kg. Once the concentrations fall below ~20 mg/kg, the correlation of the XRF with fixed laboratory results is much less reliable. The Lumex shows the opposite correlation; concentrations of mercury in soil greater than ~20 mg/kg have a weaker correlation and concentrations less than ~20 mg/kg have a stronger correlation.

Based on the regression analyses and manufacturers' literature (Table 2), the following approach should be used: initially all samples will be analyzed for mercury using the XRF. If a sample has results less than 30 mg/kg, then that sample will be analyzed for mercury using the Lumex. It is recommended that the XRF should not be used to provide results for mercury in soils with concentrations less than 30 mg/kg and the Lumex not be used to provide results for any soils with mercury concentrations greater than 30 mg/kg. The Lumex may see higher concentrations of soils, but because of field variability, regression analysis and error it is not recommended to analyze soils with the Lumex that have XRF results greater than 30 mg/kg. In addition, it is recommended that 10% to 20 % of all samples be sent off to the fixed laboratory for verification[4].

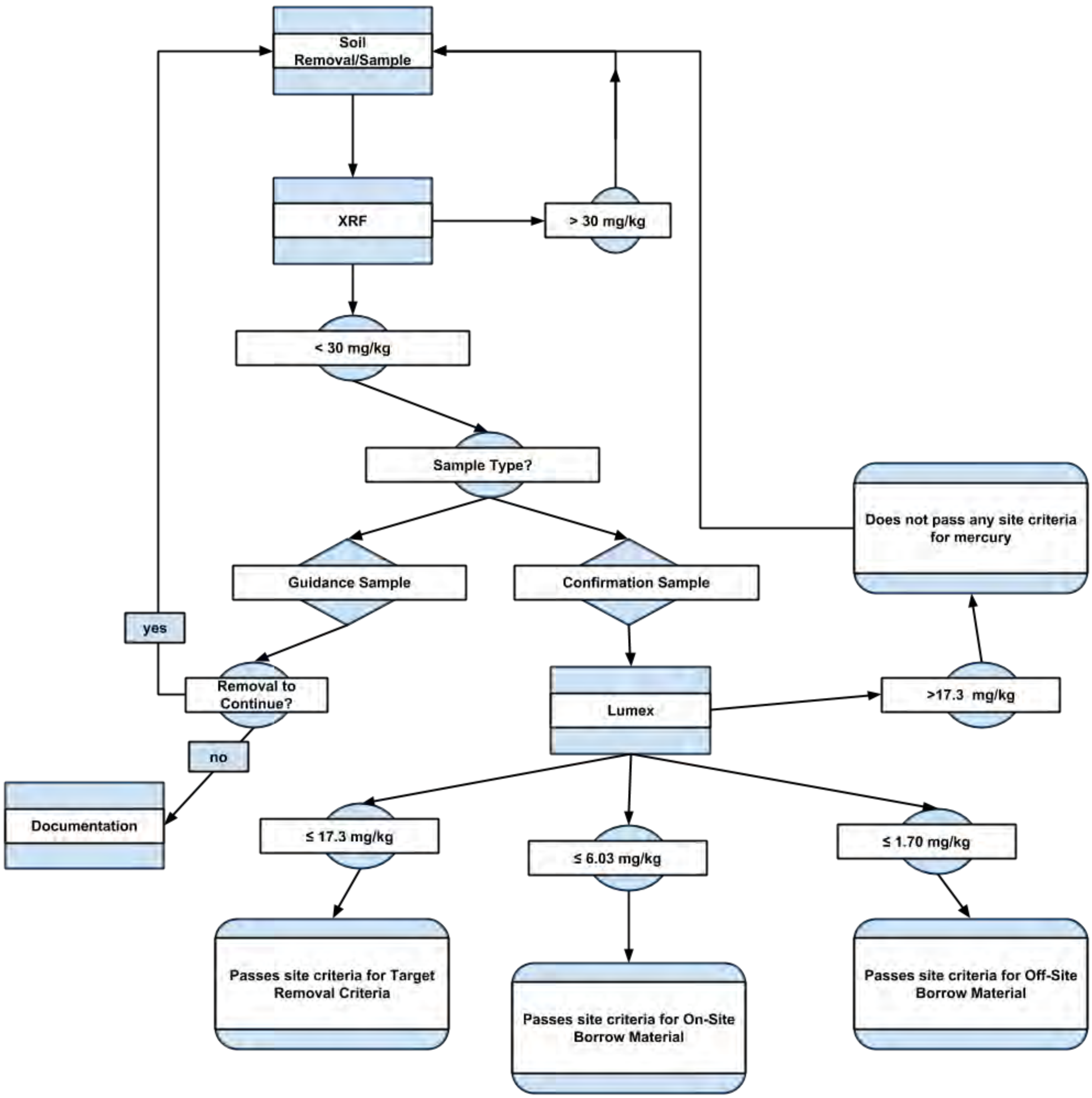
Table 2. Summary of Instrument Detection Limits		
Instrument	**Lower Detection Limit**	**Upper Detection Limit**
XRF (Arsenic)	9 mg/kg	-
XRF (Mercury)	30 mg/kg	-
Lumex (Mercury)	0.05 µg/Kg	30 mg/kg

Based on the data it is recommended to use the field analytical decision criteria listed in Table 3 for mercury. Table 3 outlines established site action criteria and the associated result needed from the Lumex in order to exceed the associated action criteria. In addition, Figure 6 presents a flowchart on potential site flow.

Table 3. Field Decision Criteria for Mercury		
Criteria Type	**Site Mercury Action Level**	**Lumex Reading***
Target Removal Criteria	20	17.3
On-site Borrow Material	7	6.03
Off-site Borrow Material	2	1.70
***Notes:** All units in milligrams per kilogram (mg/kg). Lumex instrument values were calculated by use of the linear regression equation: Lab Predicted Value = 1.1545 x (Lumex Reading) – 0.4643. Values were then corrected to include error of Y predict of 0.431 mg/kg to include error in calculation. The equation was taken from Lumex data vs Lab laboratory data less than 20 mg/kg (Figure 3).		

[4]United States Environmental Protection Agency Office of Research and Development, Washington DC, EPA/600/R-03/147, "Field Measurement Technology for Mercury in Soil and Sediment Ohio Lumex's RA-915+/RP-91C Mercury Analyzer", May 2004.

Figure 6. Mercury in Soil Evaluation Flow Chart



This page intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY MANAGEMENT PROGRAM

Site Specific Sampling Plan Alteration Form

Project Name: Black Butte Mine- Residential Removal Site ID: 10EK

Author: Bryon Alexander Company: E&E Date Completed: 10/3/2018

Changes from Final SSSP (include rationale, decision area, matrices, parameters, equipment, personnel, etc.:

Rationale

Mine tailings associated with former operations at Black Butte Mine were discovered at the residential property located at 70835 London Road, Cottage Grove, OR during an EPA remedial investigation. Discrete soil sampling conducted at the site indicated the presence of arsenic and mercury in soils above designated EPA action levels for the site, and EPA's removal program plans to remove the contaminated soil. This Sampling Plan Alteration Form is an update to the Soil Excavation Site-Specific Sampling Plan, dated June 26, 2018, for the Black Butte Mine – Furnace Creek removal action. The additional soil sampling described below will be performed to further evaluate the condition of contaminated soils at the residence and to provide information for the planned removal activities.

Action Levels

EPA designated action levels for removal include:

- 23 milligrams per kilogram (mg/kg) for Mercury
- 29 mg/kg for Arsenic

Sampling Area

Soil sampling will be limited to 17 decision units (DU1-DU17) designated throughout the residential property and extending towards London Road to the south. These areas are indicated on Figure 1.

Samples will be collected from the following media located within the DUs:

- Surface soil samples collected from 0-4 inches below ground surface (bgs).
- Subsurface soil samples collected from 12 inches bgs.

Sampling and Analysis

1. Sampling Pattern: Five sub-sample locations will be selected and flagged at spatially distributed intervals within DU1-DU17
2. Number of Samples: Approximately 34 soil samples, plus rinsate blanks.
3. Sample Type: one 5-point composite soil sample will be collected from each DU. Surface and subsurface soil composite samples will be collected as follows: from each sub-location, an aliquot of surface soil from between 0-4 inches bgs will be collected and added to a new / dedicated plastic bag, using new/dedicated plastic scoops. An equally sized aliquot will be selected from each of the five bags and homogenized into a new / dedicated plastic bag in order to generate a 5-point composite of the collected soils. Samples will be collected from the 5-point soil composite and placed into 1 x 4-oz sample jar per sample. The remainder of soil in the bag will be retained for subsequent ex-situ X-Ray Fluorescence (XRF) analysis. XRF results will be correlated with laboratory data to evaluate the use of XRF to aid the removal. After the surface soil sample is collected from each DU, hand augers will be advanced to 12 inches bgs at each sub-location in

order to obtain 5-point composite soil samples from the subsurface following the same sampling and compositing procedure.

4. Matrix: Surface Soil (excluding vegetation and rocks) collected with new / dedicated plastic scoops from between 0-4” bgs. Subsurface Soil collected with hand augers from 12” bgs

5. Sample containers: 1 x 4-oz sample jar per sample
6. Analyses: Total Mercury (EPA Method 7471B [soil] / 7470A [rinsate blanks]) and Total Arsenic (EPA Method 6010C)
7. Laboratory: EMT Laboratory, Morton Grove, IL

Field Sampling Equipment Decontamination

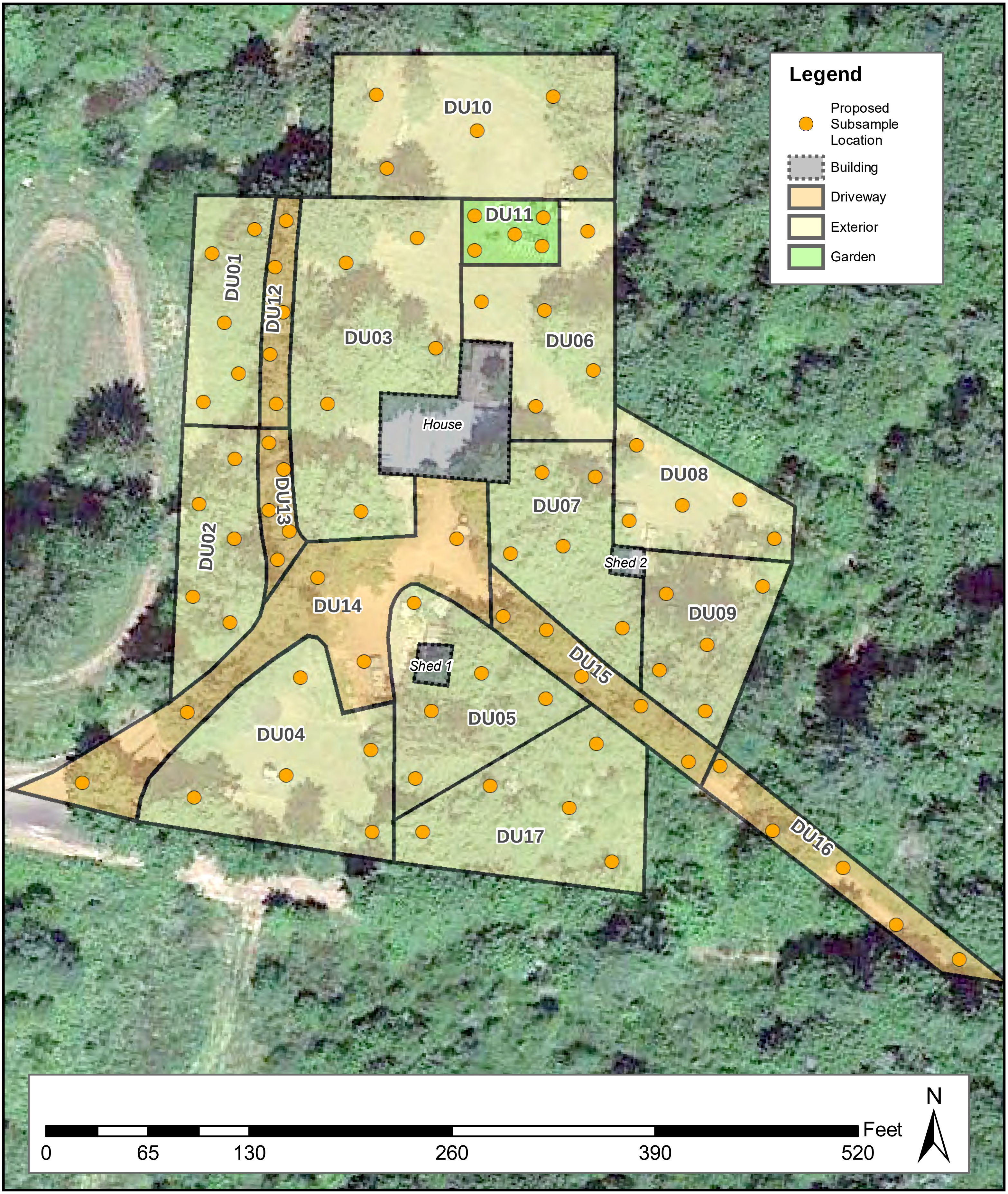
ENV 3.15 (provided in the Black Butte Mine Soil Excavation SSSP, Attachment D) describes the standard operating procedures (SOPs) used by E & E for decontaminating sampling devices and other field equipment. The decontamination procedures for this site are described as follows:

Surface Soil Sampling: New / dedicated plastic scoops will be utilized for surface soil samples and disposed of in between each DU.

Subsurface Soil Sampling: Hand augers will be utilized to collect subsurface soil samples, requiring decontamination of the equipment in between the sampling of each DU. Decontamination of the equipment will be conducted as follows:

1. Physically remove excess material / contamination via scraping and brushing.
2. Wash sampling device with a non-phosphate detergent (e.g., Alconox) and potable water solution.
3. Rinse sampling device with potable water to remove excess the Alconox / potable water solution.
4. Rinse sampling device with deionized water to complete the decontamination procedure.
5. Air dry the equipment.
6. In order to verify the effectiveness of the decontamination procedure, a rinsate sample (e.g., rinsate blank) will be collected by passing analyte-free water (deionized water) over the fully decontaminated sampling device and collected into a 1 liter polyethylene sample container for laboratory analysis. One rinsate blank will be collected per day and for every 20 subsurface soil samples collected.
7. Air dry equipment again if necessary.

Approvals of SSSP Alteration Form		
Name	**Title**	**Signature**
Randy Nattis	On-Scene Coordinator (OSC)	
Kathy Parker	Emergency Management Program (EMP) Quality Assurance Coordinator (QAC) or alternate	



Proposed Subsample Locations
Residential Assessment

BLACK BUTTE MINE - RESIDENCE

Cottage Grove, OR

ecology and environment, inc.
Global Environmental Specialists

Y:\Black Butte Mine Removal\02 Execution\GIS\Maps\mxd\BBM Residential Proposed Subsample Locations.mxd

Date: 9/19/2018

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY MANAGEMENT PROGRAM

Site Specific Sampling Plan

Project Name: Black Butte Mine – Soil Excavation (Final) Site ID: 10EK

Author: B. Ciecko/D. Giaudrone Company: E&E/CDM Smith, Inc. Date Completed: 7/11/2019

This Site Specific Sampling Plan (SSSP) is prepared and used in conjunction with the Quality Assurance Plan (QAP) for the Emergency Management Program for collecting samples during this Removal Program project. The information contained herein is based on the information available at the time of preparation. As better information becomes available, this SSSP will be adjusted.

When inadequate time is available for preparing the SSSP in advance of the sampling event, a Field Sampling Form may be prepared on-site immediately prior to sampling. This full length version of the SSSP is written after the sampling event and the completed Field Sampling Form attached to it.

1. Approvals

Name, Title	Telephone, Email, Address	Signature
Randy Nattis **On-Scene Coordinator**	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	
Donald M. Brown **Regional Quality Assurance Manager**	206-553-0717, brown.donaldm@epa.gov USEPA 1200 Sixth Ave., Seattle, WA 98101	

I. Project Management and Organization

2. Personnel and Roles involved in the project:

Name	Telephone, Email, Company, Address	Project Role	Data Recipient
Randy Nattis	503-628-9419, Nattis.Randy@epa.gov, 805 SW Broadway, Suite 500, Portland, OR 97205	On Scene Coordinator	Yes
Bryan Ciecko	503-248-5600 x4602, bciecko@ene.com, 333 SW 5th Avenue, Suite 600, Portland, OR 97204	Author of SSSP, START Project Manager	Yes
Dominic Giaudrone	425-519-8326, giaudronedj@cdmsmith.com, CDM Smith, 14432 SE Eastgate Way, Suite 100, Bellevue, WA 98007	Editing Author of SSSP, CDM Smith Project Manager	No
Steve Hall	206-920-1739, sghall@ene.com E&E, 2101 Third Ave Suite 1700 Seattle, WA 98104	START Removal Team Leader	Yes
Jason Silvertooth	503-205-7415, silvertoothjr@cdmsmith.com, CDM Smith, 1220 SW Morrison St, Suite 200, Portland, OR 97205	CDM Smith Field Engineering Support	No
Tausha Miller	208-417-2382, millertm@cdmsmith.com, CDM Smith, 1220 Big Creek Road, Kellogg, ID 83837	CDM Smith Field Engineering Support	No
Eric Nuchims	206-553-6321, nuchims.eric@epa.gov USEPA , M/S: 13-J07, 1200 Sixth	EMP Quality Assurance Coordinator	No

	Ave., Seattle, WA 98101		
Jennifer Crawford	206-553-6261, Crawford.Jennifer@epa.gov, EPA LSASD, 1200 Sixth Ave Seattle, WA 98101	QA Chemist & RSCC	No
Mark Woodke	206-624-9537, mwoodke@ene.com, E & E 720 Third Ave, Suite 1700 Seattle, WA 98104	START Quality Assurance Reviewer	Yes
Maren Fulton	503-248-5600, MFulton@ene.com, 333 SW 5th Avenue, Suite 600, Portland, OR 97204	START Scribe and Database Manager	Yes
Jason Cristino	843-556-8171, GEL Laboratories,LLC2040 Savage Road, Charleston, SC 29407	Laboratory contact	No

3. Physical Description and Site Contact Information:

Site Name	Black Butte Mine	
Site Location	The site is located approximately 10 miles south of Cottage Grove in Lane County, Oregon (Figure 1).	
Property Size	The ore processing waste area (OPWA) removal action area consists of two small areas of contamination (southern contaminated area and northern contaminated area) with a combined area of approximately 0.25 acres (Figure 2) within OU1	
Site Contact	Randy Nattis	**Phone Number:** 503-628-9419
Nearest Residents	Approximately ¼ mile	**Direction:** Northwest
Primary Land Uses Surrounding the Site	Forest/timber lands	

4. The proposed schedule of project work follows:

Activity	Estimated Start Date	Estimated Completion Date	Comments
SSSP Review/ Approval	June 26, 2019	July 11, 2019	
Mobilize to / Demobilize from Site	July 8, 2019	August 2, 2019	
Sample Collection	July 11, 2019	August 2, 2019	
Laboratory Sample Receipt	July 13, 2019	August 5, 2019	
Laboratory Analysis	July 15, 2019	August 26, 2019	Standard TAT per subcontract lab SOW
Data Validation	July 31, 2019	September 16, 2019	

5. Historical and Background Information

Describe briefly what you know about the site that is relevant to sampling and analysis for this investigation.

The Black Butte Mine (BBM) is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River basin, approximately ten miles south of Cottage Grove, Oregon (Figure 1). The BBM is located on the northwest flank of Black Butte. The landowner is The Land and Timber Company, which has used the property surrounding the site for logging.

The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Ore Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits (Figure 2).

Dennis Creek borders the northeast side of the site and flows westward into Garoutte Creek, approximately 0.25 miles downstream of BBM. Furnace Creek, an intermittent stream, borders the southwest side of the site and also flows into Garoutte Creek. Furnace Creek is adjacent to the Old Ore Furnace Area, and mill tailings were deposited in the the creek channel and drainage basin during mining operations. Garoutte Creek flows northward approximately six miles to the Coast Fork Willamette River, which empties into Cottage Grove Reservoir, a reservoir used extensively for recreational activities including contact recreation (i.e. swimming, canoeing, and scuba diving) and fishing (EPA 2017).

BBM is on the National Priorities List, and EPA is currently performing a remedial investigation (RI) at the site. The RI report was completed in May 2019.

In 2007, EPA completed a time-critical removal action (TCRA) at the Site to address uncontrolled sources of mercury migrating to Dennis Creek and Furnace Creek. During the 2007 TCRA, mercury- contaminated tailings were removed from Dennis Creek, and tailings on the slope above the creek were stabilized to limit erosion. The tailings that were removed were consolidated with the main tailings pile on site to form a repository. The repository cover was constructed with tailings/waste material which analytical results showed to be below the 2007 Removal Action Objective of 23 milligrams per kilogram (mg/kg) for mercury. Additionally, mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil/tailings that were determined to have low mercury concentrations.

Recent surface water and sediment sampling by the Oregon Department of Environmental Quality and EPA indicated that elevated concentrations of mercury and methyl mercury remained in surface water downgradient of the site. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment are the dominant source of mercury migrating to Garoutte Creek. Erosion of tailings and mercury-impacted soil into the Furnace Creek and re-suspension of mercury impacted channel bottom sediments into the water column are the two primary mechanisms for transport of particulate mercury from source areas within the Furnace Creek catchment to Garoutte Creek. Furnace Creek was not included in the scope of the 2007 TCRA.

To reduce the release of mercury to surface water, EPA decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA was to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFWR watershed.

EPA's remedial program completed an engineering evaluation / cost analysis (EE/CA; CDM Smith 2016), and the recommended removal alternative included:
excavation of mercury-contaminated tailings, bank soil, and sediment from the Furnace Creek channel;
consolidation of excavated waste material in the existing on-site repository from the 2007 TCRA;

- covering the expanded repository with a new cap composed of clean borrow soil from an onsite borrow source; and
- restoration of Furnace Creek.

The Furnace Creek NTCRA was completed in 2018 in accordance with the Final Implementation Plan (CDM Smith 2018b). The information in the plan was supplemented by three addendums (CDM Smith 2018c, 2018d, and 2018e) that were issued in response to field conditions, and an additional addendum (CDM Smith 2018g) to support post-removal site controls. Target preliminary removal action objectives (PRAOs) were outlined in a Field Decision Criteria Memo dated April 11, 2018 (CDM Smith 2018a). Construction activities for the Furnace Creek area NTCRA were completed on August

17, 2018. A total of approximately 13,100 cubic yards of waste was excavated from the Furnace Creek catchment and consolidated in the on-site repository. Stream restoration included backfilling of excavated areas with clean soil, grading of upland banks to stable slopes to prevent erosion, and installation of cobble and riprap layers and grade-control structures. Upland banks were reseeded with a native plant mix and sediment control best management practices (BMPs) were implemented to prevent soil erosion while the vegetation is establishing. A total of approximately 11,800 cubic yards of fill material and approximately 2,500 cubic yards of rock were used for channel restoration and soil stabilization.

Additionally, 2018 NTCRA activities included shallow excavation at the residential parcel near the mine entrance during the fall of 2018 to address elevated concentrations of mercury and arsenic in shallow soil.

The former OPWA was described by the site resident as an area where a settling process occurred for process water associated with the mercury ore furnaces. The affected area was initially identified

in 2013 during drilling, soil sampling, and installation of MW-7. The area was further investigated during sitewide tailings delineation in August 2016 and during a focused soil investigation in September 2018. The methods and results of the investigations of the former OPWA were presented in a technical memorandum to EPA on November 20, 2018 (CDM Smith 2018f). Soil samples were collected and analyzed using field-portable X-ray fluorescence (FPXRF), and mercury and arsenic were detected at concentrations up to 5,095 milligrams per kilogram (mg/kg) and 1,724 mg/kg, respectively.

To mitigate risk associated with elevated concentrations of mercury and arsenic in shallow soils within the OPWA, EPA has decided to perform ancillary follow-on removal activities at the OPWA to supplement the 2018 Furnace Creek NTCRA. Follow-on work will also be conducted within the Furnace Creek removal area to address minor issues observed during post-NTCRA site inspections and surface water monitoring events. The 2019 NTRCA will be completed in accordance with Addendum 5 to the Final NTCRA Implementation Plan (CDM Smith 2019). This SSSP outlines the sampling and analytical procedures to be performed by START to support the 2019 NTCRA.

References:

CDM Smith, 2019, Addendum 5 to the Final Non-Time-Critical Removal Action Implementation Plan (Ore Processing Waste Area Plan), Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. June 5, 2019.

_______, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA. April 11, 2018.

_____, 2018b, Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. April 2018.

_____, 2018c, Addendum 1 to the Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. July 3, 2018.

_____, 2018d, Addendum 2 to the Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. July 25, 2018.

_____, 2018e, Addendum 3 to the Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. August 31, 2018.

_____, 2018f, Results of Field Investigation at the Former Ore Processing Waste Area, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. November 20, 2018.

_____, 2018g, Addendum 4 to the Final Non-Time-Critical Removal Action Implementation Plan (Post-Removal Site Control Plan), Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. December 2018.

_____, 2016, Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. July 22, 2016.

U.S. Environmental Protection Agency (EPA), 2017, First Amendment to the Action Memorandum, including a Request for Exemption from, the 12-Month and $2 Million Statutory Limits on Removal Actions and an Increase in the Project Cost Ceiling for a Non-Time-Critical Removal Action for the Furnace Creek Area at Operable Unit 1 of the Black Butte Mine Superfund Site, Lane County, Oregon (SEMS IDNO.OR0000515759), September 13, 2017.

6. Conceptual Site Model

Example: Contaminant: Mercury
Transport Mechanism: vapor moving on air currents
Receptors: people living in the house

Contaminants: Mercury and arsenic in soil.

Transport Mechanisms: erosion and dissolution of contaminated soil and tailings/calcines into surface water in Furnace Creek/Garoutte Creek and Cottage Grove Reservoir; mercury vapors in air.

Receptors: aquatic invertebrates in Garoutte Creek and Cottage Grove Reservoir, fish, and nearby residents, consumption of fish or surface water from Cottage Grove Reservoir; direct contact to contaminated soil and tailings or inhalation of mercury vapors by hikers / site visitors.

7. Decision Statement

Examples: 1) Determine whether surface contamination exceeds the established action level;
2) Determine appropriate disposal options for contaminated materials.

The decision(s) to be made from this investigation is/are to:

Determine when sufficient soil has been removed to achieve the PRAOs for mercury and arsenic, as identified in Table 1.

Determine acceptable fill material based on guidelines from the OPWA Implementation Plan (CDM Smith 2019), as identified in Table 1.

8. Action Level

State the analyte, concentration, and units for each selected action level. Describe the rationale for choosing each action level and its source (i.e. MTCA, PRG, ATSDR, etc.) Example: The action level for total mercury in soil is 6.7 mg/kg (from Regional Screening Level residential).

Per the Field Decision Criteria Memo (CDM Smith 2018a) and OPWA Implementation Plan (CDM Smith 2019), removal decisions will be guided by field analytical data and visual observations. The tailings at BBM can generally be identified visually. The target affected soil within the former OPWA is gray, silty, ash-like material intermixed with brown native soil. Where present as a discrete layer, the impacted fine-grained gray material can also generally be identified visually; however, for areas with soil mixed with mine-waste material, visual identification is less reliable and will be supplemented with field analytical techniques (XRF and/or Lumex). Decision-making during excavations will be based on visual identification and field analytical instruments. Soil samples will also be collected for laboratory analysis to characterize the leave surface, but these sampling results are not required for field decisions.

The Field Decision Criteria Memo established mercury and arsenic criteria for the removal of tailings and contaminated soil/sediment and for soil from borrow source(s) to be used as fill and cover material. These criteria are outlined in Table 1 (below).

These site action levels and field and off-site laboratory reporting limits are included in Attachment A.

The target removal criteria are provided to support decision-making during excavation, and depending on site conditions, it may not be practicable to achieve these concentrations throughout the delineated excavation and restoration boundaries. As described in the OPWA implementation plan (CDM Smith 2019), the proposed excavation and restoration boundaries for the former OPWA were not delineated to fully achieve the target removal criteria in Table 1, but rather delineated based on the areas containing the highest concentrations of mercury. Discretion should be used in the field during excavation of the OPWA to remove highly contaminated material, to the extent practicable, while still allowing for restoration of the area to a stable configuration.

Key: mg/kg = milligrams per

Table 1. Field Decision Criteria for Mercury and Arsenic

Criteria Type	Mercury (mg/kg)	Arsenic (mg/kg)
Target Removal Criteria	20	100
Criteria for On-site Borrow Material	7	30
Criteria for Off-site Borrow Material	2	20

II. Data Acquisition and Measurement Objectives

9. Site Diagram and Sampling Areas

A Sampling Area is an area within in which a specific action will be performed.
Examples : 1) Each drum on the site is a Sampling Area;
2) Each section of sidewalk in front of the residence is a Sampling Area;
3) Each sampling grid section is a Sampling Area.

Figure 2 shows site features and sampling areas.
The site includes the following sampling areas:

- OPWA Removal Action Area
- Borrow Source Area(s)
- Repository Area

10. The Decision Rules

These can be written as logical If…, Then.. statements. Describe how the decisions will be made and how to address results falling within the error range of the action level. Examples: 1) In the Old Furnace Sampling Area, the soil in the area around the furnace structure will be excavated until sample analysis with XRF shows no mercury concentrations in surface soil above the lower limit of the error associated with the action level, 18.4 mg/kg. 2) If the concentrations of contaminants in a SA are less than the lower limit of the error associated with the action level, then the area may be characterized as not posing an unacceptable risk to human health or the environment and may be dismissed from additional RP activities. The area may be referred to other Federal, State or Local government agencies.

The following statement(s) describe the decision rules to apply to this investigation:

1. The XRF will be utilized to verify that soil from OPWA has been removed to acceptable levels. If XRF results indicate concentrations below 20 mg/kg for mercury and 100 mg/kg for arsenic, excavation will be considered complete. If XRF results are above those levels for mercury and/or arsenic, excavation shall continue to the extent practicable, or waste material may be left and covered in place in accordance with the OPWA Implementation Plan (CDM Smith 2019).

2. For the On-Site Borrow Source Area(s), if sample results indicate concentrations generally below 7 mg/kg for mercury and 30 mg/kg for arsenic, and if the properties listed in Section 8 and Attachment B are within the specified criteria, the material will be considered suitable as a borrow source. Note borrow materials were identified and characterized during the 2018 NTCRA. Additional borrow source characterization may not be required if the same source is used.

3. For Off-Site Borrow Source(s), if sample results indicate concentrations generally below 2 mg/kg for mercury and 20 mg/kg for arsenic, and if the other properties listed in Section 8 and Attachment B are within the specified criteria, the material will be considered suitable as a borrow source. Note borrow materials were identified and characterized during the 2018 NTCRA. Additional borrow source characterization may not be required if the same source is used.

11. Information Needed for the Decision Rule

What information needs to be collected to make the decisions – this includes non-sampling info as well: action levels, climate history, direction of water flow, etc. Examples: Current and future on-site and off-site land use; wind direction, humidity and ambient temperature; contaminant concentrations in surface soil.

The following inputs to the decision are necessary to interpret the analytical results:

Prior to using XRF and/or Lumex data to guide removal decisions during the Furnace Creek NTCRA, a correlation study was performed by analyzing site tailings, sediment, and soil samples in the field with both the XRF and the Lumex (in soil mode) and at an off-site laboratory. The samples collected and analyzed covered the range of expected mercury and arsenic concentrations at the site.

Results from the correlation study performed for the 2018 Furnace Creek will be applied to the 2019 removal action. The study provided correlation coefficients comparing mercury results from XRF and laboratory data at concentrations above and below 20 mg/kg. At concentrations above 20 mg/kg the correlation coefficient was 0.9675, and at concentrations below 20 mg/kg the correlation coefficient was 0.7202. Both coefficients are above the screening level limit of 0.7 listed in EPA Method 6200. A comparison of arsenic concentrations with XRF and laboratory data indicated a correlation coefficient of 0.9355 across all concentrations, meeting the screening level limit of 0.7 listed in EPA Method 6200. The correlation study suggests that XRF is an appropriate tool for field screening of soil samples to support decision-making during excavations. As described in Section 8, the primary objective of the OPWA removal action is to remove soil with significantly elevated mercury concentrations relative to the main tailings pile and surrounding soils, and the use of screening criteria is consistent with the objective.

The study also indicated that at mercury concentrations less than 20 mg/kg, correlation of laboratory and lumex data result in correlation coefficient of 0.9424, exceeding the limit of 0.9 for potential definitive level data in EPA Method 6200. This suggests that Lumex is appropriate for analysis of borrow material samples with mercury criteria shown in Table 1.

12. Sampling and Analysis

For each SA, describe:

1. *sampling pattern (random, targeted, scheme for composite)*
2. *number of samples, how many to be collected from where, and why*
3. *sample type (grab, composite)*
4. *matrix (air, water, soil)*
5. *analytes and analytical methods*
6. *name and locations of off-site laboratories, if applicable.*

A. Borrow Source Characterization

Pre-characterized stockpiled borrow material from the 2018 Furnace Creek NTCRA remains onsite and will be used for the 2019 OPWA NTCRA. Use of pre-characterized borrow materials (i.e., from stockpiles or from within the pre-characterized limits of the onsite borrow area) are not expected to require additional characterization.

On-Site Borrow Source

If new borrow source(s) are required or if the existing borrow source from the 2018 Furnace Creek NTCRA is expanded beyond the previously characterized limits, sampling will be performed to characterize the suitability of the material for use as fill and cover during the NTCRA. In addition to surface samples, subsurface samples will be collected to help determine the depth of the borrow source so that a volume can be extrapolated. Subsurface soils samples will be co- located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet bgs. It is anticipated that the Emergency Response and Rapid Services (ERRS) contractor will assist with collecting the subsurface soil samples through the use of heavy equipment.

Off-Site Borrow Sources

If use of material from an off-site source is necessary to achieve removal action objectives, then representative samples will be collected and screened with the XRF and/or Lumex. If the samples pass the suitability criteria in Table 1, then samples will be collected for additional laboratory testing as described in the next section.

Analytical Testing
Additional borrow source characterization is not anticipated to be required. If a new borrow source is required, field screening will be conducted using an XRF and/or Lumex and compared to the criteria in Table 1.

Additionally, at least one 20-point composite sample from the new potential borrow source will be submitted for the parameters outlined in Attachment B (Section 2.2.4.1 of the Final Implementation Plan; CDM Smith 2018b). The results of all analyses on potential borrow source materials will be compared to the criteria in Table 1 and Attachment B to determine if the material is suitable as borrow material.

Further Borrow Source Confirmation
Once a suitable borrow source or borrow sources have been identified, further characterization may be necessary depending on the amount of material needed. For mercury and arsenic, confirmation samples may be collected at an approximate rate of at least one sample per 1,000 cubic yards of on-site or off-site material. All samples will be analyzed by XRF. Confirmation of the XRF results will be performed at a rate of 20% by Lumex for mercury (100% by Lumex for results <20mg/kg) and 10% of XRF and Lumex to be submitted for mercury and arsenic testing at the off-site laboratory.

B. Removal Phase
Initially, the removal will be guided by the planned excavation limits and visual evidence of mine-impacted material. Previous investigations at the site have noted that the tailings have a distinctive and easy to identify red color. The target affected soil within the former OPWA is gray, silty, ash-like material intermixed with brown native soil. Where present as a discrete layer, the impacted fine-grained gray material can also generally be identified visually; however, for areas with soil mixed with mine-waste material, visual identification is less reliable and will be supplemented with field analysis using XRF.

Once the target excavation limits have been reached or suspected native soils are encountered (i.e., mine-impacted materials do not appear to be present), the XRF may be utilized for *in situ* (i.e., directly on the ground surface) analysis of mercury and arsenic or individual grab samples may be collected to provide an indication of whether sufficient material has been removed, or whether excavation should continue.

Once excavation is completed, composite samples will be collected from each area to document post-excavation conditions. Composite samples will be collected at a rate of at least one per 2,500 to 5,000 square feet (2 to 4 composite samples based on the planned excavation footprint). Each five-point composite sample will be collected from the surface (0-2") of the excavated area into a zip-top plastic bag for XRF analysis for mercury and arsenic. Sample procedures for XRF during the removal phase will be identical to those used during the 2018 Furnace Creek NTCRA. If an area of the excavation is unsafe to enter because of depth, steepness of slope, and/or soil type, then composite samples will be collected from freshly excavated material in the excavator bucket. The composite samples will be air dried at the site before XRF analysis.

As described in Section 11, XRF is suitable for field screening of soil concentrations and Lumex is not required during the removal phase.

Additionally, the post-excavation composite samples analyzed by XRF will be retained and submitted to the off-site laboratory for total mercury and total arsenic concentrations via EPA methods 7471B and 6010C. These sample results will provide characterization of the excavation leave surface concentrations before restoration, and are not meant to be used for field screening purposes.

C. Repository Screening
To ensure that the tailings and waste materials that are placed in the repository do not exceed 2,000 mg/kg as specified in the Final Implementation Plan (CDM Smith 2018b), a composite sample will be collected from the repository and analyzed by XRF every morning. The sample will be a 5-point composite collected from the area of the repository that received the waste the day before. Sampling and field analytical procedures will be performed as described above.

During the removal action, to the contractor may segregate "cleaner" overburden material separately from the tailings and more highly contaminated waste materials placed in the in the main repository. This cleaner overburden may be used as part of the repository cover. When cleaner overburden material is excavated and hauled to the stockpile area, a daily composite sample will also be collected and analyzed by XRF.

D. Sample Retention and Disposal

All samples collected for field XRF analyses will be retained for further analysis with the Lumex and/or fixed laboratory, if necessary. Samples may eventually be disposed of on site in the repository with the approval of the OSC.

13. Applicability of Data (place an X in front of the data categories needed, explain with comments)

Do the decisions to be made from the data require that the analytical data be:
1) definitive data, 2) screening data (with definitive confirmation) or 3) screening data (without definitive confirmation)?

__X_***A) Definitive data*** *is analytical data of sufficient quality for final decision-making. To produce definitive data on-site or off-site, the field or lab analysis will have passed full Quality Control (QC) requirements (continuing calibration checks, Method Detection Limit (MDL) study, field duplicate samples, field blank, matrix spikes, lab duplicate samples, and other method-specific QC such as surrogates) AND the analyst will have passed a Precision and Recovery (PAR) study AND the instrument will have a valid Performance Evaluation sample on file. This category of data is suitable for:* ***1) enforcement purposes, 2) determination of extent of contamination, 3) disposal, 4) RP verification or 5) cleanup confirmation.***
Comments: All fixed laboratory analyses will provide definitive data.

__X_***B) Screening data with definitive confirmation*** *is analytical data that may be used* ***to support preliminary or intermediate decision-making*** *until confirmed by definitive data. However, even after confirmation, this data is often not as precise as definitive data. To produce this category of data, the analyst will have passed a PAR study to determine analytical error AND 10% of the samples are split and analyzed by a method that produced definitive data with a minimum of three samples above the action level and three samples below it.*
Comments: Field analyses that are confirmed at a fixed laboratory will provide screening data with definitive confirmation.

__X_***C) Screening data*** *is analytical data which has not been confirmed by definitive data. The QC requirements are limited to an MDL study and continuing calibration checks. This data can be used for making decisions:* ***1) in emergencies, 2) for health and safety screening, 3) to supplement other analytical data, 4) to determine where to collect samples, 5) for waste profiling, and 6) for preliminary identification of pollutants****. This data is not of sufficient quality for final decision-making.*
Comments: Field analyses that are not confirmed at a fixed laboratory will provide screening data.

14. Special Sampling or Analysis Directions

Describe any special directions for the planned sampling and analysis such as additional quality controls or sample preparation issues. Examples: 1) XRF and Lumex for sediment will be calibrated before each day of use and checked with a second source standard. 2) A field blank will be analyzed with each calibration to confirm the concentration of non-detection. 3) A Method Detection Limit determination will be performed prior to the start of analysis so that the lower quantitation limit can be determined. 4) If particle size is too large for accurate analyses, the samples will be ground prior to analysis. If the sample contains too much moisture for accurate analyses, the sample will be decanted and air dried prior to analysis.

Standard turnaround time (4 weeks for subcontract) will be requested for laboratory confirmation samples.

Mercury and arsenic will be analyzed using method 7471B and 6010C, respectively, for lab analysis; method 6200 for XRF analysis and SOP304a, Mercury In Soil By Lumex RA-915+ (Attachment D) for Lumex analysis of mercury.

XRF and Lumex will be calibrated prior to use each day of use and checked with a second source standard.

For Lumex and XRF, a field blank will be analyzed with each calibration to confirm the concentration of non-detection.

For the XRF and Lumex, a Method Detection Limit determination will be performed prior to the start of analysis so that the lower quantitation limit can be determined. Lumex will also be checked at the lowest calibration standard after calibration for method reporting limit verification.

15. Method Requirements

[Describe the restrictions to be considered in choosing an analytical method due to the need to meet specific regulations, policies, ARARs, and other analytical needs. Examples: 1) Methods must meet USEPA Drinking Water Program requirements. 2) Methods must achieve lower quantitation limits of less than 1/10 the action levels.3) Methods must be performed exactly as written without modification by the analytical laboratory.]

The correlation study demonstrated that XRF and off-site laboratory data has a correlation coefficient greater than 0.7, indicating that XRF is suitable for use in real-time removal decisions during the OPWA removal action.

16. Sample Collection Information

[Describe any activities that will be performed related to sample collection]

The applicable sample collection Standard Operating Procedures (SOPs) or methods will be followed and include:

Field Activity Logbook SOP
Sample Packaging and Shipping SOP
Sampling and Field Equipment Decontamination SOP
Instrument SOPs: Lumex, XRF
Other SOPs: Site Control Procedures for Potentially Contaminated Sites, Surface and Shallow Subsurface Soil Sampling

All SOP's are included as Attachment D.

17. Optimization of Sampling Plan (Maximizing Data Quality While Minimizing Time and Cost)

[Describe what choices were made to reduce cost of sampling while meeting the needed level of data quality. Example: The XRF will be used in situ whenever possible to achieve accurate results. Reproducibility and accuracy of in situ XRF analyses will be checked by collecting, air drying, analyzing and comparing five in situ samples at the start of sampling. Where interferences are suspected, steps will be taken to eliminate the interferences by mechanisms such as drying, grinding or sieving the samples or analyzing them using the Lumex with soil attachment.]

XRF and Lumex analyses will be performed when possible to provide faster results and to save on analytical laboratory costs. The project has opted to subcontract laboratory services under START (Tier 4).

The format for sample number identification is summarized in Table 3. Sample collection and analysis information is summarized in Table 4. Common sample handling information is presented in Table 5.

Table 3
SAMPLE CODING

Project Name:___Black Butte Mine - Removal___________________ **Site ID:** _10EK__

SAMPLE NUMBER [(1)]		
Digits	**Description**	**Code (Example)**
1,2,3,4	Year and Month Code	1805 (YYMM)
5,6,7,8	Consecutive Sample Number (grouped by SA as appropriate)	0001 (First sample of SA)

SAMPLE NAME / LOCATION ID [(2)] ***(Optional)***		
1,2	Sampling Area	FC – Furnace Creek Removal Area BS – Borrow Source RC – Repository Cover AC – Adit Creek RS – Repository Screening LB – Left Bank RB – Right Bank FL – Floor
3,4	Consecutive Sample Number	01 – First sample of Sampling Area 150-200 – Furnace Creek post-excavation confirmation DU
5,6	Matrix Code	CC – Cleaner Cover (Repository Screening) SB – Subsurface Soil SS – Surface Soil QC – Quality Control
7,8	Depth (Optional)	01 (feet below ground surface)

Notes:
(1) The Sample Number is a unique, 8-digit number assigned to each sample.
(2) The Sample Name or Location ID is an optional identifier that can be used to further describe each sample or sample location.

Table 4. Sampling and Analysis

Data Quality	Sampling Area	Matrix	Sampling Pattern	Sample Type	Data Quality	Sample Frequency	[1]Estimated Number of Field Samples	Analyte or Parameter	Method Number	Action Level	Method Quant. Limit	#/type of Sample Containers per Sample	Preservative	Hold Time	Field QC*
Lab Analysis	Borrow Source Characterization	Soil	Targeted	20-point composite	Definitive	One per new borrow source	0	Attachment B Parameters	See Attachment B	See Attachment B	Generally 0 (units vary per method)	TBD	TBD	TBD	1 Field Duplicate and 1 MS/MSD/DUP (per method)
Lab Analysis	Borrow Source Confirmation	Soil	Targeted	Grab	Definitive	10% XRF and Lumex borrow source samples	1	Arsenic Mercury	EPA 6010C EPA 7471B	See Attachment A	5 mg/kg 0.5 mg/kg	1x2-oz glass jar	≤ 6ºC	6 months 28 days	1 Field Duplicate and 1 MS/DUP
Lab Analysis	Removal Confirmation	Soil	Targeted	5-point composite	Definitive	Every 2500 to 5000 square feet	4	Arsenic Mercury	EPA 6010C EPA 7471B	See Attachment A	5 mg/kg 0.5 mg/kg	1x2-oz glass jar	≤ 6ºC	6 months 28 days	

*- NIST Standard Reference Materials will be used for field method blank spike analyses when available at a minimum frequency of 5% of the total samples.
[1]Estimated based on anticipated removal area and borrow source volume

III. Assessment and Response

A Sample Plan Alteration Form (SPAF) will be used to describe project discrepancies (if any) that occur between planned project activities listed in the final SSSP and actual project work. The completed SPAF will be approved by the OSC and QAC and appended to the original SSSP.

Corrective actions will be assessed by the sampling team and others involved in the sampling and a corrective action report describing the problem, solution, and recommendations will be forwarded to the OSC and the EMP QAC.

IV. Data Validation and Usability

The sample collection data will be entered into Scribe and Scribe will be used to print lab Chains of Custody and sample labels. Results of field and lab analyses will be entered into Scribe as they are received and uploaded to Scibe.net when the sampling and analysis has been completed.

18. <u>Data Validation or Verification will be performed by</u>:

EMP's general recommendation on validation is that a minimum of CLP-equivalent stage IIA verification and validation be performed for every SSSP involving laboratory analyses. However, stage IIB is preferred if the lab can provide it. Dioxins should be validated at CLP-equivalent stage 4.

	Data Verification and Validation Stages						
Performed by:	I	IIA	IIB	III	IV	Verification	Other:
E and E QA Reviewer			90% Fixed Lab		10% Fixed Lab	100% Field Lab	
EPA Region 10 QA Office							
MEL staff							
Other:							

The following qualifiers shall be used in data validation:

U - The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

JH - The result is an estimated quantity, but the result may be biased high.

JK - The result is an estimated quantity, but the result may have an unknown bias.

JQ - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL, CRQL).

UJ - The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R - The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

ATTACHMENT A

REMOVAL CRITERIA AND REPORTING LIMITS

This page intentionally left blank.

Attachment A: Removal Criteria and Reporting Limits							
Primary Contaminants of Concern	Site Criteria (mg/kg)			Reporting Limits			
	Target Removal Criteria	Criteria for On-site Borrow Material	Criteria for Off-site Borrow Material	XRF EPA 6200 (ppm ww)	Lumex EPA 7473 (mg/kg dw)	Off-Site lab[a]	
						Method	Reporting Limit (mg/kg dw)
Mercury	20	7	2	11	0.5	EPA 7471B	0.02
Arsenic	100	30	20	5	N/A	EPA 6010C	0.5

[a] GEL Laboratories, LLC: 2040 Savage Road, Charleston, SC 29407TNI Accredited for identified matrix & methods.

ATTACHMENT B

SOIL COVER SUITABILITY CRITERIA

This page intentionally left blank.

Attachment B: Soil Cover Suitability Criteria and Methods		
Property	**Acceptance Criteria**	**Standard Procedure**
Coarse Fragments	20 – 30%	American Society of Agronomy (ASA) Monograph No. 9, Part 1, Method 15-5
Maximum Rock Size (inches)	0 – 3	Measured Verification in Field
Soil Reactivity (pH)	pH 5.5 – 8.5	ASA Monograph No. 9, Part 2, Method 10-3.2
Electrical Conductivity (EC) (mmhos/cm)	0 - 8	ASA Monograph No. 9, Part 2, Method 10-3.3
Sodium Adsorption Ratio (SAR)	0 - 10	ASA Monograph No. 9, Part 2, Method 10-3.4.45
Organic Matter (OM) Content	3 – 20%	ASA Monograph No. 9, Part 1, Method 29-3
Saturation Percent	25 – 85%	U.S. Department of Agriculture (USDA) Handbook 60, Method 27a
Available Water Holding Capacity	> 0.1	Soil Science Society of America, Part 4

This page intentionally left blank.

Source: DeLorme 1991, Scale 1:150,000.

ecology and environment, inc. Global Environmental Specialists Seattle, Washington	BLACK BUTTE MINE Lane County, Oregon	Figure 1 SITE LOCATION MAP	
		Date: 2/23/18	Drawn by: AES
		10:START-IV\TO25T1SS1\fig 1	

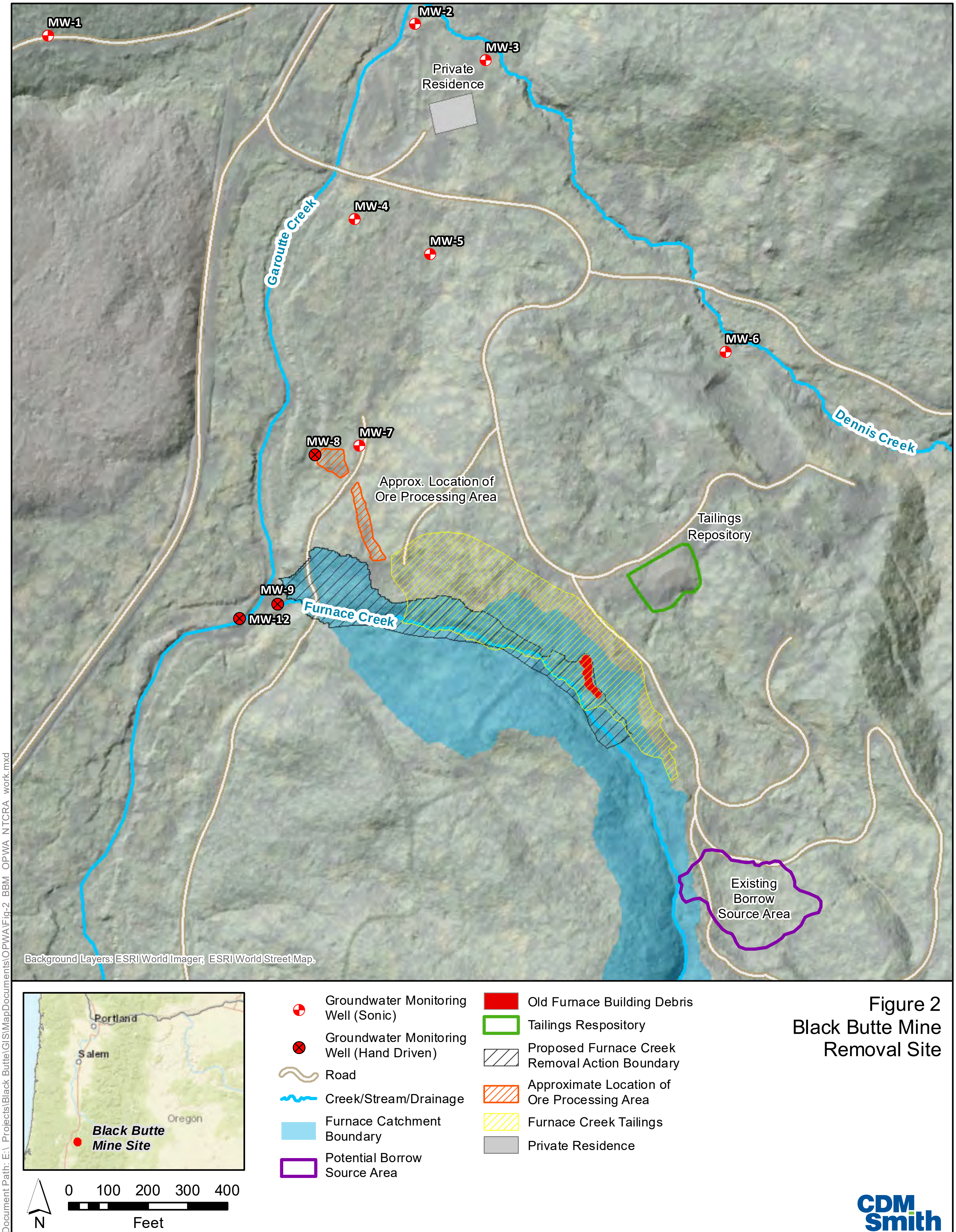


Figure 2
Black Butte Mine
Removal Site

CDM Smith

This page intentionally left blank.

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

To: Randy Nattis, On-Scene Coordinator, United States Environmental Protection Agency

From: Valeriy Bizyayev, Ecology and Environment, Inc.

CC: Bryan Ciecko, Ecology and Environment, Inc.
Mark Woodke, Ecology and Environment, Inc.
Steve Hall, Ecology and Environment, Inc.

Date: June 20, 2018

Re: Black Butte Mine XRF, Lumex and Lab Correlation Memorandum

---

Problem Statement and Memorandum Purpose

The Black Butte Mine is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River (CFWR) basin, approximately ten miles south of Cottage Grove, Oregon. The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits.

To reduce the release of mercury to surface water, United States Environmental Protection Agency (EPA) decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA is to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFWR watershed.

The NTCRA will be completed in accordance with a Final Implementation Plan[1]. Target preliminary removal action objectives were outlined in a Field Decision Criteria Memo dated April 11, 2018[2]. The SSSP[3] outlines the sampling and analytical procedures to be performed by the Superfund Technical Assessment and Response Team (START) to support the NTCRA.

---

[1] CDM Smith, April 2018b, Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

[2] CDM Smith, April 11, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA.

[3] Ecology and Environment, Inc., May 2018, Site Specific Sampling Plan (SSSP), Black Butte Mine- Soil Excavation, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington

In addition to providing sampling support to the NTCRA, START will implement the Field Analytical program to help guide field decisions. To assess the impact and success of the Field Analytical approach, a correlation study was performed to help guide the use of these to tools to support the site objectives.

This memorandum only covers instrumentation used for the correlation study. Any significant setting, manufacturer or site deviations invalidate the correlation and applicability of this memorandum. Instruments used include the Lumex 915+ mercury analyzer with Attachment RP-91C (Lumex) for solid samples and the Olympus Delta x-ray fluorescence (XRF) unit for arsenic and mercury analysis with Beams #1 and #2 set to 30 second run times and Beam #3 deactivated.

Field Analytical Study

Prior to initiation of the NTCRA, START performed a correlation study to compare the results from XRF, Lumex, and off-site laboratory analyses. Fieldwork for the correlation study was performed during the week of May 21, 2018. The results were compared to evaluate the correlation between the three types of analyses and to confirm to what degree mercury and arsenic concentrations are correlated in the site materials. This study will allow for quick turnaround times using field soil analysis and allow site NTCRA activities to progress while not waiting for results from a fixed laboratory.

<u>Number of Samples</u>

Table 1. Numbers of Samples for Correlation Study

Site Work Area	Field XRF	Field Lumex	Off-Site Lab
Borrow sources	40	20	10
Repository cover	20	16	10
Furnace Creek	41	30	20
Total	**101**	**66**	**40**

<u>Sampling Locations and Frequency</u>

Sample locations in the three site areas were selected in accordance with the following guidelines.

Furnace Creek: The XRF samples within the NTCRA footprint were collected throughout the removal action area and were not focused in any one area. No specific sampling locations or spacing were necessary for the correlation study; however, samples locations were targeted towards areas of red soils which are indicative of tailings.

Repository Cover: Samples were collected from the surface. The locations were generally evenly spaced across the existing cover at a rate of approximately 1 sample per 1,000 square feet (ft^2).

Borrow Sources: Sample locations and frequency were dependent on the size of any potential borrow sources identified at the site. Subsurface soil samples were co-located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet below ground surface (bgs). Additional details for borrow source characterization are provided in the SSSP.

Sampling Methodology

Each sample was collected using a dedicated plastic spoon or scoop and placed into a zip-top bag. Surface detritus was removed exposing mineral soil, and sufficient sample was retained for analysis by XRF, Lumex, and fixed laboratory (at least 4 to 6 ounces). The material was homogenized inside the bag, and gravel and organic material was discarded.

XRF Field Analyses

Once each sample was prepared, it was analyzed for arsenic and mercury with the XRF following the procedures of EPA Method 6200. All samples were retained for further analysis with the Lumex and fixed laboratory. EPA Method 6200 was modified to decrease volatilization of mercury vapors from samples. Samples visibly saturated or wet were analyzed before drying and then a simple air-drying method of opening the bag for several hours was conducted. After drying, they were reanalyzed to check for variation and precision. Variation between post-drying analysis and pre-drying analysis results showed no significant variability among samples treated.

Lumex Field Analyses

A subset of the samples collected for XRF analysis were split for mercury field analysis using the Lumex (soil attachment). Samples were selected to represent the range of target concentrations identified by XRF analysis. Analysis using the Lumex followed the EPA's "Standard Operating Procedures for Mercury In Soils and Solutions Using the Lumex RA-915+ Method 7473".

Off-Site Laboratory

Forty samples were submitted for fixed lab analysis of total mercury and total arsenic via EPA SW-846 Methods 7471B and 6010C, respectively. These samples were a subset of those analyzed using the Lumex and were selected to represent the full range of concentrations identified by the Lumex.

Field Observations and Data

Sample Matrix

The sample matrix was mainly silty, sandy and gravel-like material. Colors varied from browns to reds. The samples did not visually have a presence of high biomass content or appear visually wet. To decrease result variability and increase precision, all samples were homogenized before analysis with the XRF and Lumex. Sample bias does likely exist as the sample size and amount was limited by what could fit into the sampling boat for the Lumex unit. XRF sample bias and matrix bias was reduced by homogenization.

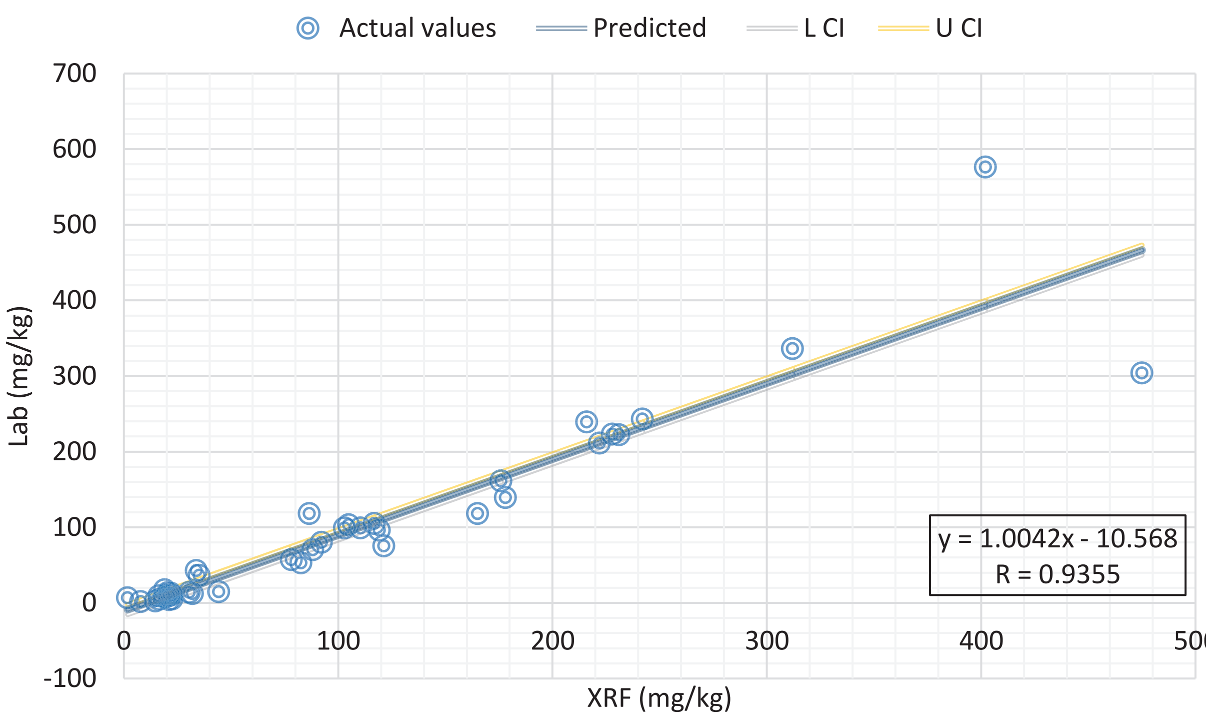
Data Integrity

All field procedures and data collection methods are held to the highest degree possible for field data quality and integrity. Field instrumentation can provide high quality data; however, there are still field variables that cannot be controlled to the same extent as at a fixed laboratory. Both Lumex and XRF instruments provide accurate results for field determination and guidance for the NTCRA in accordance with this memorandum.

Arsenic Correlation

Arsenic correlation was based on only the XRF results; all 40 samples analyzed by the fixed laboratory (Lab) were analyzed in the field by XRF. The correlation of the arsenic XRF data with the Lab data indicated a correlation coefficient value of 0.9355, meeting the screening level limit of $\geq$ 0.7, and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 6.51 milligrams per kilogram (mg/kg), indicating any Lab value produced by prediction using the XRF results will result in a value with an error of ± 6.51 mg/kg (Figure 1).

Figure 1. XRF vs. Lab arsenic values for all samples in correlation study. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 40).

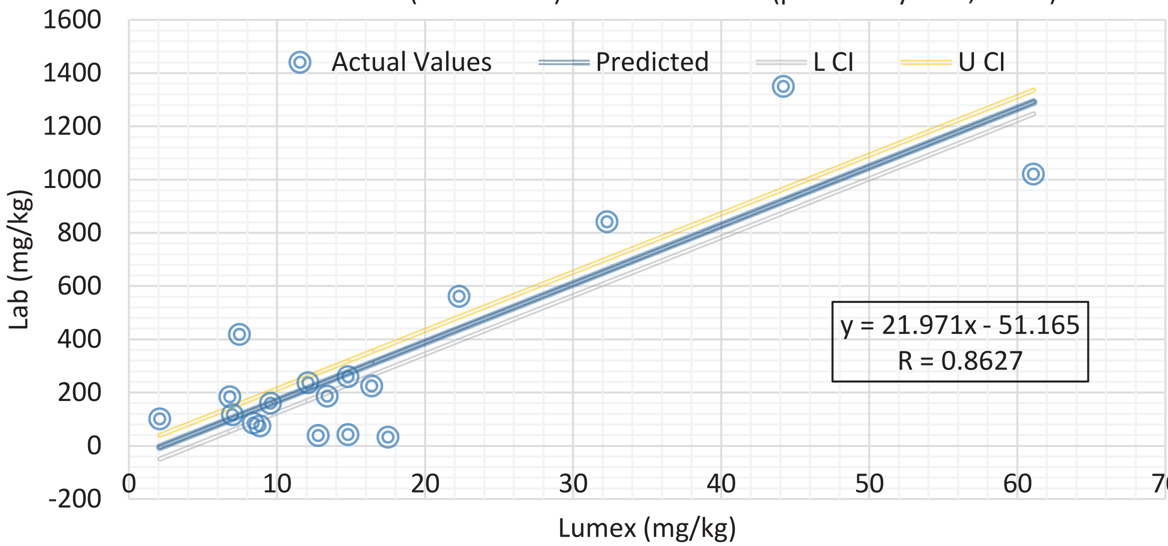


Mercury Correlation

Of the 40 samples sent for offsite analysis, all were analyzed by Lumex and XRF for mercury. For correlation purposes, the initial population of mercury data was split into two populations: one population is representative of samples with mercury laboratory values greater than 20 mg/kg, and the other is representative of mercury values less than 20 mg/kg. This was done to reflect the mercury action level established for the site and to provide greater confidence in results less than 20 mg/kg. Figures 2 through 5 present the correlations for mercury using the Lumex and XRF.

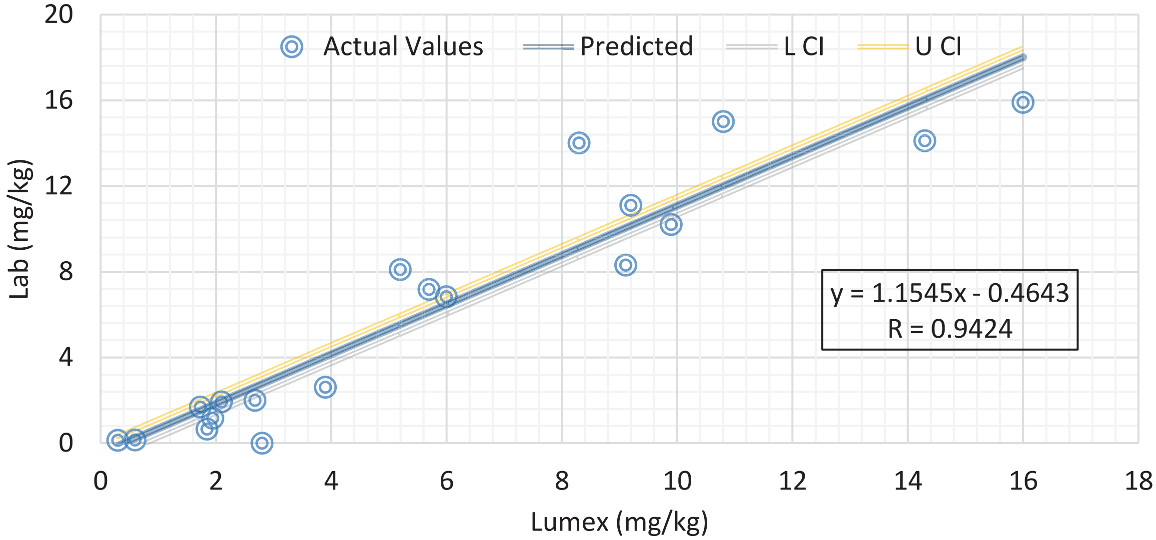
The correlation of the mercury Lumex data with the fixed laboratory values greater than ~20 mg/kg indicated a correlation coefficient value of 0.8627, meeting the screening level limit of $\geq$ 0.7 listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 44.5 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 44.5 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 2).

Figure 2. Lumex vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (LCI and UCI) calculate to 95% (probability 0.05, n= 18).



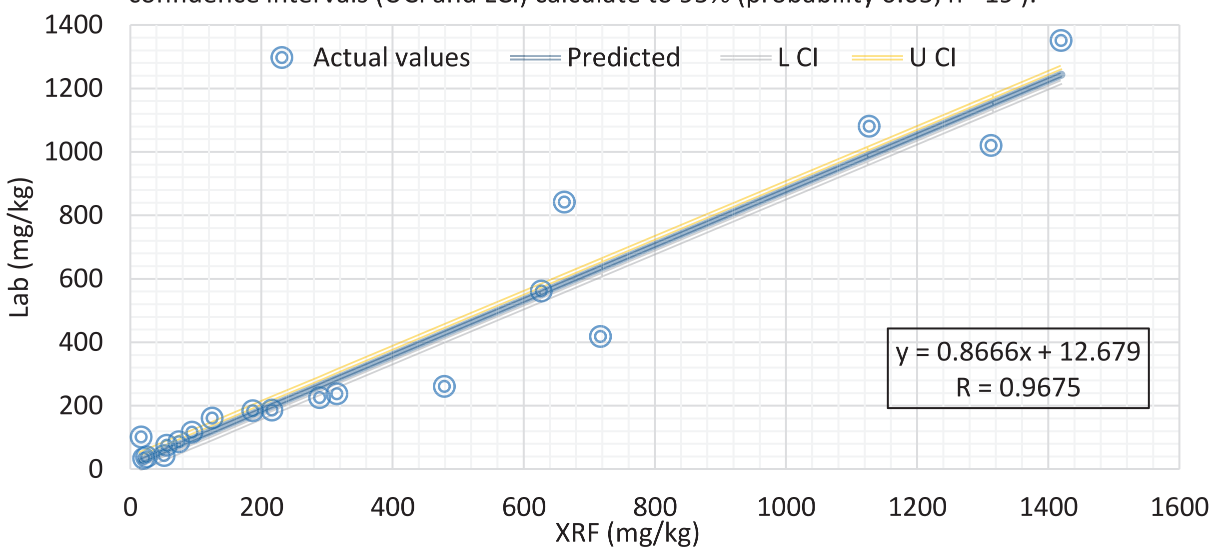
The correlation of the mercury Lumex data with the fixed laboratory values less than ~20 mg/kg indicated a correlation coefficient value of 0.9424, meeting the screening level limit of $\geq$ 0.7 and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 0.431 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 0.431 mg/kg. Two outliers were excluded from this sample population based on visual assessment of the data (Figure 3).

Figure 3. Lumex vs. Lab mercury values less than~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



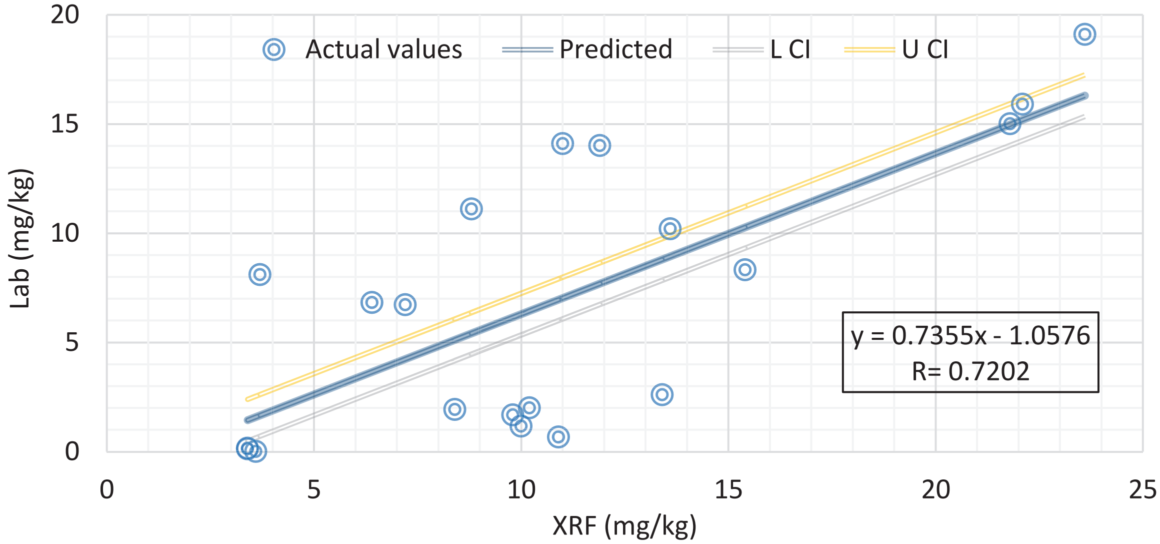
The correlation of the mercury XRF data with the fixed laboratory values greater than ~20 mg/kg data indicated a correlation coefficient value of 0.9675 exceeding the screening level limit of 0.7 and exceeding 0.9, potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for predicted fixed laboratory value is 23.2 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 23.2 mg/kg (Figure 4).

Figure 4. XRF vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



The correlation of the mercury XRF data with the fixed laboratory values less than ~20 mg/kg data indicated a correlation coefficient value of 0.7202, meeting the screening level limit of $\geq$ 0.7 but not exceeding 0.9, indicating the definitive level data criteria listed in EPA Method 6200 is not met. The standard error for a predicted fixed laboratory value is 0.953 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 0.953 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 5).

Figure 5. XRF vs. Lab mercury values less than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 20).



Conclusions and Recommendations

Arsenic

Based on the data, correlation with fixed laboratory results and history of the XRF instrument and its reliability of detecting arsenic, it is recommended that the field XRF instrument can be used to detect arsenic in soils without any correction in values. This can be implemented in accordance with EPA Method 6200, the SSSP, and following appropriate QA/QC parameters listed in the XRF Standard Operating Procedure and indicated on the XRF daily operations checklist.

Based on the regression analysis and XRF manufacturer's recommendations it is not recommended to use the XRF for detection of arsenic less than 9 mg/kg (Table 2).

Mercury

Based on the data, the XRF has a good correlation with fixed laboratory results for mercury in soils with concentrations greater than ~20 mg/kg. Once the concentrations fall below ~20 mg/kg, the correlation of the XRF with fixed laboratory results is much less reliable. The Lumex shows the opposite correlation; concentrations of mercury in soil greater than ~20 mg/kg have a weaker correlation and concentrations less than ~20 mg/kg have a stronger correlation.

Based on the regression analyses and manufacturers' literature (Table 2), the following approach should be used: initially all samples will be analyzed for mercury using the XRF. If a sample has results less than 30 mg/kg, then that sample will be analyzed for mercury using the Lumex. It is recommended that the XRF should not be used to provide results for mercury in soils with concentrations less than 30 mg/kg and the Lumex not be used to provide results for any soils with mercury concentrations greater than 30 mg/kg. The Lumex may see higher concentrations of soils, but because of field variability, regression analysis and error it is not recommended to analyze soils with the Lumex that have XRF results greater than 30 mg/kg. In addition, it is recommended that 10% to 20 % of all samples be sent off to the fixed laboratory for verification[4].

Table 2. Summary of Instrument Detection Limits

Instrument	Lower Detection Limit	Upper Detection Limit
XRF (Arsenic)	9 mg/kg	-
XRF (Mercury)	30 mg/kg	-
Lumex (Mercury)	0.05 µg/Kg	30 mg/kg

Based on the data it is recommended to use the field analytical decision criteria listed in Table 3 for mercury. Table 3 outlines established site action criteria and the associated result needed from the Lumex in order to exceed the associated action criteria. In addition, Figure 6 presents a flowchart on potential site flow.

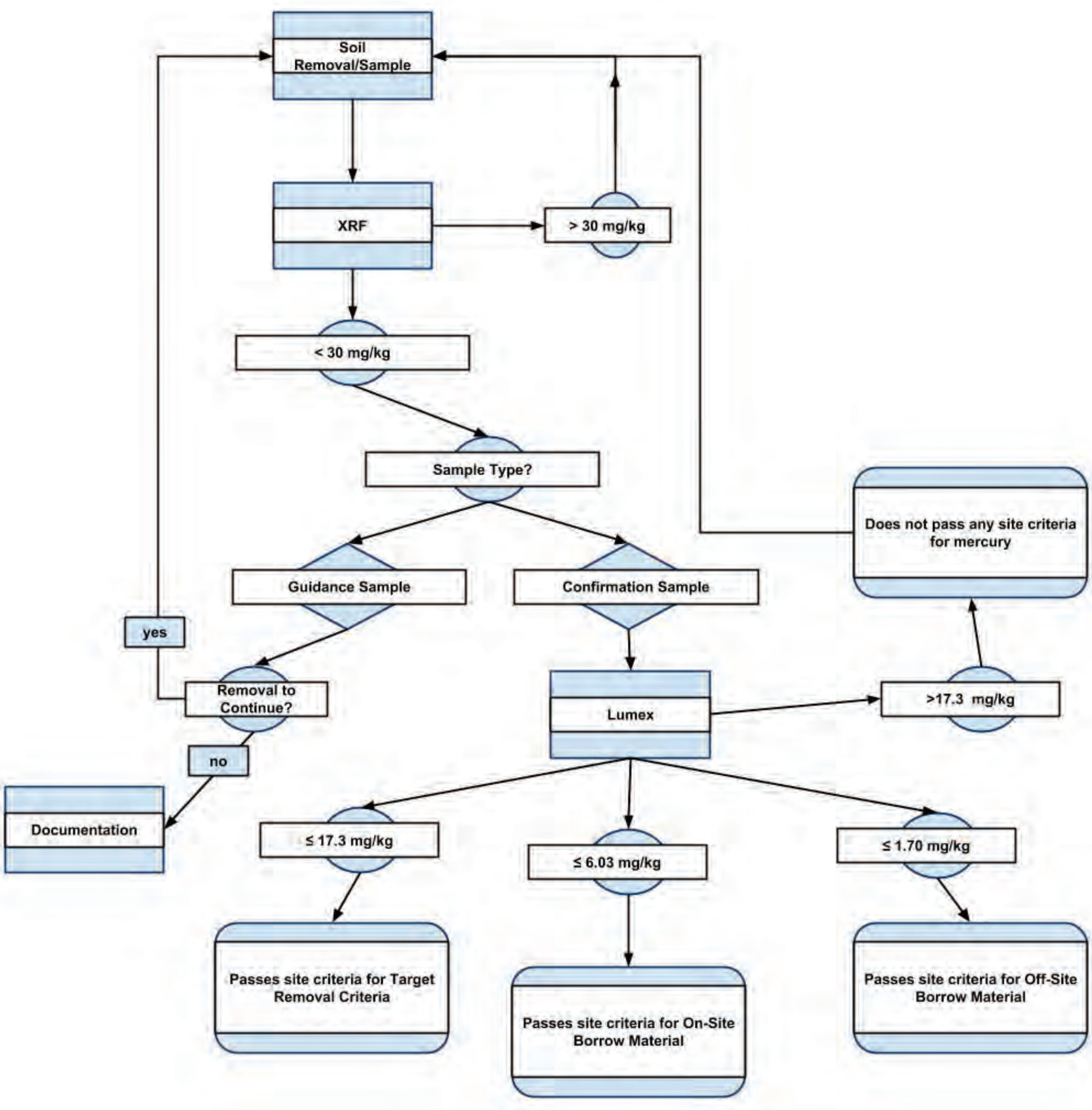
Table 3. Field Decision Criteria for Mercury

Criteria Type	Site Mercury Action Level	Lumex Reading*
Target Removal Criteria	20	17.3
On-site Borrow Material	7	6.03
Off-site Borrow Material	2	1.70

***Notes:** All units in milligrams per kilogram (mg/kg). Lumex instrument values were calculated by use of the linear regression equation: Lab Predicted Value = 1.1545 x (Lumex Reading) – 0.4643. Values were then corrected to include error of Y predict of 0.431 mg/kg to include error in calculation. The equation was taken from Lumex data vs Lab laboratory data less than 20 mg/kg (Figure 3).

[4]United States Environmental Protection Agency Office of Research and Development, Washington DC, EPA/600/R-03/147, "Field Measurement Technology for Mercury in Soil and Sediment Ohio Lumex's RA-915+/RP-91C Mercury Analyzer", May 2004.

Figure 6. Mercury in Soil Evaluation Flow Chart



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10

1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY RESPONSE UNIT

Region 10 Site-Specific Data Management Plan

Site Name:	Black Butte Mine	**TO Number/Site ID:**	TO-25-T1-SS1
Author:	David Burford	**Company:**	Ecology & Environment, Inc.
Date Initiated:	May 15, 2017	**Last Updated:**	September 6, 2018

This data management plan (DMP) is intended to provide guidance for data collection by field personnel and subsequent data management activities. The data collection and management practices presented in this plan are designed to ensure data integrity and consistency for all data collection personnel and from operational period to the next. Listed in this DMP are data elements, data collection equipment, and data management processes, and end-use products appropriate for supporting the EPA On-Scene Coordinator (OSC). Electronic tools and files used during data management at the site may include a GPS with a data dictionary to gather site specific data, EDD files for laboratory results, an XRF database used to validate the data, field monitoring equipment (such as air monitoring equipment), a SCRIBE database to manage all field data and analytical results, and ArcGIS to manage geospatial data. Manual data entry or Excel spreadsheets will be used to incorporate field notes and historic data when electronic data is not available.

Planning:

<table>
<tr><th>DQO #</th><th>Activity</th><th colspan="2">Action Level</th><th>Action</th><th>Data Stream</th><th>Tool/Instrument</th></tr>
<tr><td>1</td><td>Determine the correlation between mercury and arsenic concentrations in soil using the field portable x-ray fluorescence (XRF; mercury and arsenic) and Lumex (mercury only) instruments.</td><td colspan="2">N/A</td><td rowspan="3">Prior to using XRF and/or Lumex data to guide removal decisions, a correlation study will be performed by analyzing site tailing, sediment, and soil samples in the field with both the XRF and the Lumex (in soil mode) and at an off-site laboratory. The samples collected and analyzed shall cover the range of expected mercury and arsenic concentrations at the site.

If results of the correlation study indicate that the XRF and off-site laboratory data has a minimum correlation (r) of 0.7, then the XRF will be used to provide real time removal decisions during the NTCRA . If the XRF correlation does not meet the minimum method criteria for mercury, the Lumex will be relied upon to give near-real time mercury results to guide the removal.</td><td rowspan="3">XRF Monitoring, Lumex Soil Field Analytical, Fixed Laboratory Analysis</td><td rowspan="3">XRF, Data Recon Device, Lumex + Soil Attachment</td></tr>
<tr><td>2</td><td>Determine the correlation between mercury and arsenic concentrations in soil using field analytical methods (XRF and Lumex) and off-site laboratory analyses.</td><td colspan="2">N/A</td></tr>
<tr><td>3</td><td>Determine whether there is a direct correlation between arsenic and mercury concentrations in site soils and tailings</td><td colspan="2">N/A</td></tr>
<tr><td>4</td><td>Determine when sufficient soil/sediment have been removed to achieve the PRAOs for mercury and arsenic.</td><td>Mercury (mg/kg)

20</td><td>Arsenic (mg/kg)

100</td><td>The XRF will be utilized to verify that tailings from Furnace Creek have been removed to acceptable levels. If XRF results indicate concentrations below 20 mg/kg for mercury and 100 mg/kg for arsenic, excavation will be considered complete. If XRF results are above those levels for mercury and/or arsenic, excavation shall continue, or further discussion with the OSC will be necessary to determine an alternative.</td><td>XRF Monitoring</td><td>XRF, Data Recon Device, Scribe</td></tr>
</table>

DQO #	Activity	Action Level	Action	Data Stream	Tool/Instrument
5	Determine acceptable fill material based on guidelines from the Implementation Plan (CDM Smith, 2018) and Memo (CDM Smith 2018b).	**Mercury (mg/kg)** / **Arsenic (mg/kg)** Criteria for On-site Borrow Material: 7 / 30 Criteria for Off-site Borrow Material: 2 / 20 See SSSP for other criteria	For the On-Site Borrow Source Area(s), if sample results indicate concentrations below 7 mg/kg for mercury and 30 mg/kg for arsenic, and if the properties listed in Section 8 and Attachment B of the SSSP are within the specified criteria, the material will be considered suitable as a borrow source. For Off-Site Borrow Source(s), if sample results indicate concentrations below 2 mg/kg for mercury and 20 mg/kg for arsenic, and if the other properties listed in Section 8 and Attachment B of the SSSP are within the specified criteria, the material will be considered suitable as a borrow source.	Fixed Laboratory Analysis	Analytical Results
6	Determine if particulates are present in air during removal activities	139 µg/m^3 sustained for 24 hours	START: Notify PM immediately Viper: Notification via email alert from ERT to pre-determined START operators on site.	Air Monitoring	VIPER, DustTrak
7	Establish Decision Units	N/A	As excavation proceeds through the Furnace Creek channel and catchment basin, DUs will be identified by field personnel including the OSC, START project manager, and ERRS response manager. The target area for each DU is approximately 1,000 ft^2, and approximately 125 DUs are estimated for the NTCRA. The specific number, size, and boundaries of the DUs will be determined in the field based on the excavation sequence, schedule, and topographic features. Once established, the corner of each DU boundary will be marked with wooden stakes and recorded with the GPS unit. These DUs will be transferred to the ER Cloud SDE to use for site removal tracking.	GPS	GPS
8	Document Site Removal Activities	N/A	Mark site features and removal progress in Collector. Utilize DU features to track progress of removal. Once a DU is established, a five-point composite sample from the surface of the excavated area will be collected into a zip-top plastic bag for XRF analysis for mercury and arsenic. Sample procedures for XRF during the removal phase will be identical to those discussed in the Correlation Study above. All of the samples will also be retained and analyzed by the Lumex for mercury confirmation testing. Additionally, 20% of the samples analyzed by the Lumex will be retained and submitted to the off-site laboratory for total mercury and total arsenic concentrations via EPA methods 7471B and 6010C. XRF results for mercury and arsenic will be compared against the criteria in Table 1 to determine if the removal of tailings and contaminated soils in each DU is complete.	Tailings Removal, XRF Monitoring, Lumex Soil Field Analytical, Fixed Laboratory Analysis	GPS, Data Recon Device
9	Document interim profile of Furnace Creek, post excavation and final profile, post backfill	N/A	Mark site features and removal progress in Collector.	XRF Monitoring, Tailings Removal	GPS, Data Recon Device
10	Document profile of on-site repository	N/A	Mark site features and removal progress in Collector.	Tailings Removal	GPS, Data Recon Device

Data Processing

The following table outlines the specific requirements for various data types being collected during the project.

DQO #	Data Stream	Required Data Elements	Processing Instructions	Processing Frequency	Processing Responsibility	Storage Location	Final Output [format]
All	Site Documents	Site files, SSSP, SSDMP, logbook	File hard copies and electronic copies in indicated storage location	Beginning of project, and as needed	Project Manager	**Primary Digital:** Comms Truck NAS **Backup Digital:** Network Drive **Hard Copy:** Site Doc Box	Site file deliverable
1,2,3,4,8	Scribe Project	Scribe .mdb	Publish to scribe.net	As data is loaded	Field Sample Coordinator	\02 Execution\SCRIBE	scribe.net **Project ID:** 3555 Scribe .mdb file
1,2,3,4,8	Scribe Subscription		**Subscription Name:** R10 BlackButteFurnaceCreek **Password:** proj3555removal (case-sensitive) Project added to R10 ER Cloud Database subscription		Data Manager	Scribe.net	
8	Digital Photos	Date, Device ID, Time, Direction, Description, Photographer	Photos will be downloaded from field cameras and from data recon devices and stored in site files	Daily	Project Manager	\02 Execution\Photos	Photos [.jpg], Photographic log [.xls]
1,2,3,5,8	Fixed Laboratory Analysis	Location ID, sample number, sample date, sample time, analyte, result, qualifier, unit, MDL	Electronic data will be imported into Scribe	Daily	Project Manager, START chemist	Data: Scribe Raw: \03 Analytical & QA\Laboratory Data	Tabular reports [.xls], Data Memoranda [.pdf]
7,8,9,10	GPS	Location, latitude, longitude	Data will be processed according to the GPS Data Processing SOP and uploaded into Scribe	Conclusion of project	Project Manager and GIS Analyst	Data: Scribe Raw: \02 Execution\GIS	Tabular reports [.xls] and/or maps [.pdf]
6	Air Monitoring DustTrak	InstrumentID, Location, Mon_Time, Mon_Date, Mon_Parameter, Mon_Measurement Mon_Meas_Units	Download from instrumentation weekly and store with site files	Conclusion of project or as needed	Data Manager	Site Files	Tabular reports [.xls]
6	VIPER Particulate Monitoring (DustTrak)	All Viper Data Elements	Viper Cluster #1: Either continually connected via satellite or synced Viper Cluster #2: Prototype gateway would need to be connected to internet in the evening via either satellite or hotel. See **Daily Viper Checklist**	Daily at end of Day	Data Manager	Deployment Manager	Viper.net, Deployment Manager and Geoplatform
1,2,3,4,8,9	XRF Monitoring	Location, Sample Number	Use XRF Filemaker Form to record and process Mercury and Arsenic Data. Export EDD and import into Scribe. See **Daily XRF Checklist**	Daily	Data Manager	Data: Scribe Raw: \02 Execution\XRF	Scribe

DQO #	Data Stream	Required Data Elements	Processing Instructions	Processing Frequency	Processing Responsibility	Storage Location	Final Output [format]
1,2,3,4,8	Lumex Soil Field Analytical	Location ID, sample number, sample date, sample time, analyte, result, qualifier, unit	Use Lumex Bench Sheet to record and process Mercury and Arsenic Data. Export EDD and import into Scribe. See **Daily Lumex Checklist**	Daily	Data Manager	Data: Scribe Raw: \03 Analytical & QA\Field Analytical\Lumex	Scribe
8,9,10	Tailings Removal	See Data Dictionary	START will document removal progress utilizing collector to provide real-time updates of progress utilizing a dynamic-based system	Continual	Data Manager	R10 ER Cloud SDE	Geoplatform and/or maps [.pdf]

All electronic files will be written to a CD-ROM or DVD and provided to the Task Monitor. Hard copy files will be assembled and provided to the Task Monitor. Hard copy files will include, but are not limited to, logbooks and field forms.

Reporting

Reporting Task	Data Streams/Elements	Instructions	Deliverables Format	Frequency	Responsibility
Situational Viewer	Spatial Features		Geoplatform	Continuous	START
Daily Summary Report	Work Accomplished		Email to EPA	Daily when Site activities are performed	START
Weekly Summary Report	Work Accomplished, Air Monitoring Data, Removal Progress, Sample Data, Staffing Schedule, Budget Update		Email to EPA	Weekly	START
Weekly VIPER Summary Report	VIPER Particulate Monitoring (DataRam)	Generate Weekly Summary pdf for all air stations for the previous week's data. Also, export data for each air station for Air Station summary tables to be inserted into Weekly Summary Report.	.pdf, .xlsx table	Weekly	START

Geospatial Presentation

Name	Purpose	URL
Black Butte Mine – Furnace Creek OSC Site	Response.epa.gov site	https://response.epa.gov/BBM_FurnaceCreek
Black Butte Mine – Collector	Webmap for Collector	https://epa.maps.arcgis.com/home/webmap/viewer.html?webmap=788758d1434a42339321df5293560ef9
Black Butte Mine – Situational	Webmap for Situational Awareness/Viewers	https://epa.maps.arcgis.com/home/webmap/viewer.html?webmap=18b4e19a37a446cd882f4884988175d9
Black Butte Mine – Scene	3D Viewer for response features	https://epa.maps.arcgis.com/home/webscene/viewer.html?webscene=3264f7bbac0f45d2b1d63ff11fea1f2f

Viper Deployments

Instruments	LINCS/Locations	Alarms and Notifications	Survey Controller Location	Run ID	Deployment ID	Response.epa.gov Site ID
2 DustTraks	See Viper Equipment Table	See Notification Table	VIPER Removal Kit Laptop in Comms Truck	3692	459	12663
1 Dustrak	See Viper Equipment Table	See Notification Table	Integrated laptop in Gateway EPAERT231	3721	459	12663

Viper Equipment

Cluster	Instrument	Serial	Location	Location Description	Latitude	Longitude	LINC	Gateway	SSID	Power Type
1	DustTrak	SB6639	AS01	Command Post NE Corner of EPA Job Trailer	43.578728	-123.069442	121	EPAERT197	EPAERT1	Shore Power
1	DustTrak	SB6638	AS02	Repository off-loading area	43.578700	-123.069043	125	EPAERT197	EPAERT1	Goal Zeros charged overnight or shore power depending on availability
2	DustTrak	SB6640	AS03	Excavation Area	43.578028	-123.070005	122	EPAERT231 (Prototype w/built in laptop)	EPAERT1	Powered by DustTrak Battery

Viper Alarms

Name	Type	Sensor	Settings
10min Total TWA > .3 mg/m	RollingTWAAlarm	Total 10 min TWA	WARNING - High Alarm: 0.3; Low Alarm: n/a
Total 10 min TWA	RollingTWA	Total	Window: 10 Minute(s)

Viper Alarm Notification List

Name	Title	email	Text
Randy Nattis	EPA OSC	Randy.Nattis@epa.gov	N/A
Bryan Ciecko	START PM	bciecko@ene.com	N/A
David Burford	START Data Manager	dburford@ene.com	N/A

Viper Data Exports

Description	Frequency	Website	Username	Password	Instructions
Automated Data Export	Weekly, Saturday at Midnight	https://viper.ert.org/R10BlackButteMine	R10BlackButteMine	Bl@ckButteM1ne (case sensitive)	When looking at the data export, please remember to format the date/time correctly - down to the seconds - in order to see exactly what time a reading was received.

Spatial Data

Layer	MXD Location (E:\MXDfilesforArcGISServer\START\Removals\Black_Butte_Mine\)	Mapping Service	REST Endpoint (https://r10.ercloud.org/arcgis/rest/services/START/)	Data Location	Editable	Related Tables
BBM Features - Points	BBM_Features.mxd	Feature Service	BBM_Features/FeatureServer/0	START.DBO.Black_Butte_Mine: START.DBO.BBM_Points	Yes	Yes
BBM Features - Lines	BBM_Features.mxd	Feature Service	BBM_Features/FeatureServer/2	START.DBO.Black_Butte_Mine: START.DBO.BBM_Lines	Yes	No
BBM Features - Polygons	BBM_Features.mxd	Feature Service	BBM_Features/FeatureServer/4	START.DBO.Black_Butte_Mine: START.DBO.BBM_Polygons	Yes	Yes
CDM GIS Features	BBM_CDM_Features.mxd	Mapping Service	BBM_CDM_Features/MapServer		No	No
BBM 1ft Slope	Published directly from raster	Image Service	BBM_be_blck_btte_1ft_slp/ImageServer	START.DBO.BBM_be_blck_btte_1ft_slp	No	Yes
BBM Hillshade	Published directly from raster	Image Service	BBM_Hillshade_be_blck_btte_1ft/ImageServer	START.DBO.BBM_Hillshade_be_blck_btte_1ft	No	Yes

Data Dictionary

Data Stream	Data Element	Required	Description	Format	Valid Values
TBD	TBD	TBD	TBD	TBD	TBD

Attachments

Name	Purpose
Daily Comms Truck Checklist	Document procedures for use of the Comms truck with proper startup and shut down procedures.
Daily Viper Checklist	Document deployment and configuration of Air Stations and VIPER equipment
Daily XRF Checklist	XRF Field Analytical documentation
Daily Lumex Checklist	Lumex Field Analytical documentation

Document Revision Summary

Revision	Date	Description of change
Initial Release (V 1.0)	5/15/18	Initial Release
V1.1	5/23/18	Added current VIPER setup info
V1.2	6/8/18	Added expanded VIPER setup info
V1.3	9/6/18	Fixed inconsistent DustTrak data storage location

D Correlation Study

This page intentionally left blank.

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

To: Randy Nattis, On-Scene Coordinator, United States Environmental Protection Agency

From: Valeriy Bizyayev, Ecology and Environment, Inc.

CC: Bryan Ciecko, Ecology and Environment, Inc.
Mark Woodke, Ecology and Environment, Inc.
Steve Hall, Ecology and Environment, Inc.

Date: June 20, 2018

Re: Black Butte Mine XRF, Lumex and Lab Correlation Memorandum

---

Problem Statement and Memorandum Purpose

The Black Butte Mine is a former mercury mine located in southern Lane County, in the Coast Fork Willamette River (CFWR) basin, approximately ten miles south of Cottage Grove, Oregon. The primary features of the site include mine waste piles consisting of waste rock and mill tailings; a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area); an additional mill and furnace area (Old Furnace Area); several old dilapidated buildings; a system of unimproved roads; and mine adits.

To reduce the release of mercury to surface water, United States Environmental Protection Agency (EPA) decided to perform a non-time-critical removal action (NTCRA) at the site. The primary goal of the NTCRA is to stabilize, remove, or contain tailings, bank soil, and sediment within the Furnace Creek catchment to mitigate releases of high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the CFWR watershed.

The NTCRA will be completed in accordance with a Final Implementation Plan[1]. Target preliminary removal action objectives were outlined in a Field Decision Criteria Memo dated April 11, 2018[2]. The SSSP[3] outlines the sampling and analytical procedures to be performed by the Superfund Technical Assessment and Response Team (START) to support the NTCRA.

---

[1]CDM Smith, April 2018b, Final Non-Time-Critical Removal Action Implementation Plan, Furnace Creek Area, Black Butte Mine, Black Butte Mine Superfund Site, Operable Unit 1, Cottage Grove, Oregon, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

[2] CDM Smith, April 11, 2018a, memorandum re: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria, from Dominic Giaudrone, P.E., and Kyle Vickstrom of CDM Smith to Dave Tomten, EPA.

[3] Ecology and Environment, Inc., May 2018, Site Specific Sampling Plan (SSSP), Black Butte Mine- Soil Excavation, prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington

In addition to providing sampling support to the NTCRA, START will implement the Field Analytical program to help guide field decisions. To assess the impact and success of the Field Analytical approach, a correlation study was performed to help guide the use of these to tools to support the site objectives.

This memorandum only covers instrumentation used for the correlation study. Any significant setting, manufacturer or site deviations invalidate the correlation and applicability of this memorandum. Instruments used include the Lumex 915+ mercury analyzer with Attachment RP-91C (Lumex) for solid samples and the Olympus Delta x-ray fluorescence (XRF) unit for arsenic and mercury analysis with Beams #1 and #2 set to 30 second run times and Beam #3 deactivated.

Field Analytical Study

Prior to initiation of the NTCRA, START performed a correlation study to compare the results from XRF, Lumex, and off-site laboratory analyses. Fieldwork for the correlation study was performed during the week of May 21, 2018. The results were compared to evaluate the correlation between the three types of analyses and to confirm to what degree mercury and arsenic concentrations are correlated in the site materials. This study will allow for quick turnaround times using field soil analysis and allow site NTCRA activities to progress while not waiting for results from a fixed laboratory.

Number of Samples

Table 1. Numbers of Samples for Correlation Study

Site Work Area	**Field XRF**	**Field Lumex**	**Off-Site Lab**
Borrow sources	40	20	10
Repository cover	20	16	10
Furnace Creek	41	30	20
Total	**101**	**66**	**40**

Sampling Locations and Frequency

Sample locations in the three site areas were selected in accordance with the following guidelines.

Furnace Creek: The XRF samples within the NTCRA footprint were collected throughout the removal action area and were not focused in any one area. No specific sampling locations or spacing were necessary for the correlation study; however, samples locations were targeted towards areas of red soils which are indicative of tailings.

Repository Cover: Samples were collected from the surface. The locations were generally evenly spaced across the existing cover at a rate of approximately 1 sample per 1,000 square feet (ft^2).

Borrow Sources: Sample locations and frequency were dependent on the size of any potential borrow sources identified at the site. Subsurface soil samples were co-located with surface soil samples and collected at approximate 2-foot intervals up to a maximum of 8-feet below ground surface (bgs). Additional details for borrow source characterization are provided in the SSSP.

Sampling Methodology

Each sample was collected using a dedicated plastic spoon or scoop and placed into a zip-top bag. Surface detritus was removed exposing mineral soil, and sufficient sample was retained for analysis by XRF, Lumex, and fixed laboratory (at least 4 to 6 ounces). The material was homogenized inside the bag, and gravel and organic material was discarded.

XRF Field Analyses

Once each sample was prepared, it was analyzed for arsenic and mercury with the XRF following the procedures of EPA Method 6200. All samples were retained for further analysis with the Lumex and fixed laboratory. EPA Method 6200 was modified to decrease volatilization of mercury vapors from samples. Samples visibly saturated or wet were analyzed before drying and then a simple air-drying method of opening the bag for several hours was conducted. After drying, they were reanalyzed to check for variation and precision. Variation between post-drying analysis and pre-drying analysis results showed no significant variability among samples treated.

Lumex Field Analyses

A subset of the samples collected for XRF analysis were split for mercury field analysis using the Lumex (soil attachment). Samples were selected to represent the range of target concentrations identified by XRF analysis. Analysis using the Lumex followed the EPA's "Standard Operating Procedures for Mercury In Soils and Solutions Using the Lumex RA-915+ Method 7473".

Off-Site Laboratory

Forty samples were submitted for fixed lab analysis of total mercury and total arsenic via EPA SW-846 Methods 7471B and 6010C, respectively. These samples were a subset of those analyzed using the Lumex and were selected to represent the full range of concentrations identified by the Lumex.

Field Observations and Data

Sample Matrix

The sample matrix was mainly silty, sandy and gravel-like material. Colors varied from browns to reds. The samples did not visually have a presence of high biomass content or appear visually wet. To decrease result variability and increase precision, all samples were homogenized before analysis with the XRF and Lumex. Sample bias does likely exist as the sample size and amount was limited by what could fit into the sampling boat for the Lumex unit. XRF sample bias and matrix bias was reduced by homogenization.

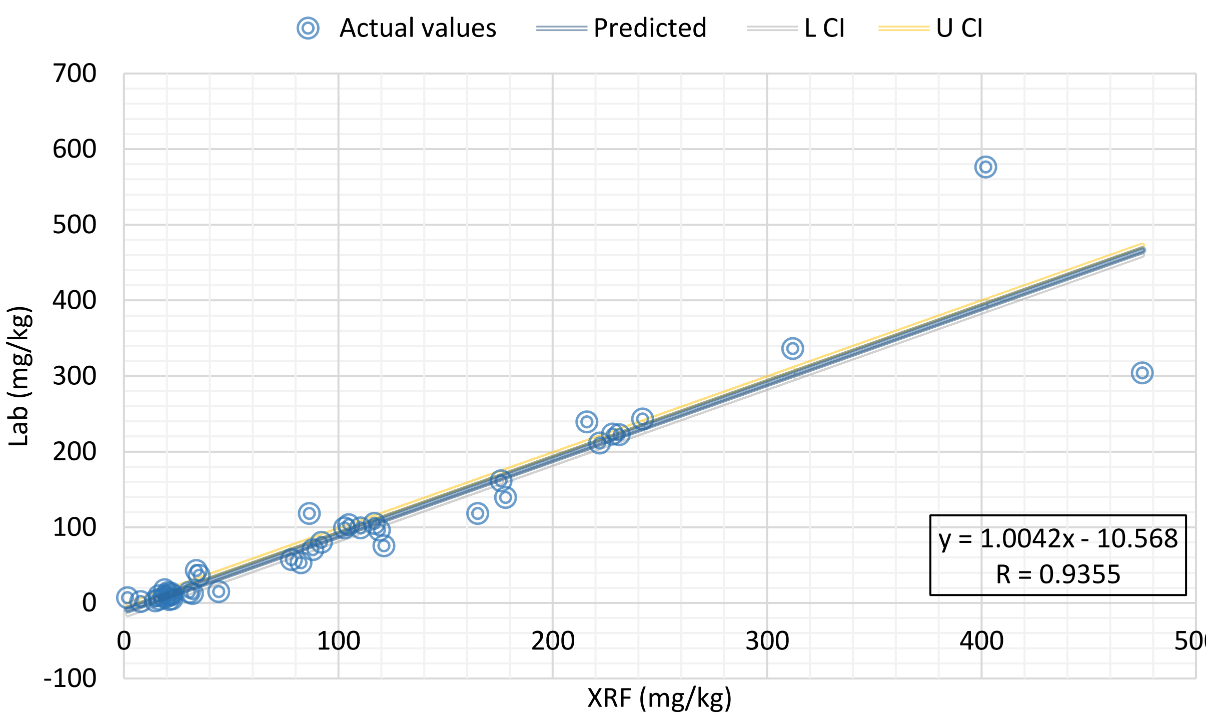
Data Integrity

All field procedures and data collection methods are held to the highest degree possible for field data quality and integrity. Field instrumentation can provide high quality data; however, there are still field variables that cannot be controlled to the same extent as at a fixed laboratory. Both Lumex and XRF instruments provide accurate results for field determination and guidance for the NTCRA in accordance with this memorandum.

Arsenic Correlation

Arsenic correlation was based on only the XRF results; all 40 samples analyzed by the fixed laboratory (Lab) were analyzed in the field by XRF. The correlation of the arsenic XRF data with the Lab data indicated a correlation coefficient value of 0.9355, meeting the screening level limit of $\geq$ 0.7, and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 6.51 milligrams per kilogram (mg/kg), indicating any Lab value produced by prediction using the XRF results will result in a value with an error of ± 6.51 mg/kg (Figure 1).

Figure 1. XRF vs. Lab arsenic values for all samples in correlation study. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 40).

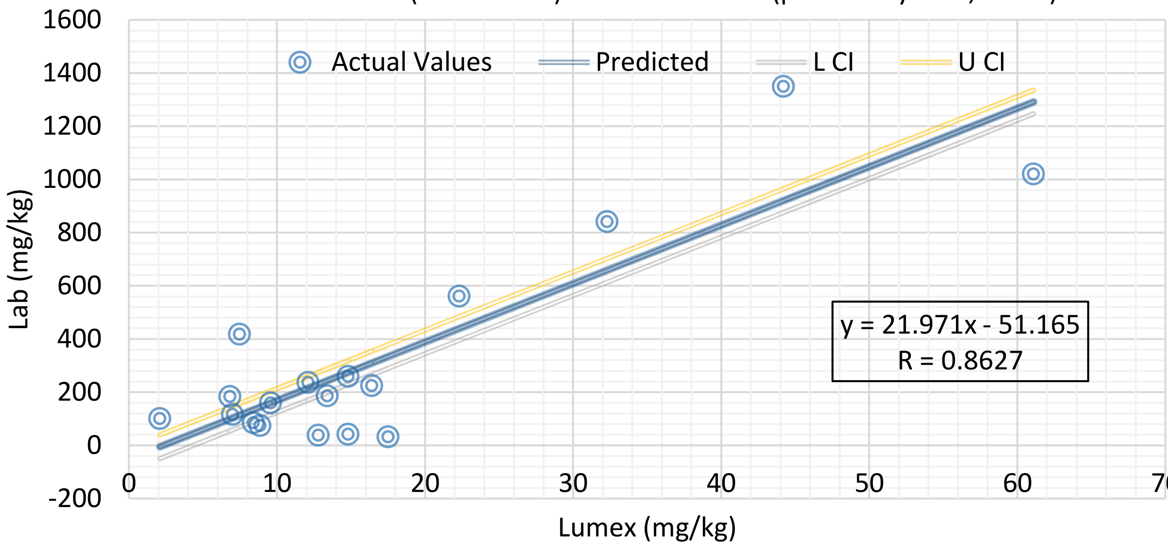


Mercury Correlation

Of the 40 samples sent for offsite analysis, all were analyzed by Lumex and XRF for mercury. For correlation purposes, the initial population of mercury data was split into two populations: one population is representative of samples with mercury laboratory values greater than 20 mg/kg, and the other is representative of mercury values less than 20 mg/kg. This was done to reflect the mercury action level established for the site and to provide greater confidence in results less than 20 mg/kg. Figures 2 through 5 present the correlations for mercury using the Lumex and XRF.

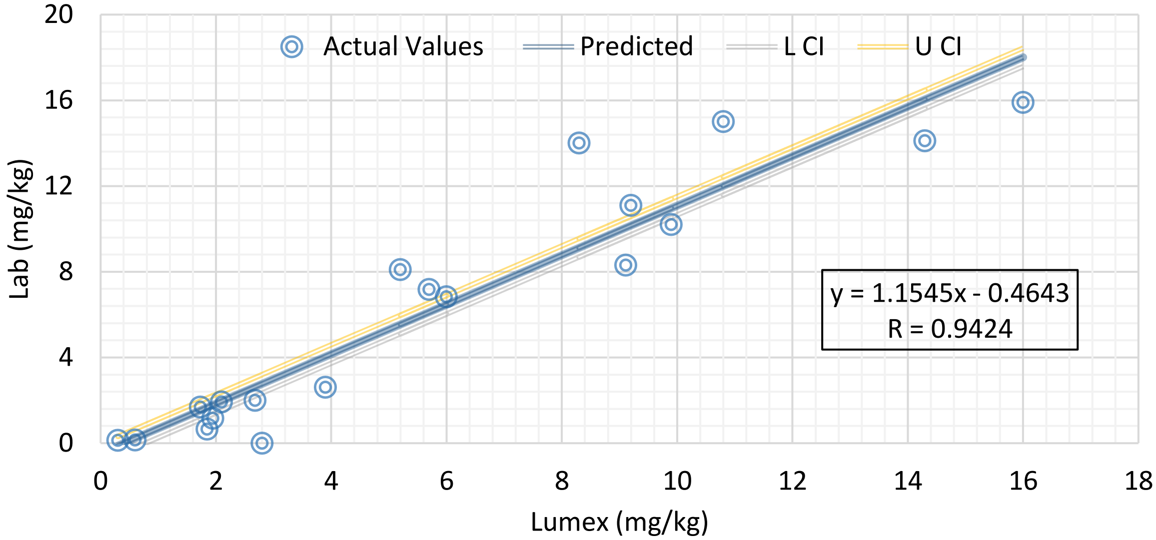
The correlation of the mercury Lumex data with the fixed laboratory values greater than ~20 mg/kg indicated a correlation coefficient value of 0.8627, meeting the screening level limit of $\geq$ 0.7 listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 44.5 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 44.5 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 2).

Figure 2. Lumex vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (LCI and UCI) calculate to 95% (probability 0.05, n= 18).



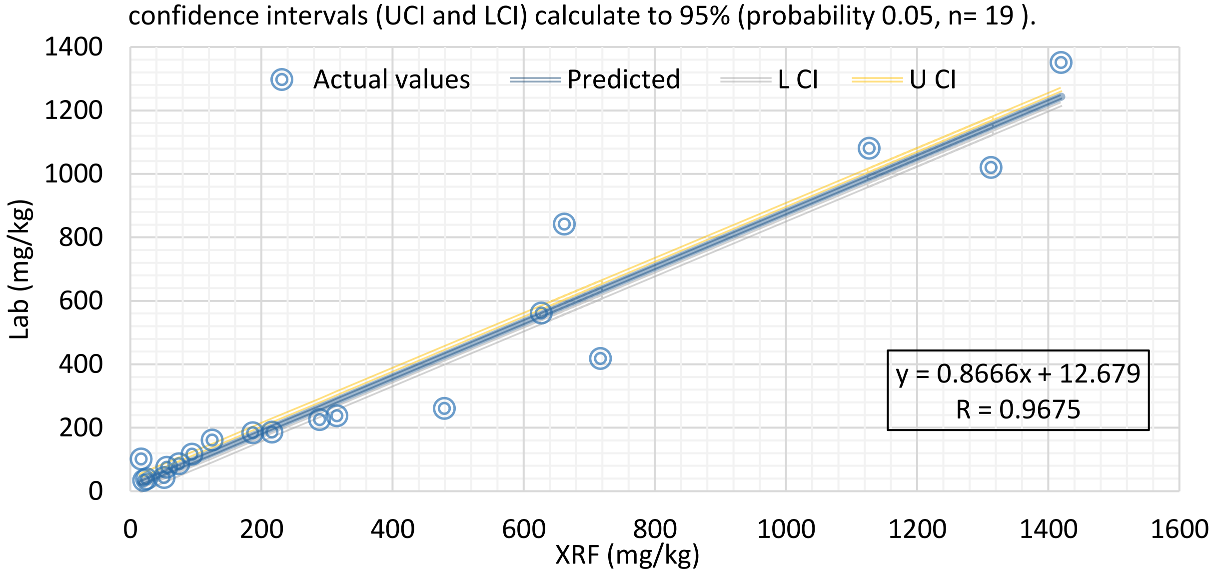
The correlation of the mercury Lumex data with the fixed laboratory values less than ~20 mg/kg indicated a correlation coefficient value of 0.9424, meeting the screening level limit of $\geq$ 0.7 and exceeding 0.9, therefore potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for a predicted fixed laboratory value is 0.431 mg/kg, indicating any Lab value produced by prediction using the Lumex will result in a value with an error of ± 0.431 mg/kg. Two outliers were excluded from this sample population based on visual assessment of the data (Figure 3).

Figure 3. Lumex vs. Lab mercury values less than~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



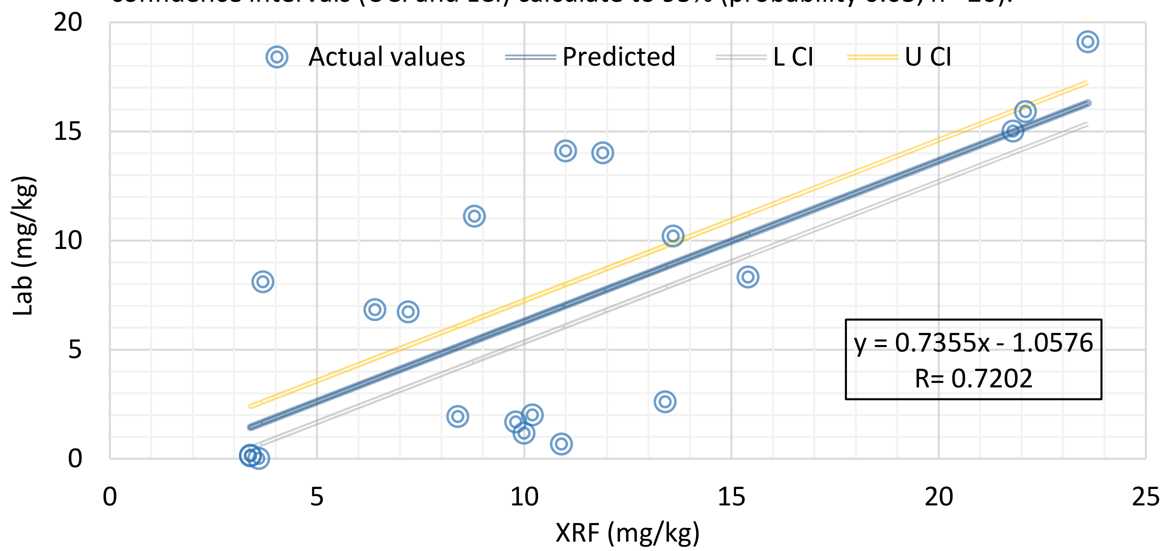
The correlation of the mercury XRF data with the fixed laboratory values greater than ~20 mg/kg data indicated a correlation coefficient value of 0.9675 exceeding the screening level limit of 0.7 and exceeding 0.9, potentially meeting the definitive level data criteria listed in EPA Method 6200. The standard error for predicted fixed laboratory value is 23.2 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 23.2 mg/kg (Figure 4).

Figure 4. XRF vs. Lab mercury values greater than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 19).



The correlation of the mercury XRF data with the fixed laboratory values less than ~20 mg/kg data indicated a correlation coefficient value of 0.7202, meeting the screening level limit of $\geq$ 0.7 but not exceeding 0.9, indicating the definitive level data criteria listed in EPA Method 6200 is not met. The standard error for a predicted fixed laboratory value is 0.953 mg/kg, indicating any Lab value produced by prediction using the XRF will result in a value with an error of ± 0.953 mg/kg. One outlier was excluded from this sample population based on visual assessment of the data (Figure 5).

Figure 5. XRF vs. Lab mercury values less than ~20 mg/kg. Upper and lower confidence intervals (UCI and LCI) calculate to 95% (probability 0.05, n= 20).



Conclusions and Recommendations

Arsenic

Based on the data, correlation with fixed laboratory results and history of the XRF instrument and its reliability of detecting arsenic, it is recommended that the field XRF instrument can be used to detect arsenic in soils without any correction in values. This can be implemented in accordance with EPA Method 6200, the SSSP, and following appropriate QA/QC parameters listed in the XRF Standard Operating Procedure and indicated on the XRF daily operations checklist.

Based on the regression analysis and XRF manufacturer's recommendations it is not recommended to use the XRF for detection of arsenic less than 9 mg/kg (Table 2).

Mercury

Based on the data, the XRF has a good correlation with fixed laboratory results for mercury in soils with concentrations greater than ~20 mg/kg. Once the concentrations fall below ~20 mg/kg, the correlation of the XRF with fixed laboratory results is much less reliable. The Lumex shows the opposite correlation; concentrations of mercury in soil greater than ~20 mg/kg have a weaker correlation and concentrations less than ~20 mg/kg have a stronger correlation.

Based on the regression analyses and manufacturers' literature (Table 2), the following approach should be used: initially all samples will be analyzed for mercury using the XRF. If a sample has results less than 30 mg/kg, then that sample will be analyzed for mercury using the Lumex. It is recommended that the XRF should not be used to provide results for mercury in soils with concentrations less than 30 mg/kg and the Lumex not be used to provide results for any soils with mercury concentrations greater than 30 mg/kg. The Lumex may see higher concentrations of soils, but because of field variability, regression analysis and error it is not recommended to analyze soils with the Lumex that have XRF results greater than 30 mg/kg. In addition, it is recommended that 10% to 20 % of all samples be sent off to the fixed laboratory for verification[4].

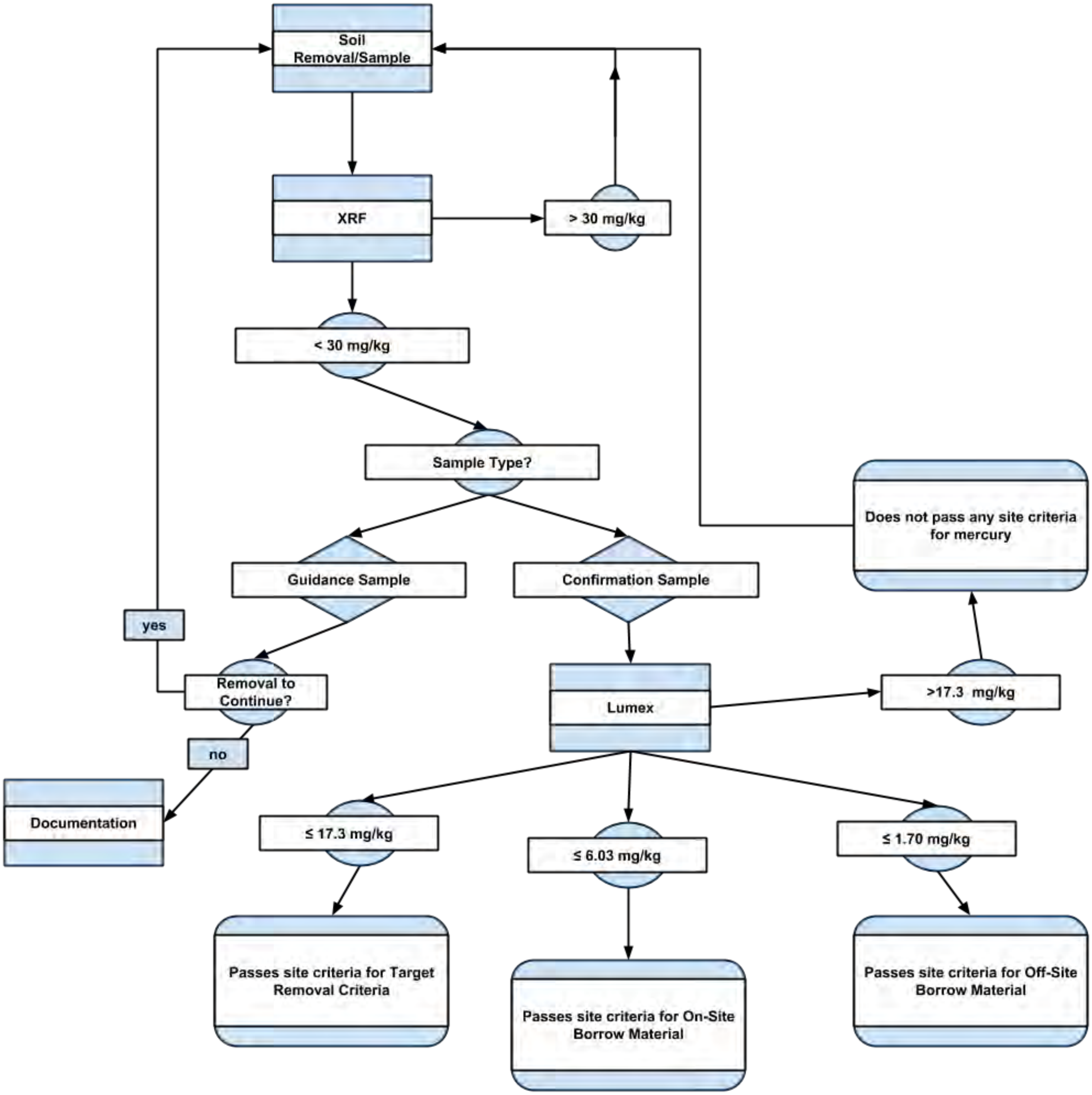
Table 2. Summary of Instrument Detection Limits		
Instrument	**Lower Detection Limit**	**Upper Detection Limit**
XRF (Arsenic)	9 mg/kg	-
XRF (Mercury)	30 mg/kg	-
Lumex (Mercury)	0.05 µg/Kg	30 mg/kg

Based on the data it is recommended to use the field analytical decision criteria listed in Table 3 for mercury. Table 3 outlines established site action criteria and the associated result needed from the Lumex in order to exceed the associated action criteria. In addition, Figure 6 presents a flowchart on potential site flow.

Table 3. Field Decision Criteria for Mercury		
Criteria Type	**Site Mercury Action Level**	**Lumex Reading***
Target Removal Criteria	20	17.3
On-site Borrow Material	7	6.03
Off-site Borrow Material	2	1.70
***Notes:** All units in milligrams per kilogram (mg/kg). Lumex instrument values were calculated by use of the linear regression equation: Lab Predicted Value = 1.1545 x (Lumex Reading) – 0.4643. Values were then corrected to include error of Y predict of 0.431 mg/kg to include error in calculation. The equation was taken from Lumex data vs Lab laboratory data less than 20 mg/kg (Figure 3).		

[4]United States Environmental Protection Agency Office of Research and Development, Washington DC, EPA/600/R-03/147, "Field Measurement Technology for Mercury in Soil and Sediment Ohio Lumex's RA-915+/RP-91C Mercury Analyzer", May 2004.

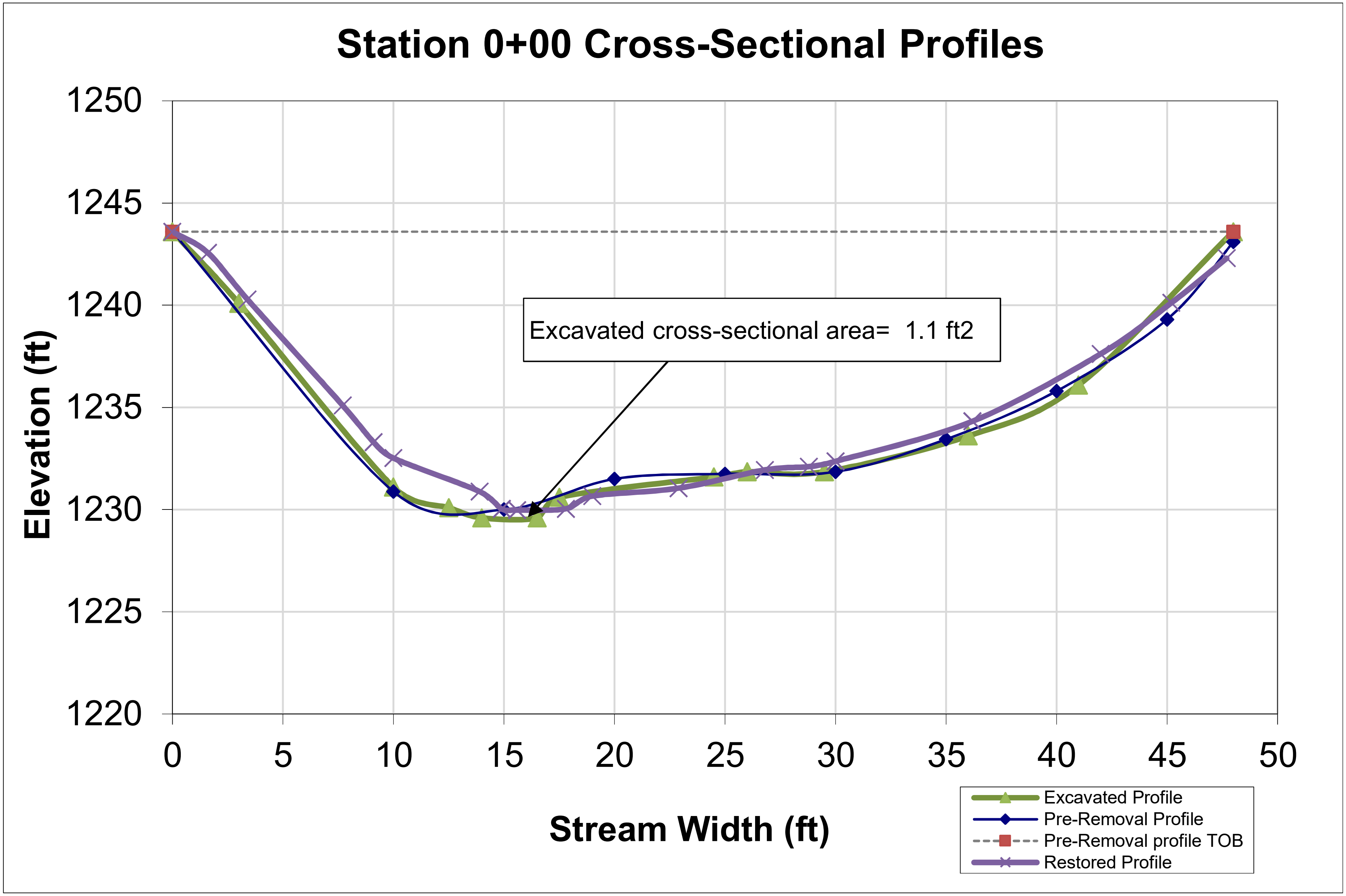
Figure 6. Mercury in Soil Evaluation Flow Chart



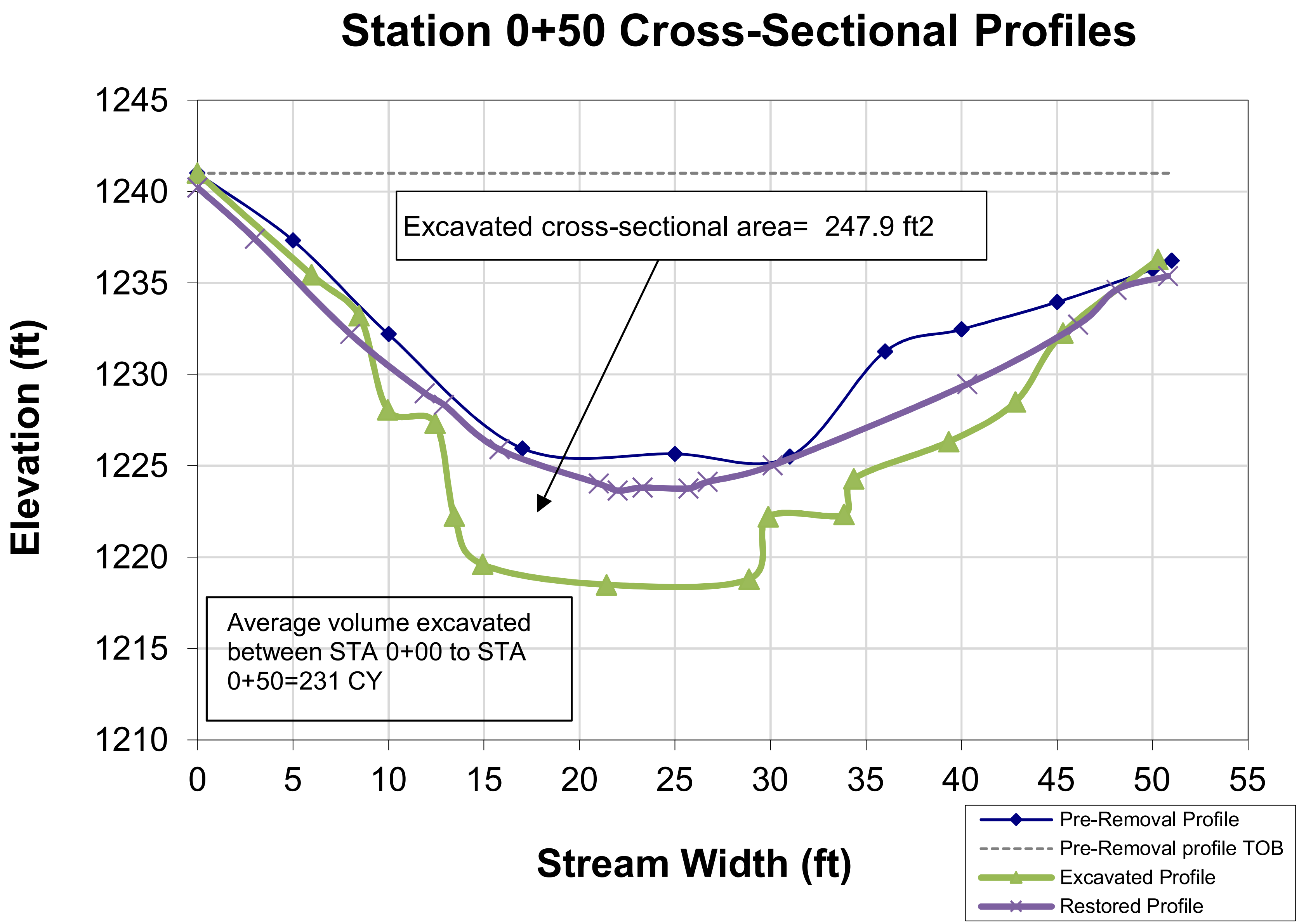
This page intentionally left blank.

E Stream Profile Surveys

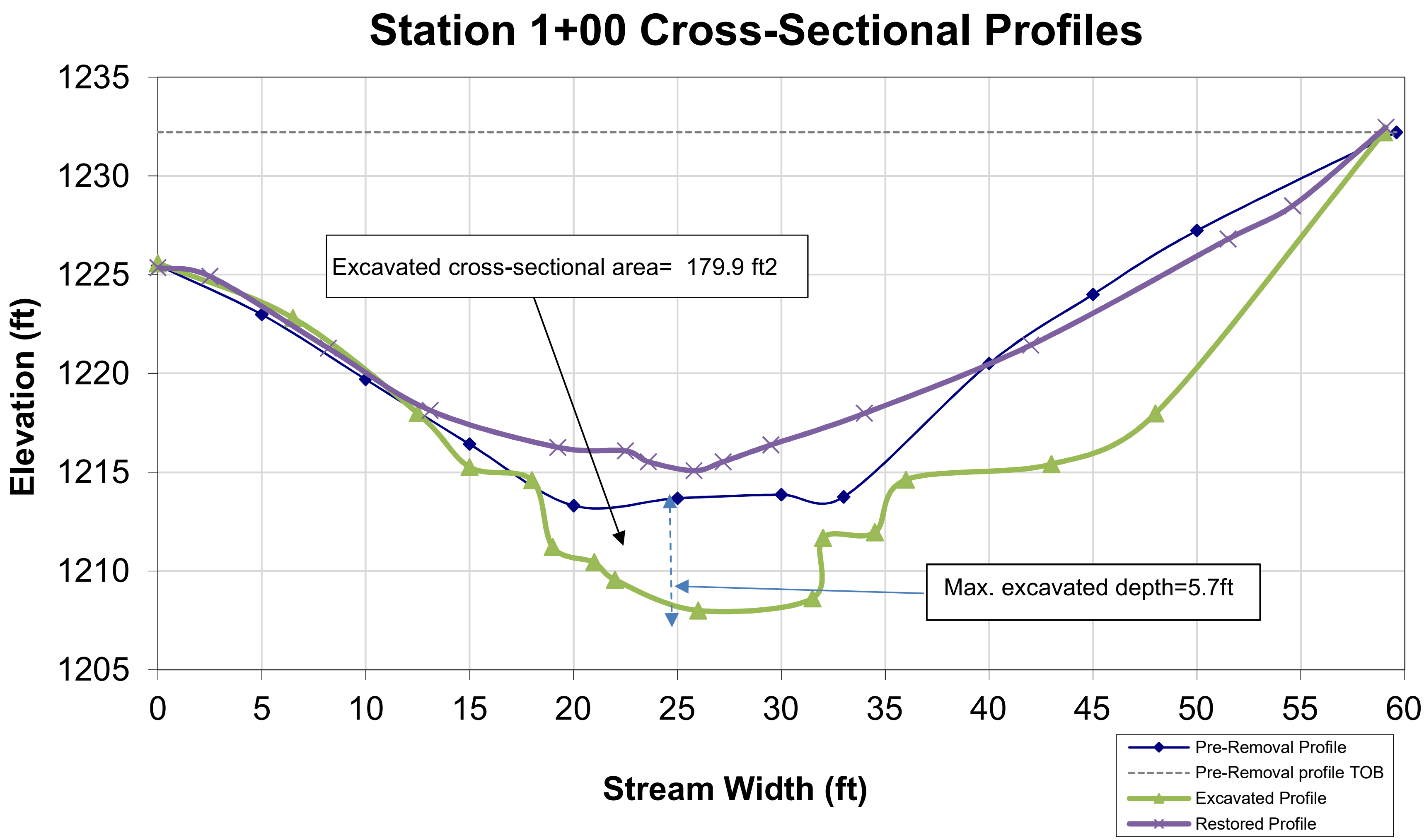
This page intentionally left blank.



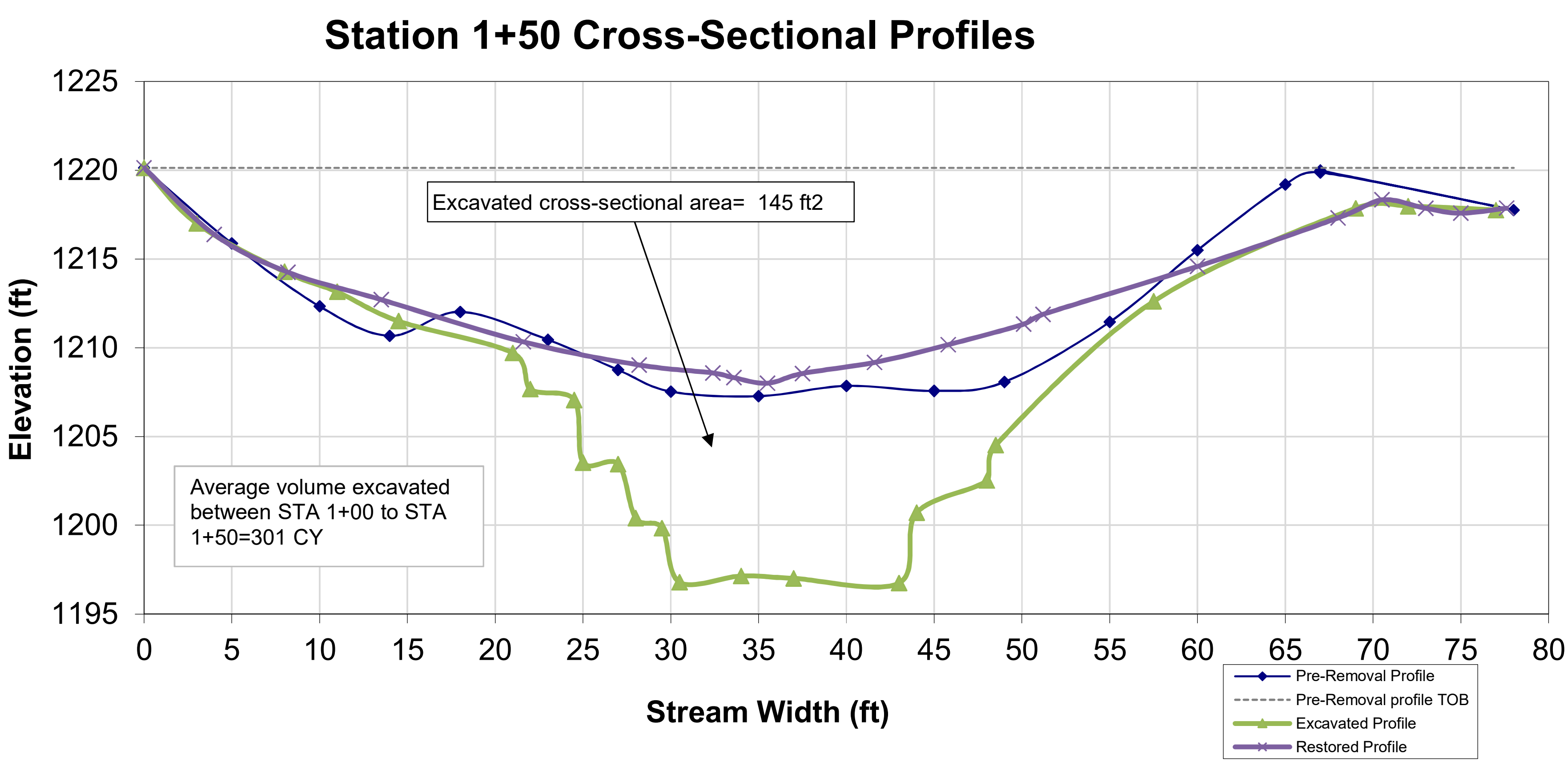
Station 0+00 Cross-Sectional Profiles
Elevation (ft)
1250
1245
1240
1235
1230
1225
1220
0
5
10
15
20
25
30
35
40
45
50
Stream Width (ft)
Excavated cross-sectional area= 1.1 ft2
Excavated Profile
Pre-Removal Profile
Pre-Removal profile TOB
Restored Profile

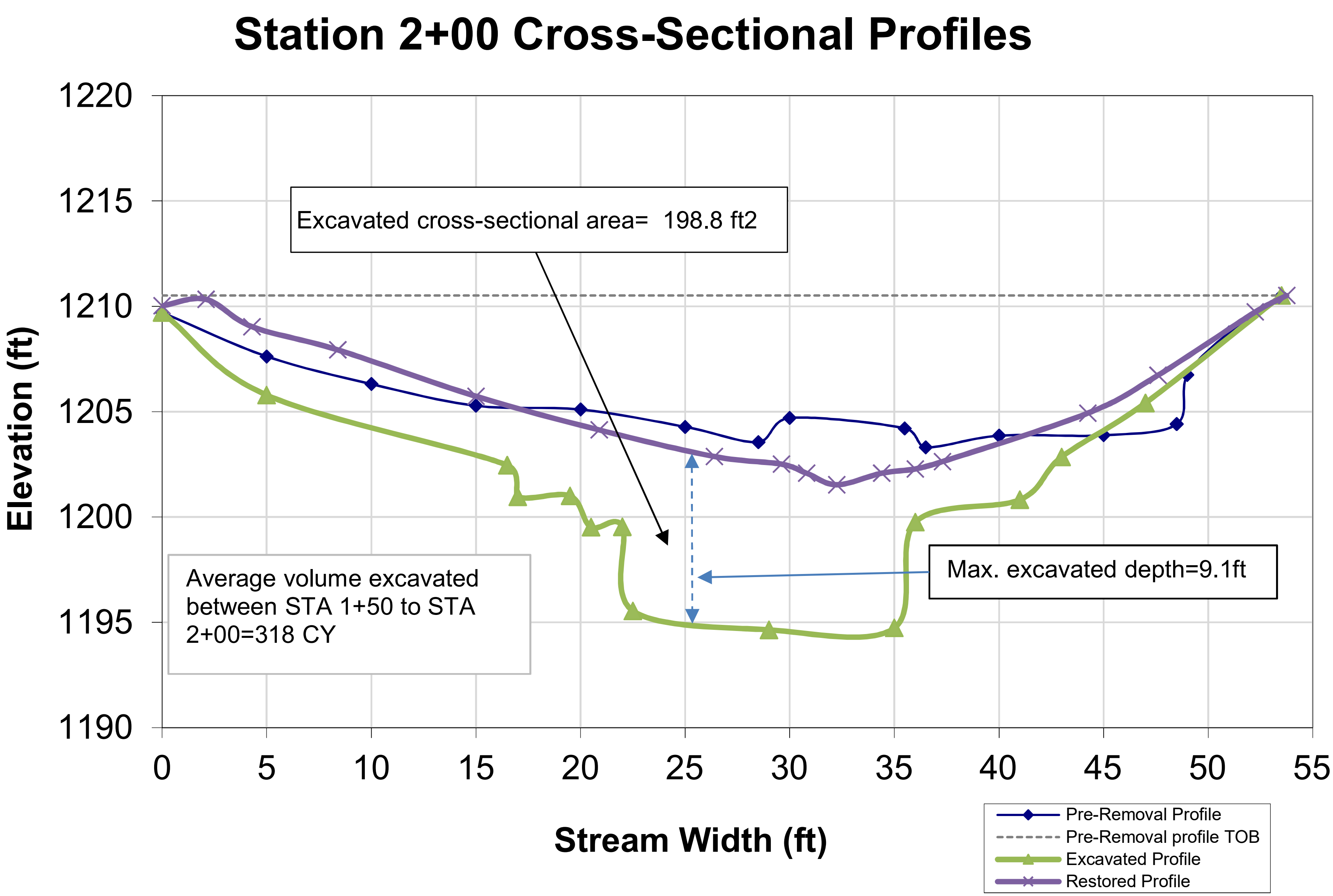


Station 0+50 Cross-Sectional Profiles
Elevation (ft)
1245
1240
1235
1230
1225
1220
1215
1210
0
5
10
15
20
25
30
35
40
45
50
55
Stream Width (ft)
Excavated cross-sectional area= 247.9 ft2
Average volume excavated between STA 0+00 to STA 0+50=231 CY
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

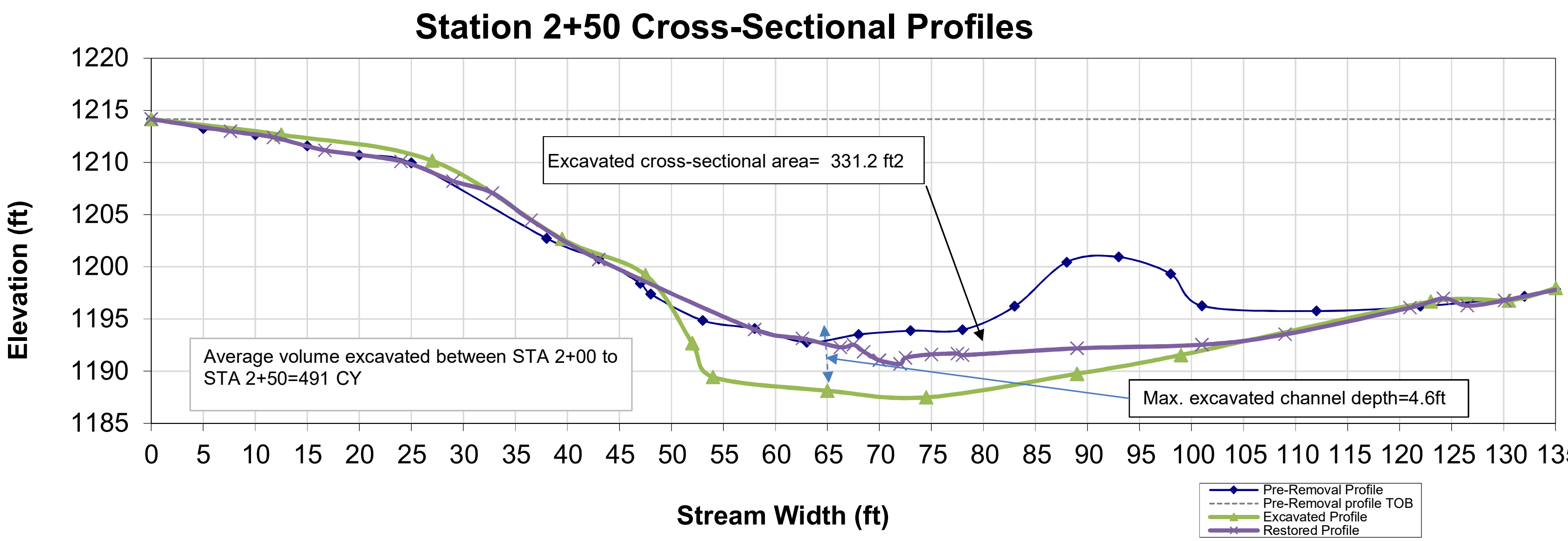


Station 1+00 Cross-Sectional Profiles
Elevation (ft)
1235
1230
1225
1220
1215
1210
1205
0
5
10
15
20
25
30
35
40
45
50
55
60
Stream Width (ft)
Excavated cross-sectional area= 179.9 ft2
Max. excavated depth=5.7ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

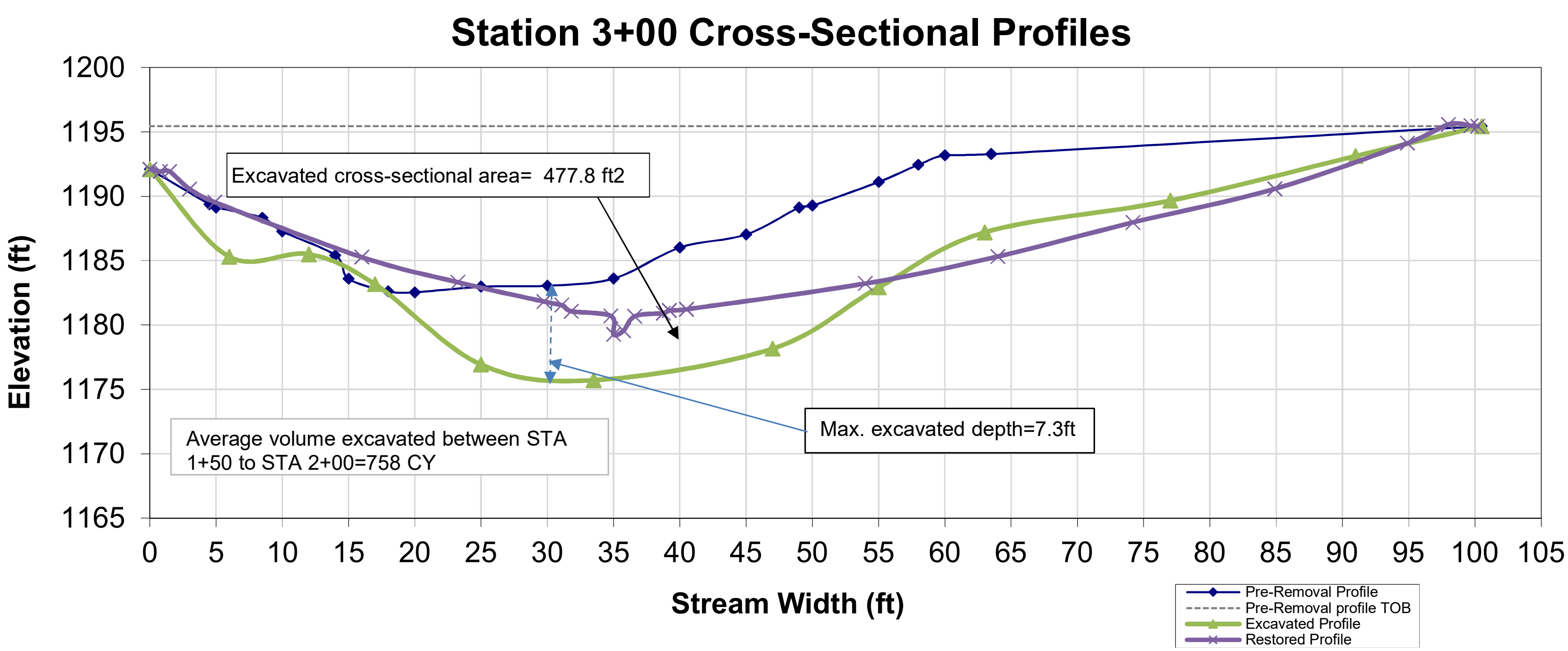

Station 1+50 Cross-Sectional Profiles
Excavated cross-sectional area= 145 ft2
Average volume excavated between STA 1+00 to STA 1+50=301 CY
Elevation (ft)
1225
1220
1215
1210
1205
1200
1195
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Stream Width (ft)
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



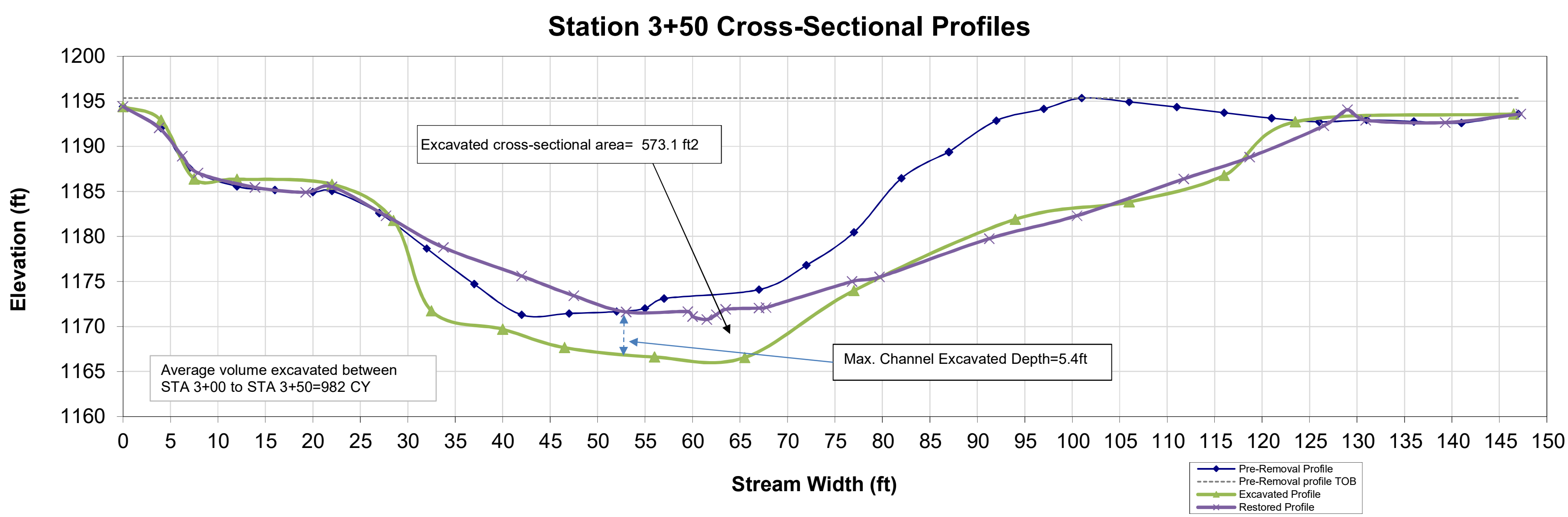
Station 2+00 Cross-Sectional Profiles
Excavated cross-sectional area= 198.8 ft2
Average volume excavated between STA 1+50 to STA 2+00=318 CY
Max. excavated depth=9.1ft
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
Stream Width (ft)
0
5
10
15
20
25
30
35
40
45
50
55
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



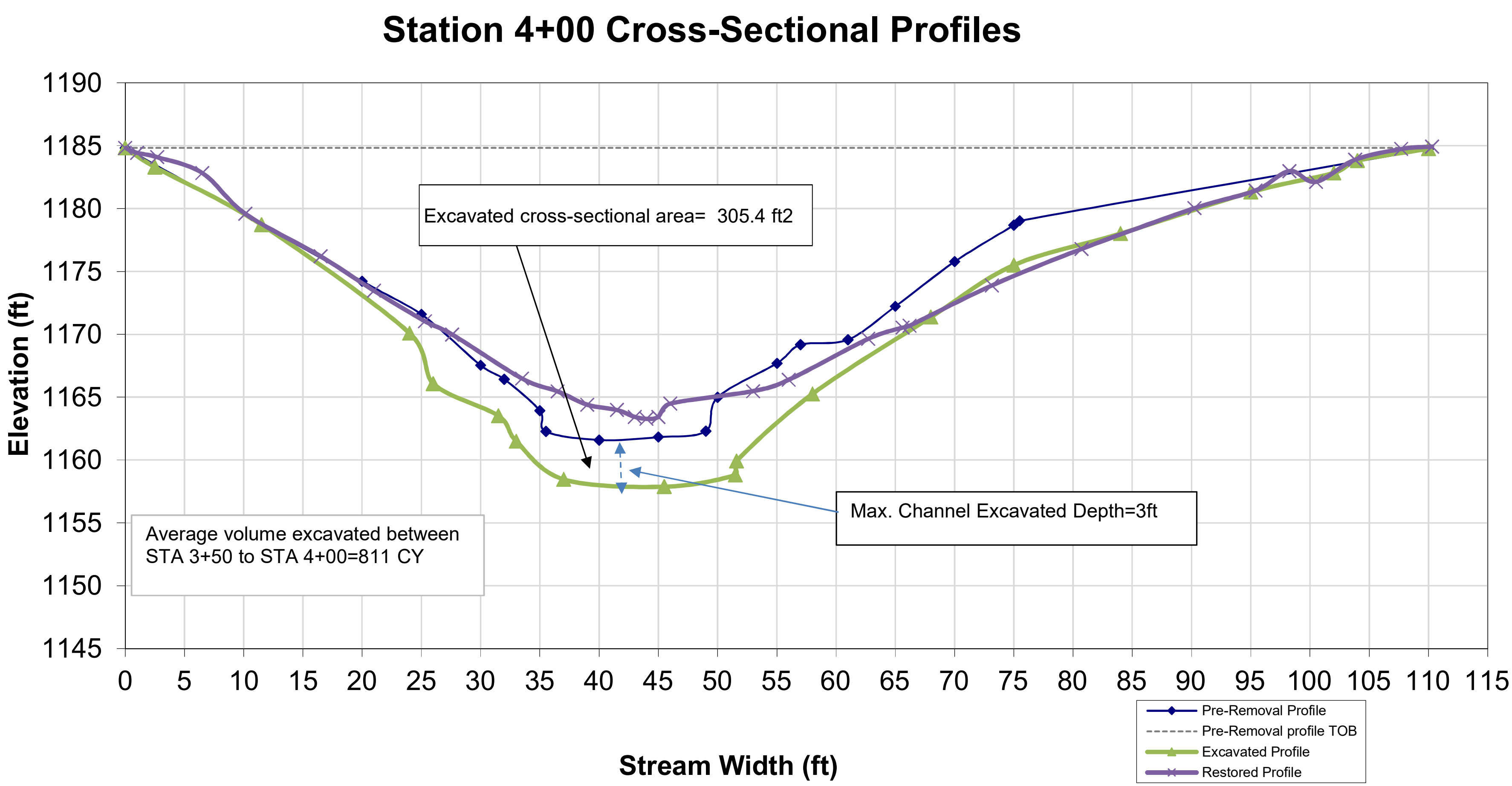
Station 2+50 Cross-Sectional Profiles
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
1185
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
Stream Width (ft)
Excavated cross-sectional area= 331.2 ft2
Average volume excavated between STA 2+00 to STA 2+50=491 CY
Max. excavated channel depth=4.6ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



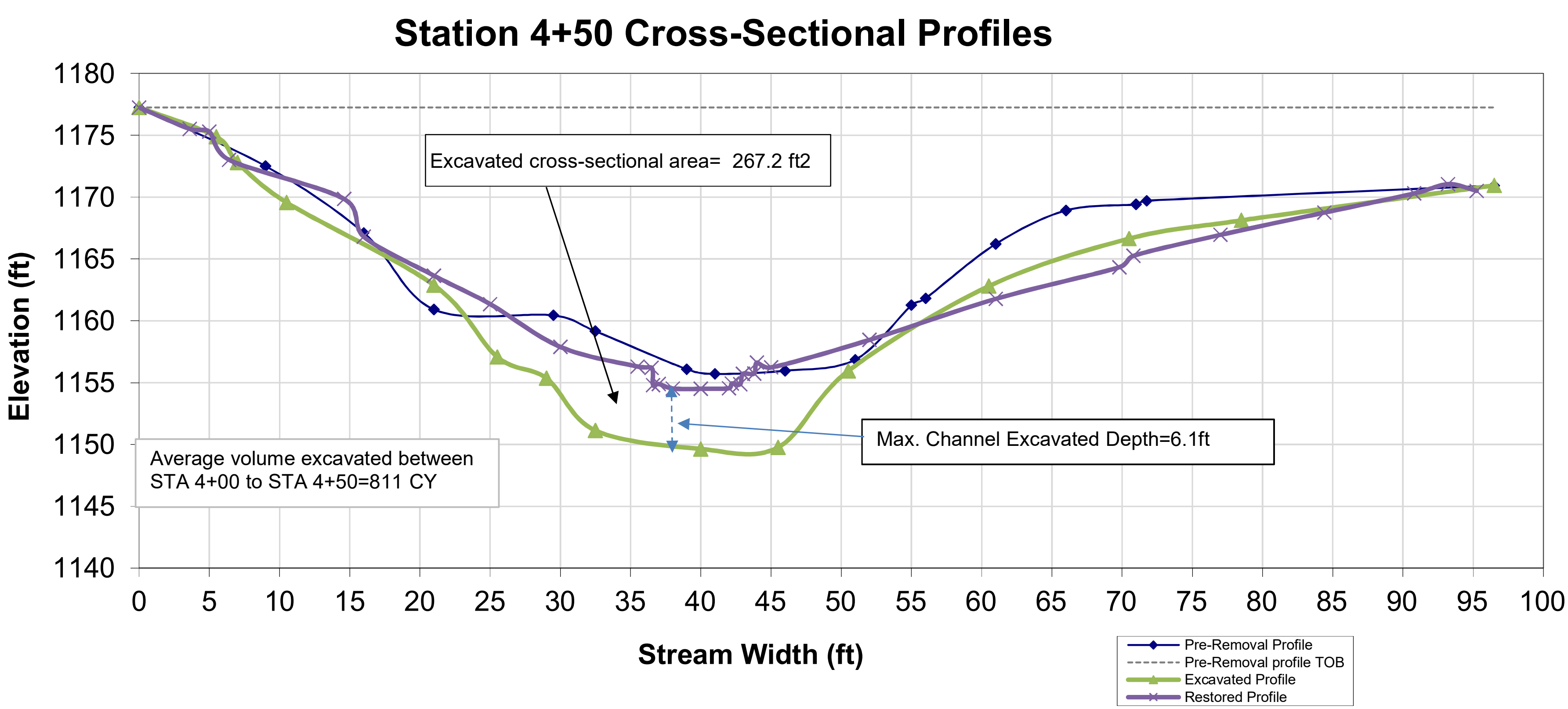
Station 3+00 Cross-Sectional Profiles
Elevation (ft)
1200
1195
1190
1185
1180
1175
1170
1165
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
Stream Width (ft)
Excavated cross-sectional area= 477.8 ft2
Average volume excavated between STA 1+50 to STA 2+00=758 CY
Max. excavated depth=7.3ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



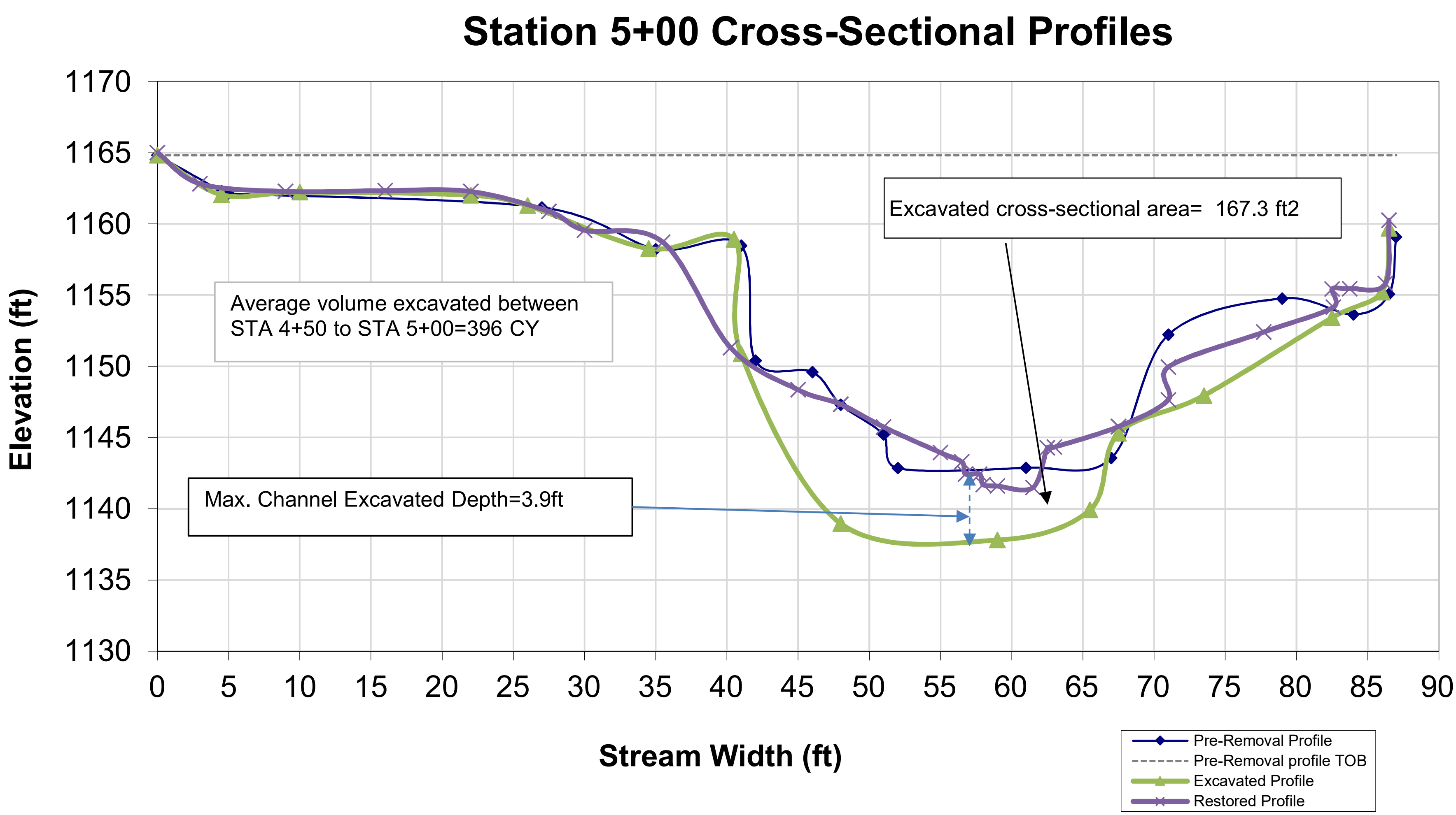
Station 3+50 Cross-Sectional Profiles
Elevation (ft)
1200
1195
1190
1185
1180
1175
1170
1165
1160
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
Stream Width (ft)
Excavated cross-sectional area= 573.1 ft2
Max. Channel Excavated Depth=5.4ft
Average volume excavated between
STA 3+00 to STA 3+50=982 CY
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



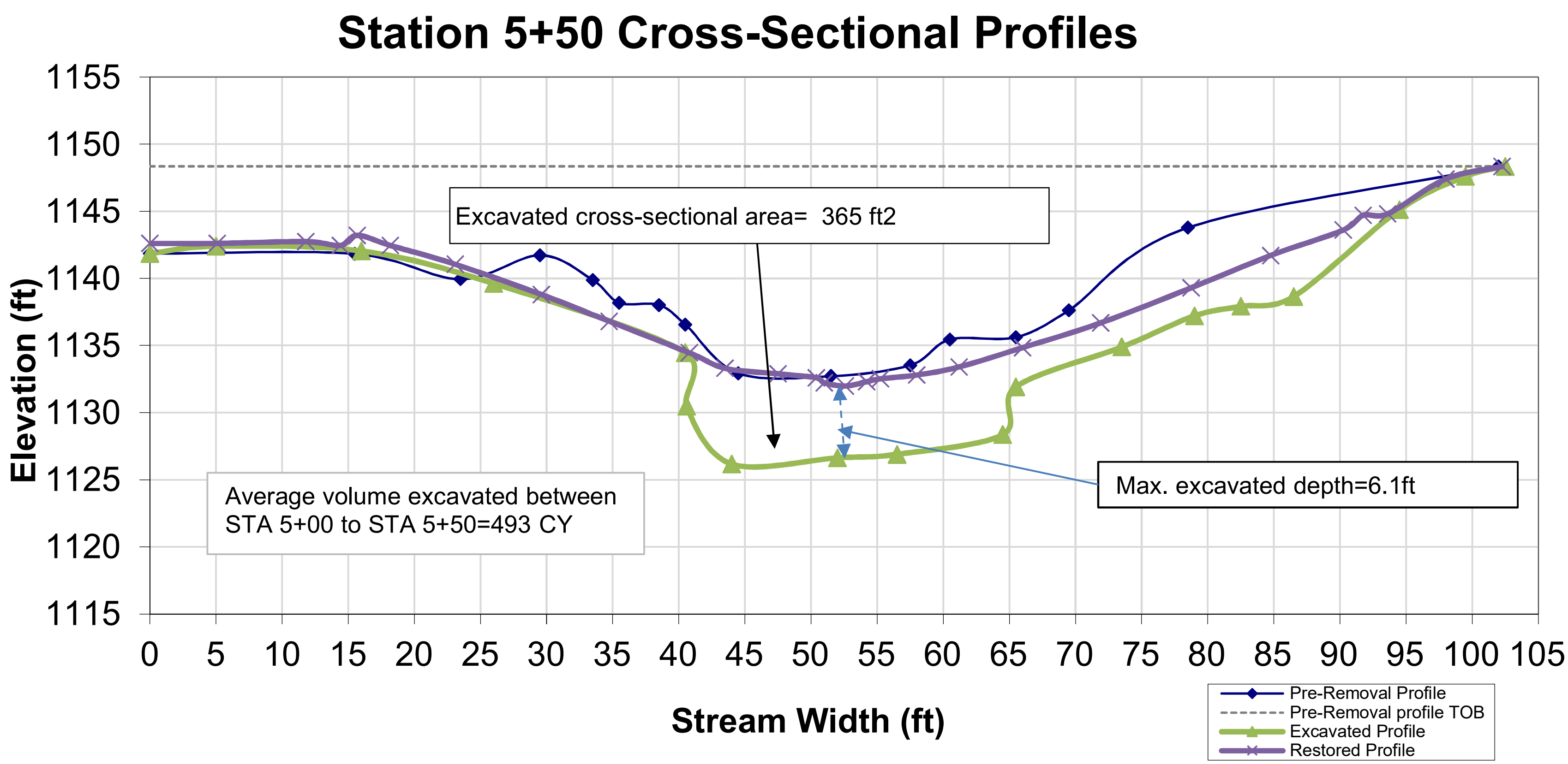
Station 4+00 Cross-Sectional Profiles
Elevation (ft)
1190
1185
1180
1175
1170
1165
1160
1155
1150
1145
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115
Stream Width (ft)
Excavated cross-sectional area= 305.4 ft2
Max. Channel Excavated Depth=3ft
Average volume excavated between
STA 3+50 to STA 4+00=811 CY
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



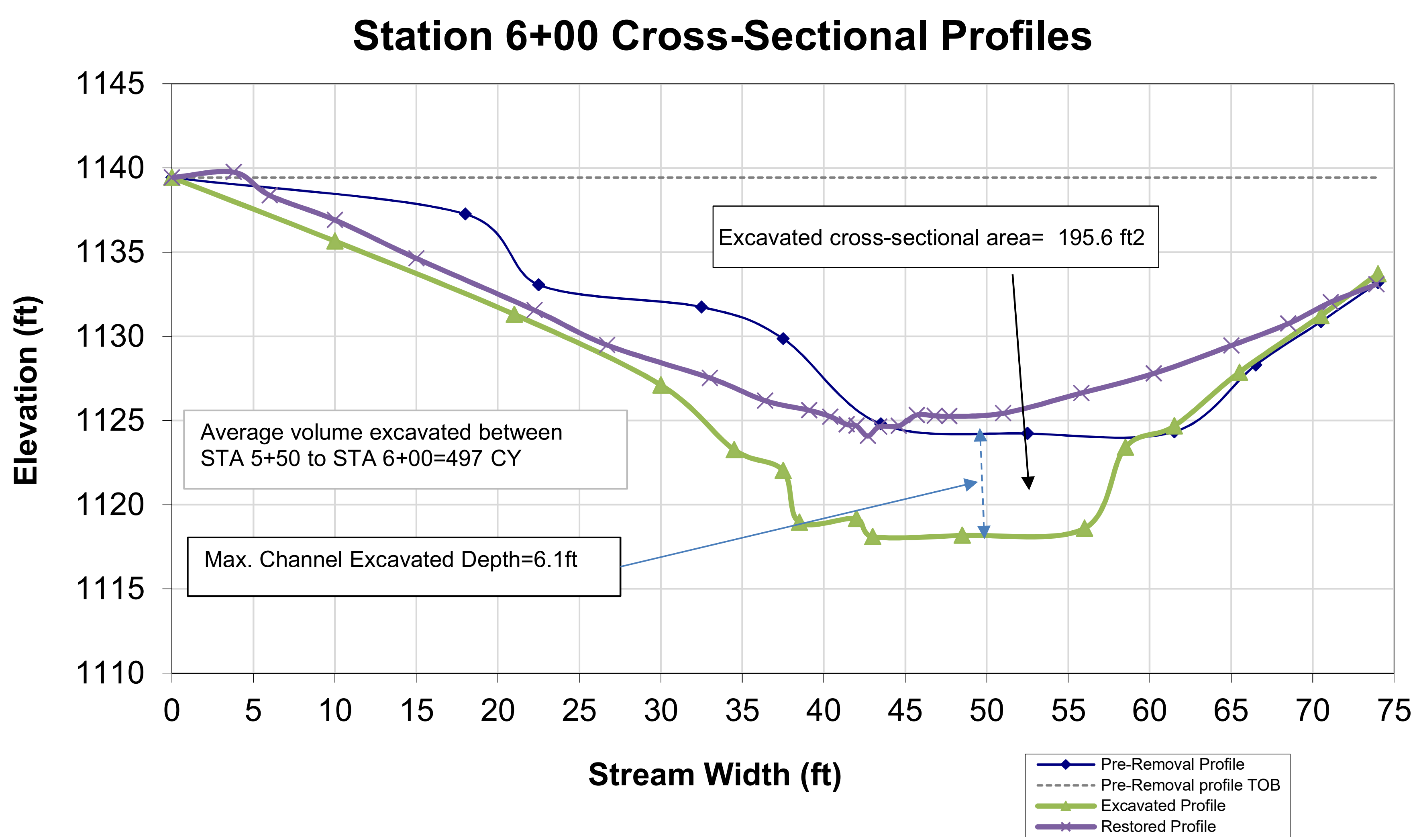
Station 4+50 Cross-Sectional Profiles
1180
1175
1170
1165
1160
1155
1150
1145
1140
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Stream Width (ft)
Excavated cross-sectional area= 267.2 ft2
Max. Channel Excavated Depth=6.1ft
Average volume excavated between
STA 4+00 to STA 4+50=811 CY
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

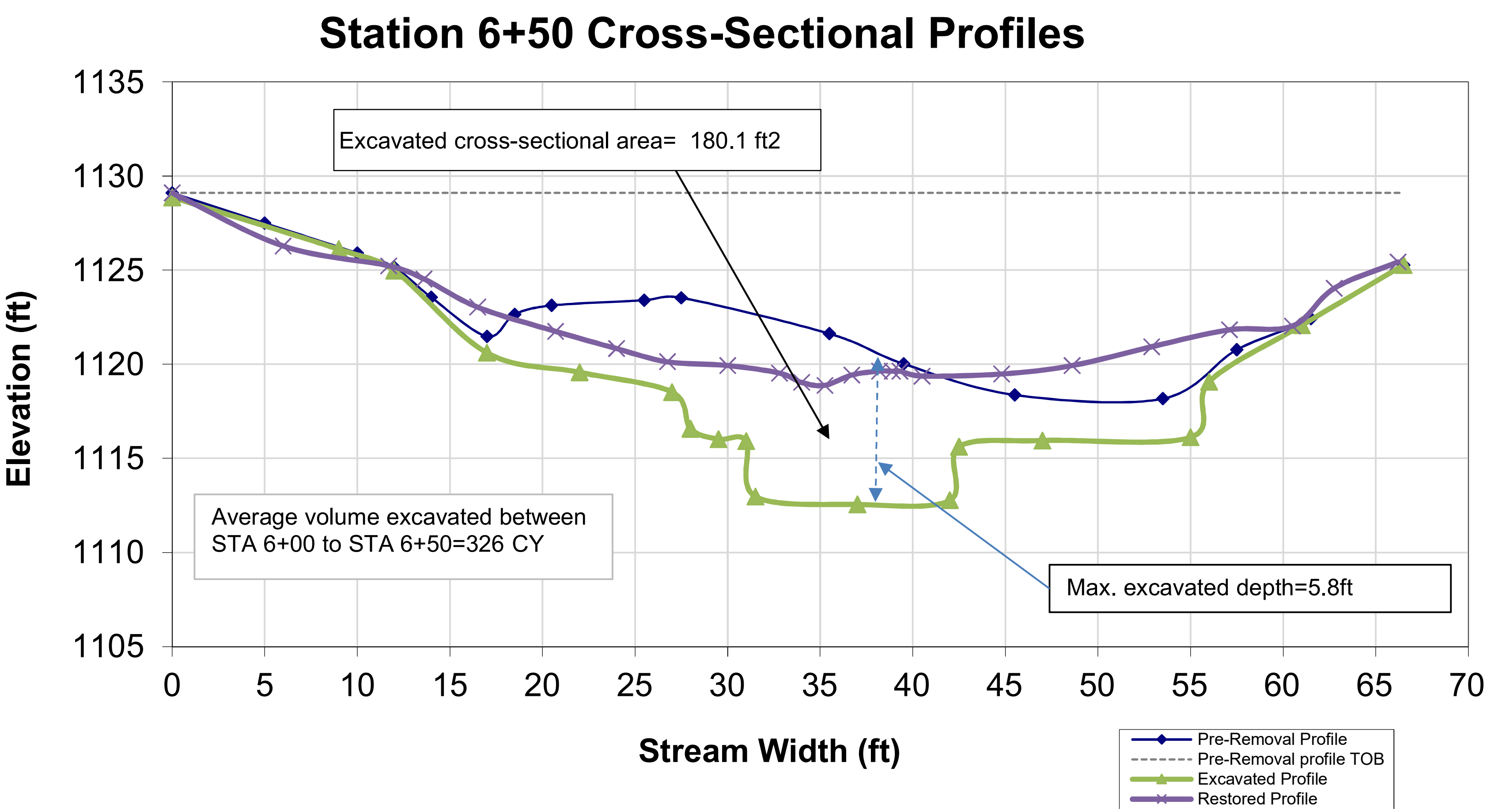


Station 5+00 Cross-Sectional Profiles
Elevation (ft)
1170
1165
1160
1155
1150
1145
1140
1135
1130
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Stream Width (ft)
Excavated cross-sectional area= 167.3 ft2
Average volume excavated between STA 4+50 to STA 5+00=396 CY
Max. Channel Excavated Depth=3.9ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

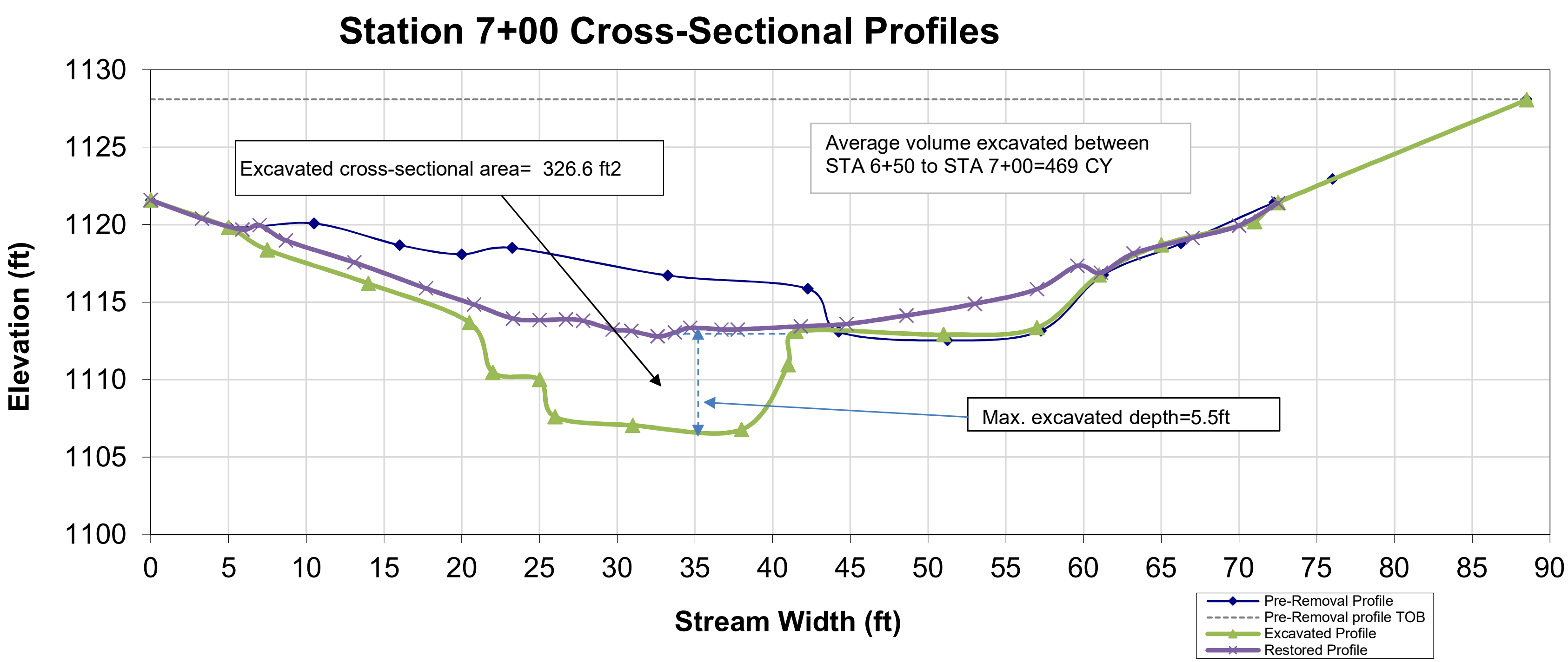


Station 5+50 Cross-Sectional Profiles
1155
1150
1145
1140
1135
1130
1125
1120
1115
Elevation (ft)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105
Stream Width (ft)
Excavated cross-sectional area= 365 ft2
Max. excavated depth=6.1ft
Average volume excavated between STA 5+00 to STA 5+50=493 CY
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

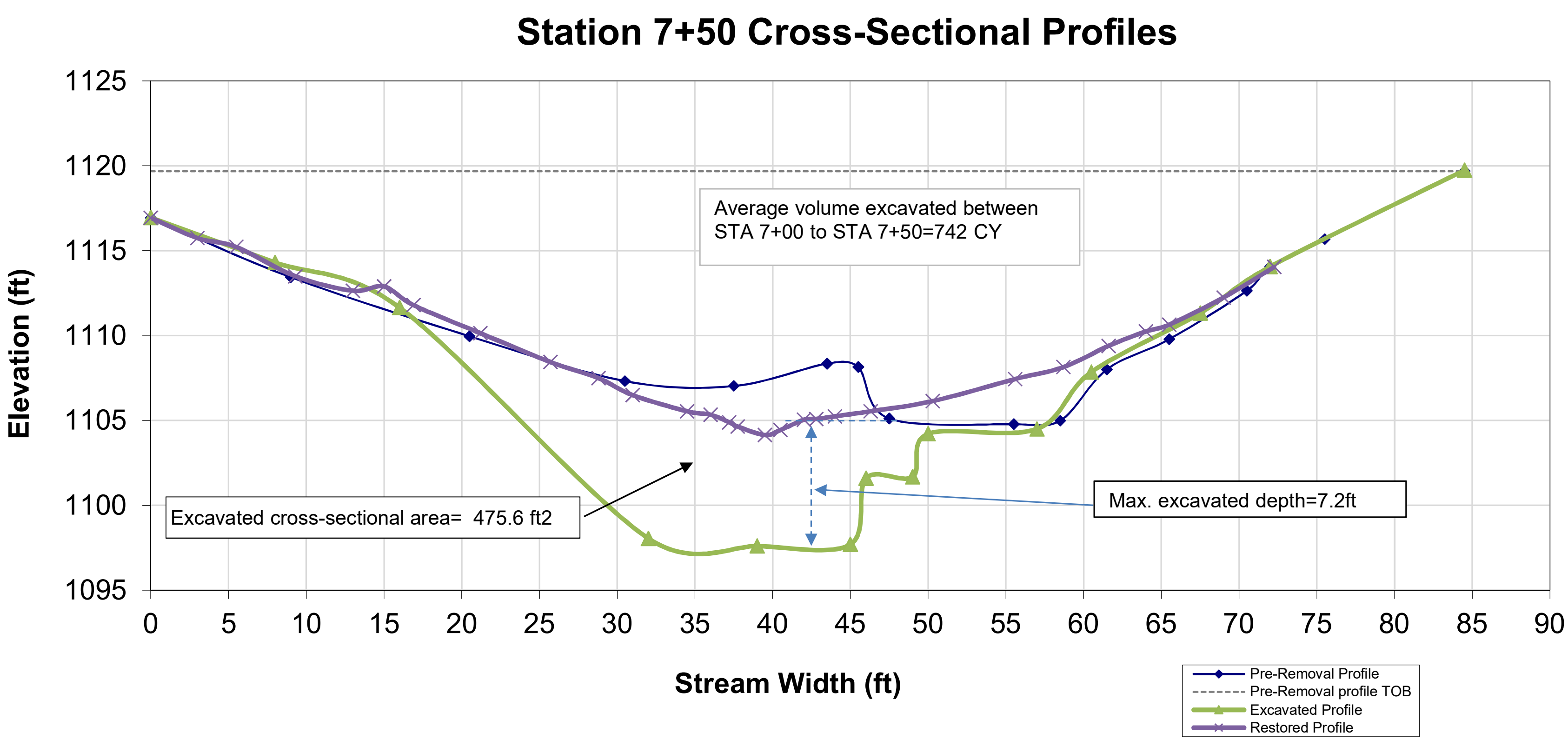

Station 6+00 Cross-Sectional Profiles
Elevation (ft)
1145
1140
1135
1130
1125
1120
1115
1110
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
Stream Width (ft)
Excavated cross-sectional area= 195.6 ft2
Average volume excavated between
STA 5+50 to STA 6+00=497 CY
Max. Channel Excavated Depth=6.1ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



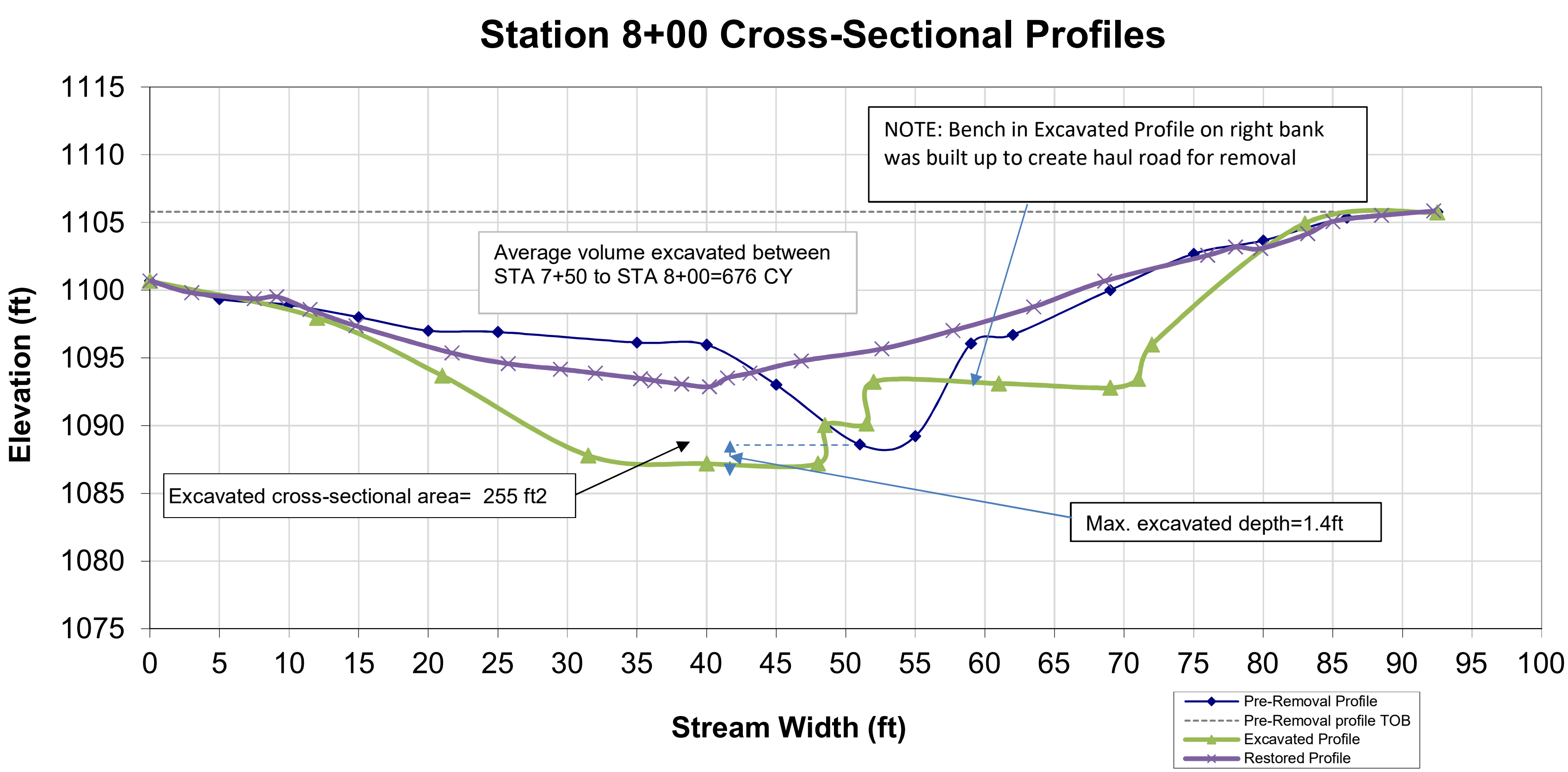
Station 6+50 Cross-Sectional Profiles
1135
1130
1125
1120
1115
1110
1105
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Stream Width (ft)
Excavated cross-sectional area= 180.1 ft2
Average volume excavated between
STA 6+00 to STA 6+50=326 CY
Max. excavated depth=5.8ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



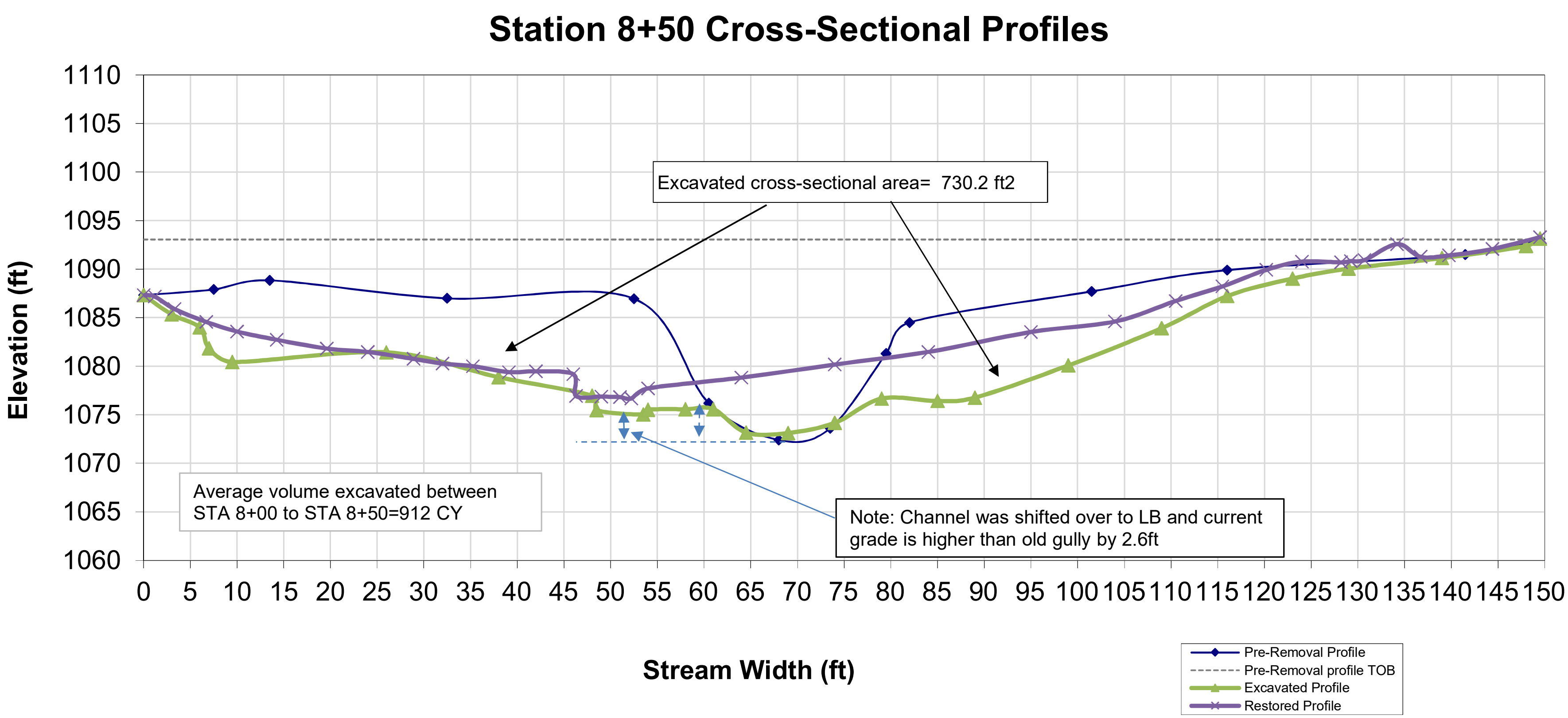
Station 7+00 Cross-Sectional Profiles
1130
1125
1120
1115
1110
1105
1100
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Stream Width (ft)
Excavated cross-sectional area= 326.6 ft2
Average volume excavated between
STA 6+50 to STA 7+00=469 CY
Max. excavated depth=5.5ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

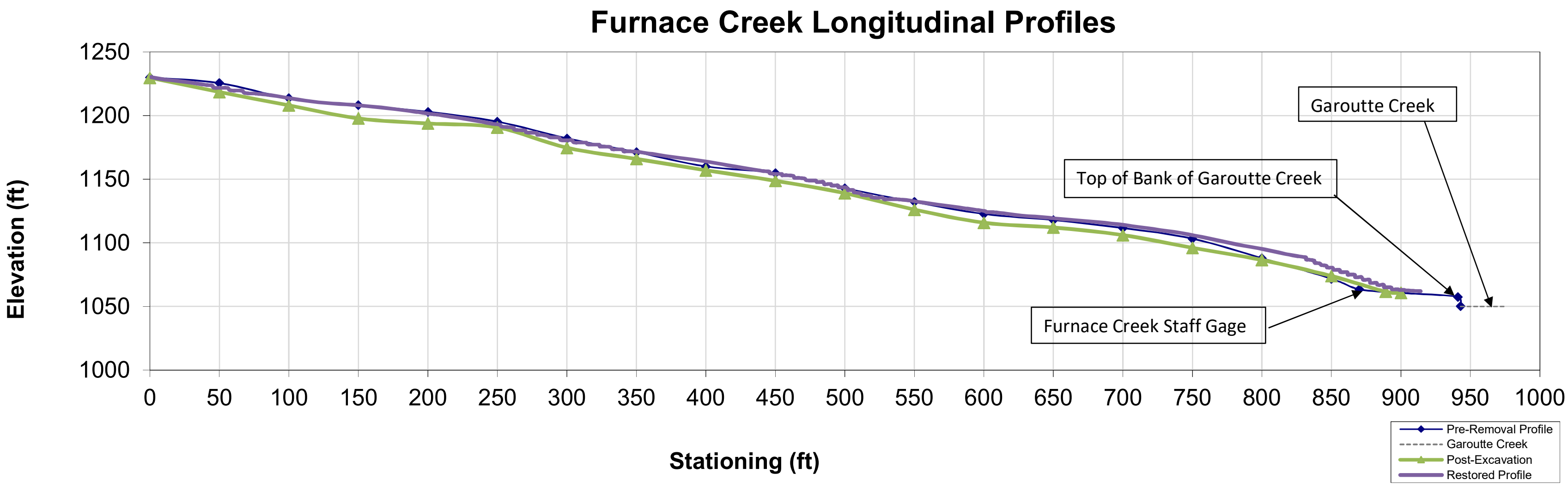


Station 7+50 Cross-Sectional Profiles
Elevation (ft)
Stream Width (ft)
1125
1120
1115
1110
1105
1100
1095
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Average volume excavated between STA 7+00 to STA 7+50=742 CY
Excavated cross-sectional area= 475.6 ft2
Max. excavated depth=7.2ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



Station 8+00 Cross-Sectional Profiles
1115
1110
1105
1100
1095
1090
1085
1080
1075
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Stream Width (ft)
NOTE: Bench in Excavated Profile on right bank was built up to create haul road for removal
Average volume excavated between STA 7+50 to STA 8+00=676 CY
Excavated cross-sectional area= 255 ft2
Max. excavated depth=1.4ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile


Station 8+50 Cross-Sectional Profiles
Elevation (ft)
1110
1105
1100
1095
1090
1085
1080
1075
1070
1065
1060
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
Stream Width (ft)
Excavated cross-sectional area= 730.2 ft2
Average volume excavated between STA 8+00 to STA 8+50=912 CY
Note: Channel was shifted over to LB and current grade is higher than old gully by 2.6ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile



Furnace Creek Longitudinal Profiles
Elevation (ft)
1250
1200
1150
1100
1050
1000
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
Stationing (ft)
Garoutte Creek
Top of Bank of Garoutte Creek
Furnace Creek Staff Gage
Pre-Removal Profile
Garoutte Creek
Post-Excavation
Restored Profile

This page intentionally left blank.

F Well Abandonment Logs

This page intentionally left blank.

LANE 76015

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

7/13/2018

WELL I.D. LABEL# L 111325

START CARD # 1039490

(1) LAND OWNER

Owner Well I.D. MW-10

First Name ______ Last Name ______

Company LAND & TIMBER COMPANY

Address PO BOX 1758

City EUGENE State OR Zip 97440

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☒ Abandonment

(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other OVER EXCAVATE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 15.00 ft. Special Standard ☒

MONUMENT/VAULT ______
From ______ To ______

BORE HOLE
Diameter 6 From 0 To 15

CASING
Dia. ______ From ☐ ______ To ______
Gauge ______ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

LINER
Dia. ______ From ☐ ______ To ______
Gauge ______ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 15
Material Other
Amount 0 Pounds Grout weight ______

SCREEN
Casing/Liner ______ Material ______
Diameter ______ From ______ To ______
Slot Size ______

FILTER
From ______ To ______ Material ______ Size of pack ______

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature ______ °F Lab analysis ☐ Yes By ______

Supervising Geologist/Engineer ______

Water quality concerns? ☐ Yes (describe below) TDS amount 0 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County LANE Twp 23.00 S N/S Range 3.00 W E/W WM

Sec 8 SE 1/4 of the SE 1/4 Tax Lot 2303080000800

Tax Map Number ______ Lot ______

Lat ______ ° ______ ' ______ " or ______ DMS or DD

Long ______ ° ______ ' ______ " or ______ DMS or DD

◯ Street address of well ◉ Nearest address

70800 LONDON ROAD, COTTAGE GROVE, OR 97424

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES

Depth water was first found ______

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation ______

Material	From	To
overexcavated well along creek - removed	0	13
well materials completely removed	13	14
no backfill required	14	15

Date Started 7/13/2018 Completed 7/13/2018

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number ______ Date ______

Password : (if filing electronically) ______

Signed ______

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10432 Date 7/13/2018

Password : (if filing electronically) ______

Signed DONALD LARSON (E-filed)

Contact Info (optional) ______

MONITORING WELL REPORT - continuation page

LANE 76015

7/13/2018

WELL I.D. LABEL# L 111325

START CARD # 1039490

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

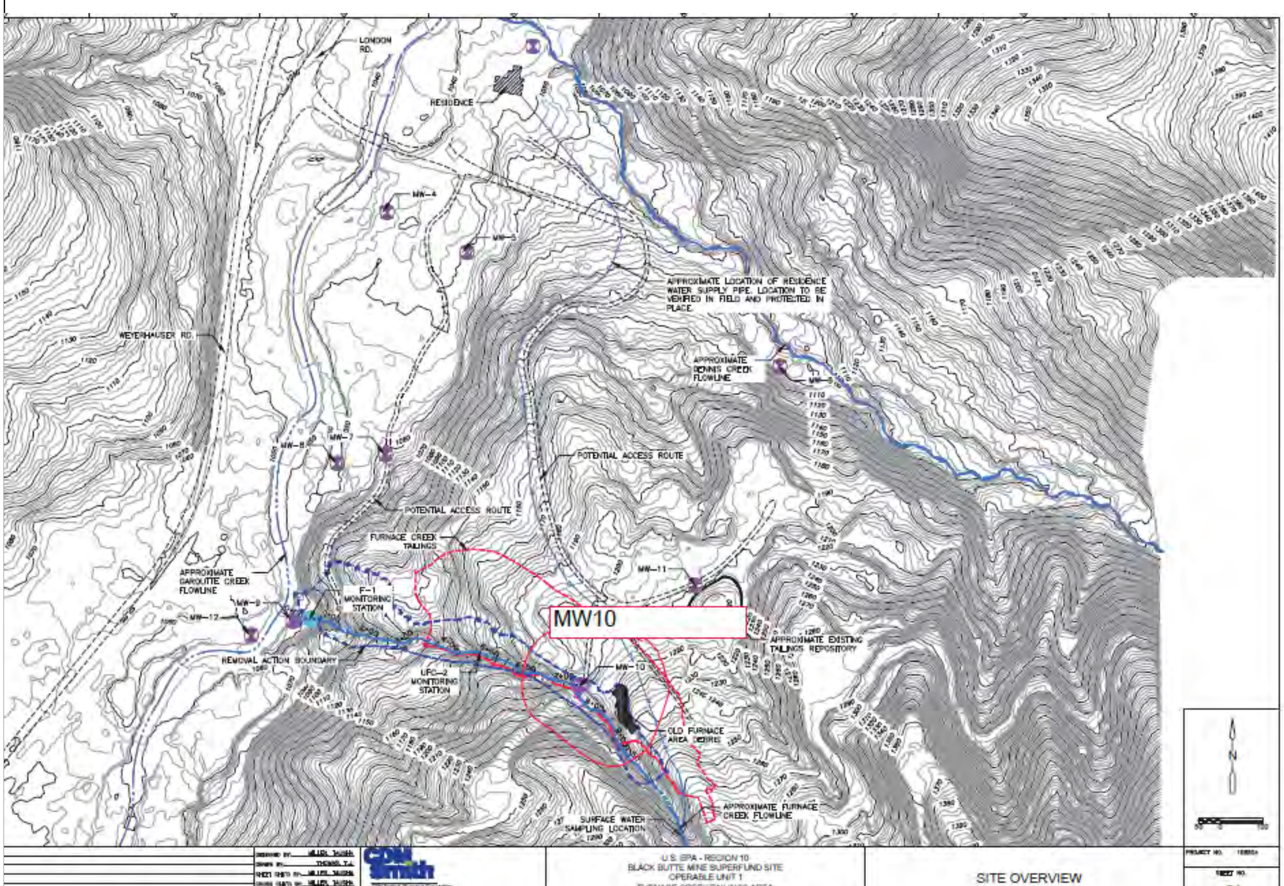
Black Butte Mine Site - EPA

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

LANE 76015

7/13/2018

Map of Hole



LANE 75997

STATE OF OREGON
MONITORING WELL REPORT

LANE 75997

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

Well ID# L 111323

Start Card # 196764

(1) OWNER/PROJECT

WELL NO. 11

Name Black Butte Mine Superfund Site

Address 70800 London Road

City C State Zip

(2) TYPE OF WORK

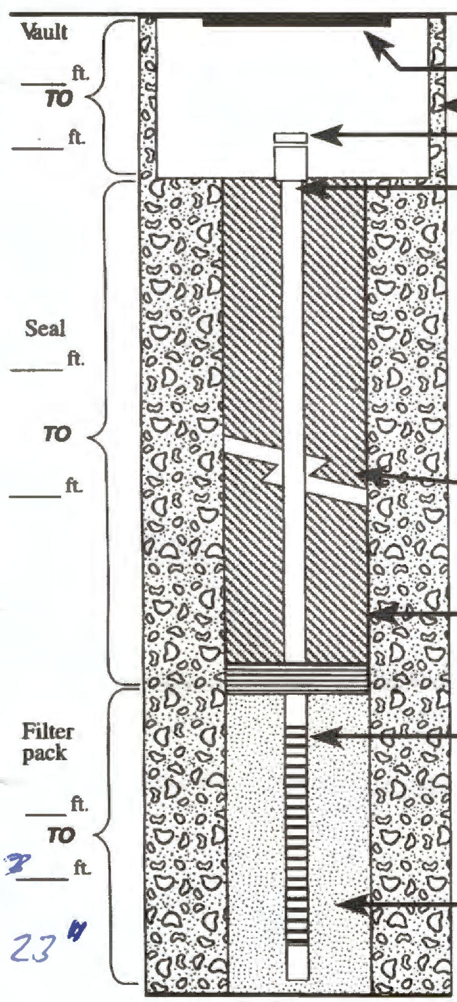
☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☒ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other Augar

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes ☐ No ☒ Depth of Completed Well 23' ft.



Casing diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Well seal:
Material ______
Amount ______
Grout weight ______

Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Screen material ______
interval(s):
From ______ To ______
From ______ To ______
Slot size ______ in.

Filter pack:
Material ______
Size ______ in.

(5) WELL TESTS:

☐ Pump ☒ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity 320 PH 5.84

Temperature of water 57.2 °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? Wes Harper

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks:

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description:

County Lane Latitude 43.219679 Longitude 123°285706

Township 23 (N or S) Range 3 (E or W) Section SE SE 8

______ 1/4 of ______ 1/4 of above section.

Street address of well location 70800 London Rd

Tax lot number of well location 2303080000800

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

16.45 Ft. below land surface. Date 06-21-18

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

RECEIVED
AUG 06 2018
OWRD

(9) WELL LOG:

Ground Elevation ______

Material	From	To	SWL
Screen Removed			
23' 2"			
over drilled 8" to			
10", material is 3/4" to			
2 1/2", no fines hole			
filled in as we were			
drilling, could not			
place 7/8" Betonite in			
hole.			
Call Joel water			
Resources.			

RECEIVED
JUN 27 2018
OWRD

Date started ______ Completed ______

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed [signature] N/A MWC Number ~~10528~~ Date ~~06-21-18~~

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed [signature] MWC Number 10528 Date 06-21-18

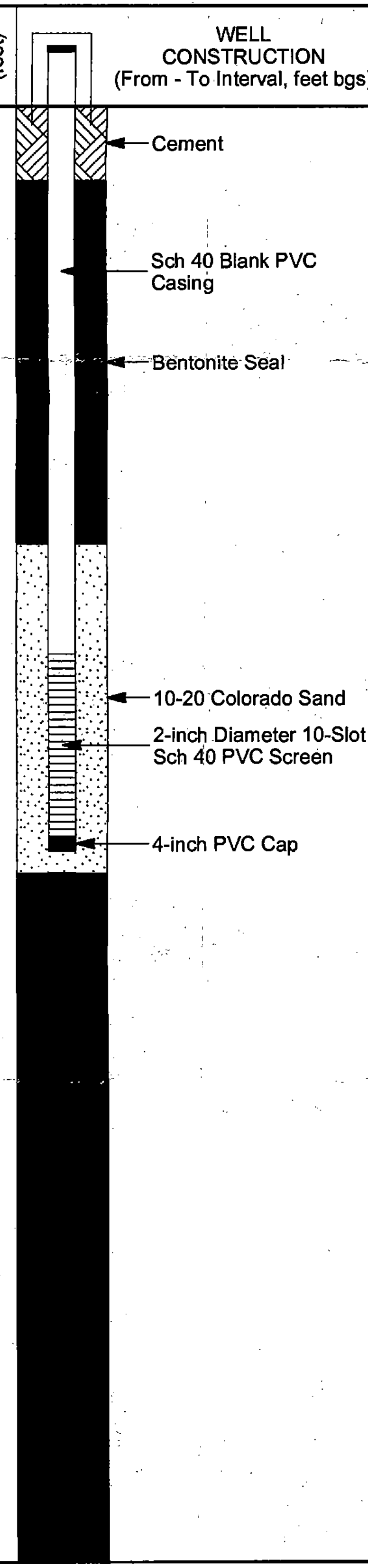
ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

PROJECT: Black Butte Mine Superfund Site	NO:	**MW-11**
LOCATION: Cottage Grove, Oregon	LANE 75997 U.S. EPA	

STARTED: 6/21/13 COMPLETED: 6/21/13	NORTHING: NA	EASTING: NA
DRILLING COMPANY: Cascade	G.S. ELEVATION: NA	M.P. ELEV:
DRILLING EQUIPMENT: AMS C-17	WATER:	[redacted]
DRILLING METHOD: Sonic, 6 In. Dia. Borehole	LOGGED BY: AG	
SAMPLING METHOD: Core Barrel	HORIZONTAL DATUM: , COORD. SYS.: NA	
SURFACE COMPLETION: Steel Stickup	VERTICAL DATUM:	

DEPTH (feet)	USCS	DESCRIPTION	SAMPLE ID	SAMPLER ADV. (feet)	RECOV. (feet)	PID (ppm)	ELEV. (feet)
0–5	GW	GRAVEL with SAND: reddish brown (5YR 4/4); 60% gravel, fine to coarse, well graded, angular, max. dia. 2"; 40% sand, fine to coarse, well graded, angular to subangular, trace silt, in mine tailings					
5–7.5	GW	Becomes moist from 5 to 7.5 ft bgs					
7.5–10	CL	CLAY: reddish brown (5YR 4/4); 90% clay, moist, hard, medium plasticity; 5% sand; 5% gravel, homogeneous					
10–12	CH	SANDY CLAY: reddish brown (5YR 4/4); 70% clay, high plasticity, firm, dry to moist; 30% sand, fine to coarse, angular to subangular, trace gravel					
12–15	CH	SANDY CLAY: dark gray (2.5YR 4/1); 70% clay, high plasticity, firm, dry to moist; 30% sand, fine to coarse, angular to subangular, trace gravel					
15–19	CL	CLAY with SAND: reddish brown (5YR 4/3); 85% clay, moist, firm, medium plasticity; 15% sand, fine to coarse, angular to subangular, trace gravel					
19–29	CL	SANDY CLAY: dark gray (10YR 4/1); 70% clay, moist soft, medium plasticity; 30% sand, fine to coarse, subangular; trace gravel; blue-gray mottles					
29–39	CL	SANDY CLAY: dark gray (2.5YR 4/1); 70% clay, moist soft, medium plasticity; 30% sand, fine to coarse, subangular; trace gravel; blue-gray mottles					
39–	CL						

WELL CONSTRUCTION (From - To Interval, feet bgs)



RECEIVED
JUN 27 2018
OWRD

PROJECT NO. 50898-92004

WELL CONSTRUCTION LOG

This page intentionally left blank.

G Borrow Source Area and Old Furnace Area Repair Recommendations (CDM Smith)

This page intentionally left blank.

Fulton, Maren

From: Miller, Tausha <MillerTM@cdmsmith.com>
Sent: Tuesday, July 23, 2019 6:53 PM
To: Nattis, Randy; Vanderboom, Eric
Cc: Dave Tomten (Tomten.Dave@epa.gov); Clark, Josie; Miller, Brendan A.; Lechleitner, Cody; Giaudrone, Dominic; Silvertooth, Jason R.; Fulton, Maren
Subject: BBM Borrow Source Area and Old Furnace Area Repair Recommendations
Attachments: Slope Stability Analyses.pdf; BBM STA 1+00 Cross-Section_Proposed Improvements.pdf; Borrow Source Update Notes.pdf; Remaining Action Items.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Randy / Eric –

Attached are several documents regarding CDM Smith's recommendations for the repair work at the site, including the Borrow Source Area and the Old Furnace Area. These documents include:

- Punchlist of Remaining Site Activities
- Borrow Source Area Updates
- Old Furnace Area Updates
  - Cross-Section Markup for Proposed Stabilization Improvements
  - Slope Stability Analysis / Results

Please note that the guidance documents provided in this email are based on field discussions and site observations conducted last week on 7/18. These supplemental recommendations are being provided as an informal markup rather than a formal implementation plan addendum deliverable due to the expedited schedule.

In regards to the repair at the Old Furnace Area, please note the below summary of the assumptions and analyses performed:

- The cross-section of stream channel, including the original excavation and replacement limits, were provided via email on July 22, 2019. Slope stability analyses were performed for the provided geometry for the failed embankment slope.

- Groundwater data was not available at the time of our analyses. As such, normal pool for the stream channel was assumed to be at elevation (El.) 1,217. The phreatic water surface was also assumed to be flowing slightly downhill toward the channel in the in-situ soils from each side of the stream channel, starting from an initial El. 1,222.

- Subsurface data regarding in-situ soils and previously backfill soils were not available at the time of our analyses. Photographs during construction and after construction were provided to CDM Smith. Per the field team, in-situ and backfill soils appeared to be a primarily cohesive material (assumed clay). Without compaction data of the previously backfilled soils at the site, it was assumed that minimal compaction occurred during placement of the backfill soils.

- An initial slope stability analysis was performed using the software SLOPE/W (developed by GeoStudio) to model the "post-construction" existing conditions in an attempt to estimate the insitu soil parameters. These analyses included modeling the undrained (short-term) and drained (steady-state) soil conditions to try and achieve an approximate factor of safety (FS) equal to 1.0. Based on the clayey nature of the previous fill material and lack of new load, it was assumed the slope failed in a drained (steady-state) soil condition. The estimated soil parameters used in the analyses for the previously backfilled materials and insitu soils can be found on the attached figures.

- Based on site photographs, only deep-seated failures having depths greater than 4 feet were considered in this analysis. Shallow, surficial sloughing-type failures were not considered. Also, based on site photographs the failure plane for the models was assumed to occur within a few feet of the fill materials towards the top of the slope and daylight near the toe of the slope.

- To improve the slope stabilization, the US Army Corps of Engineers recommended values for factor of safety of 1.5 for drained (steady-state) analyses and 1.3 for undrained (short-term) analyses, were used as a guideline for the proposed improvements. Over-excavation of the existing soils at the toe of the failed slope and replacement with compacted stone was considered as an improvement to the cross-section provided. The assumed soil parameters for the crushed stone in the buttress included a unit weight of 135 pcf and a friction angle of 42 degrees based on a maximum of 12-inch lifts and compacted with suitable compaction equipment.

- Based on the above analyses, the attached proposed key trench geometry, backfilled with properly placed and compacted crushed stone, is recommended for stabilization of the analyzed slope. This geometry of the key trench resulted in FS values of 5.3 and 1.5 for the undrained and drained soil conditions, respectively.

Please let us know if you have any additional questions regarding our recommendations.

Thanks,

Tausha

Tausha M. Miller
CDM Smith
1220 Big Creek Road, Kellogg, ID 83837
O: 208.417.2382
C: 208.967.5134
Connect with me on LinkedIn @TaushaMiller
cdmsmith.com

Black Butte Mine OPWA Removal Action – Punchlist Items to Complete

Punchlist items identified based on site observations conducted on 7/18/19 and field discussions with EPA. Final items to complete should be verified based on site conditions and in accordance with the OPWA Implementation Plan.

Borrow Source Area

- Repair slumping and erosion at Borrow Source Area. The following items should be completed as shown on "Borrow Source Update Notes" figure:
    - Regrade upper portion where erosion occurred into the existing hillside at maximum 2H:1V slope. Stable slope configuration of 3H:1V preferred, if possible.
    - Install rock-lined stormwater channels to convey seep drainage into the main rock-lined channel.
    - Perform maintenance on the access road / bench as shown on Sheet C10 of OPWA Implementation Plan Figures.

OPWA Restoration

- Restore lower portion of OPWA.
    - Regrade the area to drain (i.e., minimum 0.5%) as shown on markup to Sheet C5 (sent by email on 7/19/19).
    - Install at-grade road crossing between upper and lower areas (see Detail E on Sheet CD2 of OPWA Implementation Plan Figures).
    - Armor area below at-grade crossing (i.e., 4-foot by 4-foot riprap rock pool) to prevent erosion from water conveyed through at-grade crossing and to act as a settling basin. Refer to markup to Sheet C5 for additional information.
    - Soil should be amended/reseeded per Sheet C6 of the OPWA Implementation Plan.
- Install mulch berm along the outer edges of the restoration area.
- Prepare soil for hydroseeding.

Furnace Creek Area

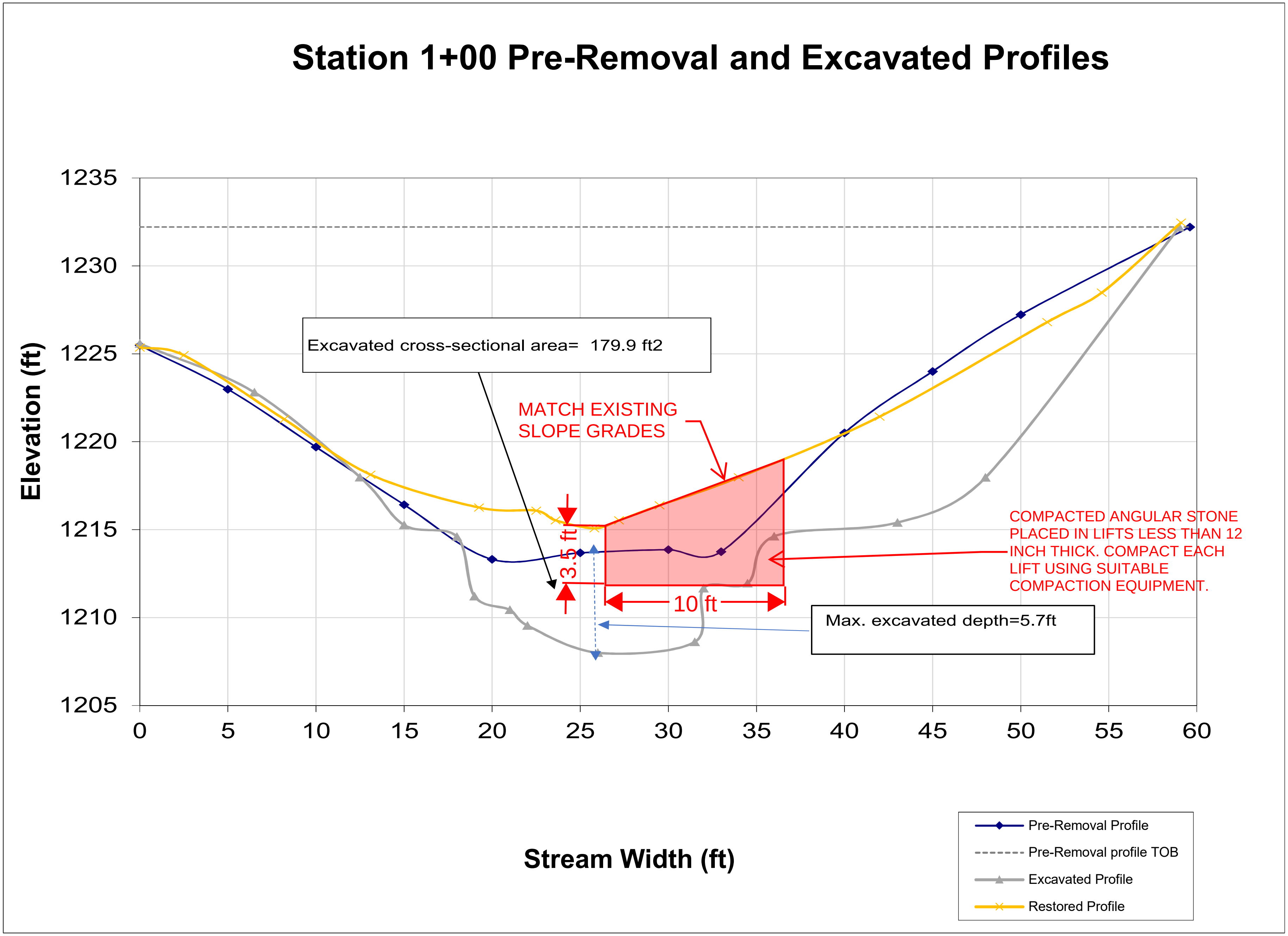
- Repair scarp area with exposed tailings as described in markups/notes provided by CDM Smith.

Repository

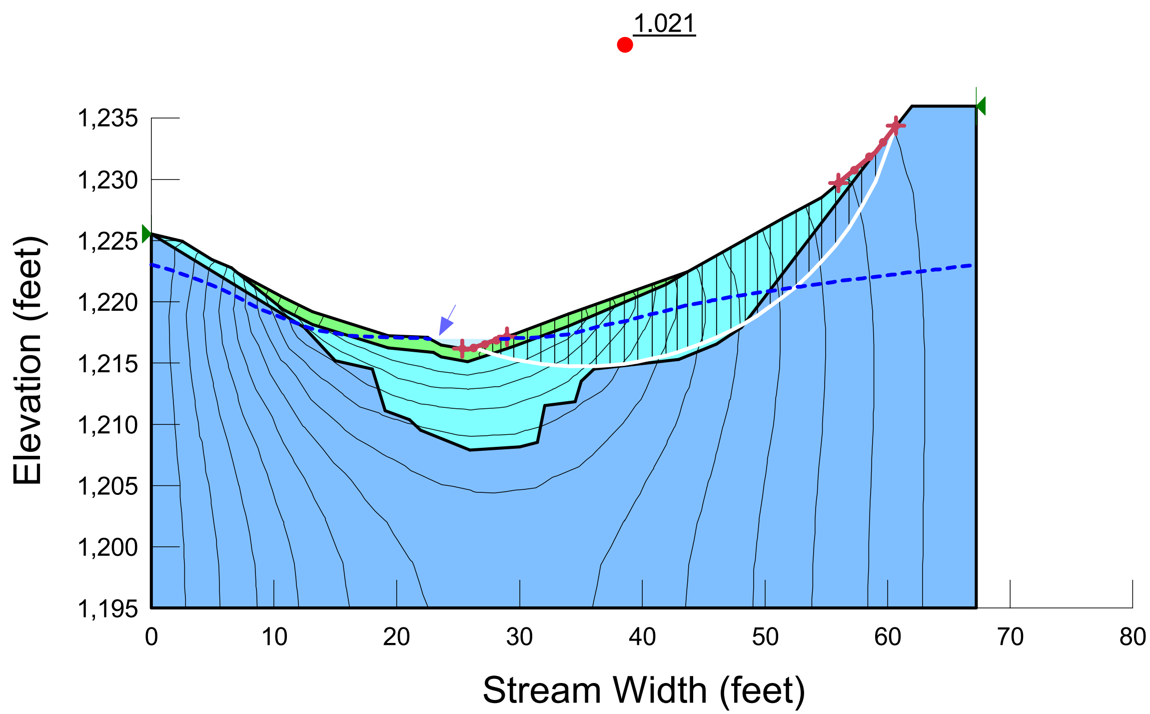
- Open enough of the repository to add the contaminated materials removed from the Furnace Creek area, as necessary.
- After placing contaminated material in the repository, regrade and cover the repository, and fix any portion of the perimeter stormwater channel that was impacted by the additional placement of contaminated materials.
- Excavate sediment that has deposited in the repository stormwater basin.

Main Access Road

- Install rolling dips (i.e., water bars) in the main access road between the residence and the repository as shown on Sheet C4 and detailed on Sheet CD2 of the OPWA Implementation Plan Figures.
- Add additional rolling dips (i.e., water bars) between the repository and the borrow source area that drain water on the main road toward the Adit Creek channel at locations identified by the field engineer.

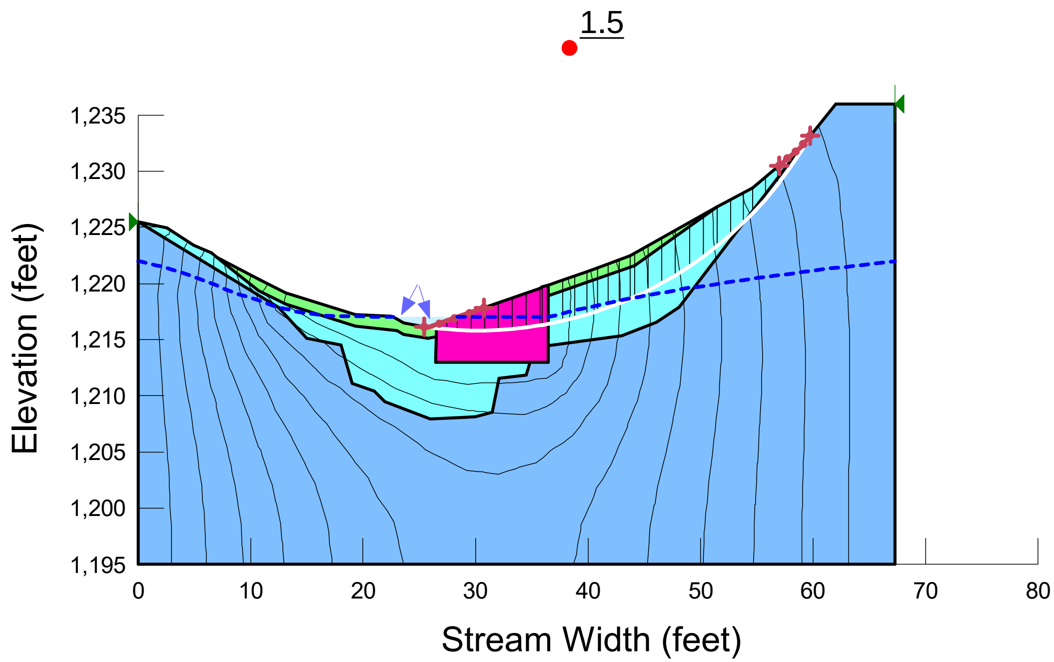

Station 1+00 Pre-Removal and Excavated Profiles
Elevation (ft)
1235
1230
1225
1220
1215
1210
1205
0
5
10
15
20
25
30
35
40
45
50
55
60
Stream Width (ft)
Excavated cross-sectional area= 179.9 ft2
MATCH EXISTING SLOPE GRADES
3.5 ft
10 ft
COMPACTED ANGULAR STONE PLACED IN LIFTS LESS THAN 12 INCH THICK. COMPACT EACH LIFT USING SUITABLE COMPACTION EQUIPMENT.
Max. excavated depth=5.7ft
Pre-Removal Profile
Pre-Removal profile TOB
Excavated Profile
Restored Profile

Furnace Creek Station 1+00 - Post-Construction Conditions
Assumed Cohesive Backfill (Drained)
Designed By: Zach Mickel Date: 07/23/2019
Checked By: Jeff Van Pelt Date: 07/23/2019



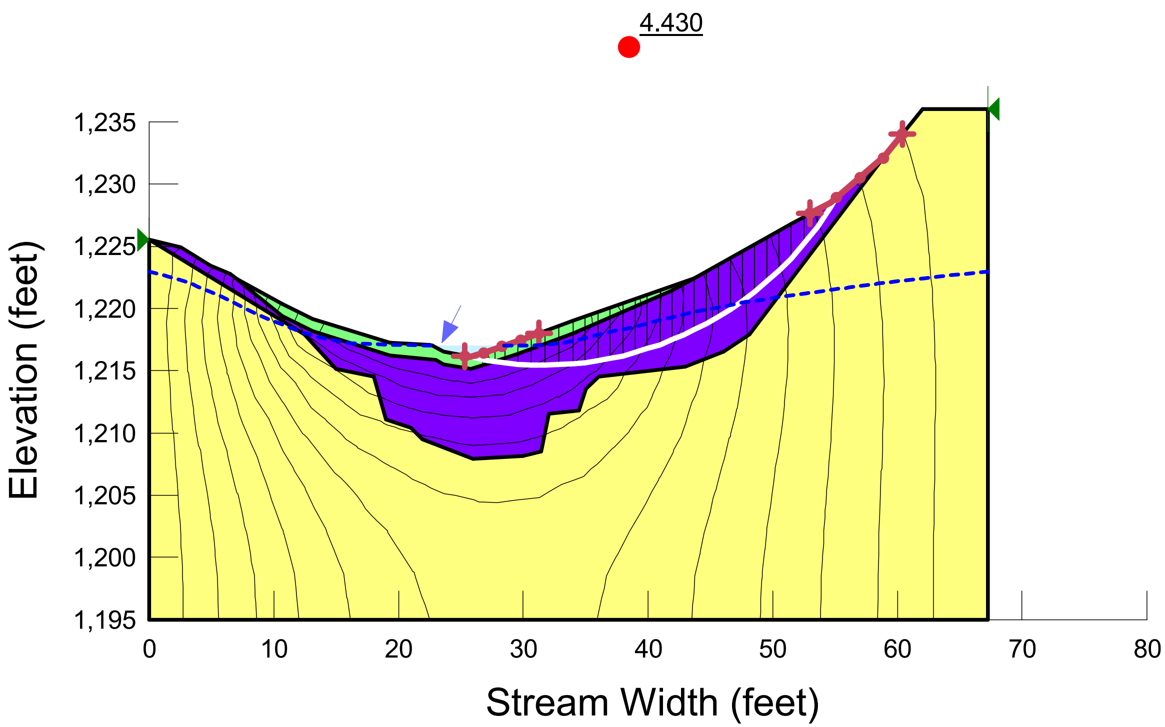
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	6" D-50 Gravel	Mohr-Coulomb	125	0	36
	Cohesive Backfill (Drained)	Mohr-Coulomb	115	0	26
	Native Soils (Drained)	Mohr-Coulomb	115	0	28

Furnace Creek Station 1+00 - Proposed Improvements
Designed By: Zach Mickel Date: 07/23/2019
Checked By: Jeff Van Pelt Date: 07/23/2019



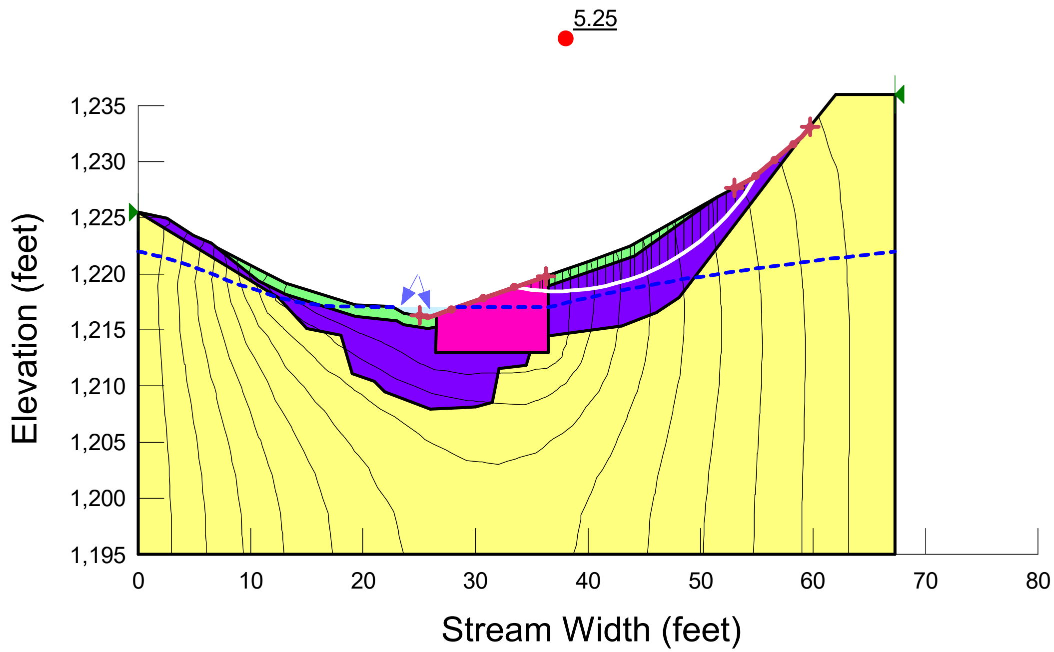
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	6" D-50 Gravel	Mohr-Coulomb	125	0	36
	Cohesive Backfill (Drained)	Mohr-Coulomb	115	0	26
	Native Soils (Drained)	Mohr-Coulomb	115	0	28
	Buttress	Mohr-Coulomb	135	0	42

Furnace Creek Station 1+00 - Post-Construction Conditions
Assumed Cohesive Backfill (Undrained)
Designed By: Zach Mickel Date: 07/23/2019
Checked By: Jeff Van Pelt Date: 07/23/2019



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Native Soils (Undrained)	Mohr-Coulomb	115	500	0
	6" D-50 Gravel	Mohr-Coulomb	125	0	36
	Cohesive Backfill (Undrained)	Mohr-Coulomb	115	500	0

Furnace Creek Station 1+00 - Proposed Improvements
Designed By: Zach Mickel Date: 07/23/2019
Checked By: Jeff Van Pelt Date: 07/23/2019



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Native Soils (Undrained)	Mohr-Coulomb	115	500	0
	6" D-50 Gravel	Mohr-Coulomb	125	0	36
	Cohesive Backfill (Undrained)	Mohr-Coulomb	115	500	0
	Buttress	Mohr-Coulomb	135	0	42

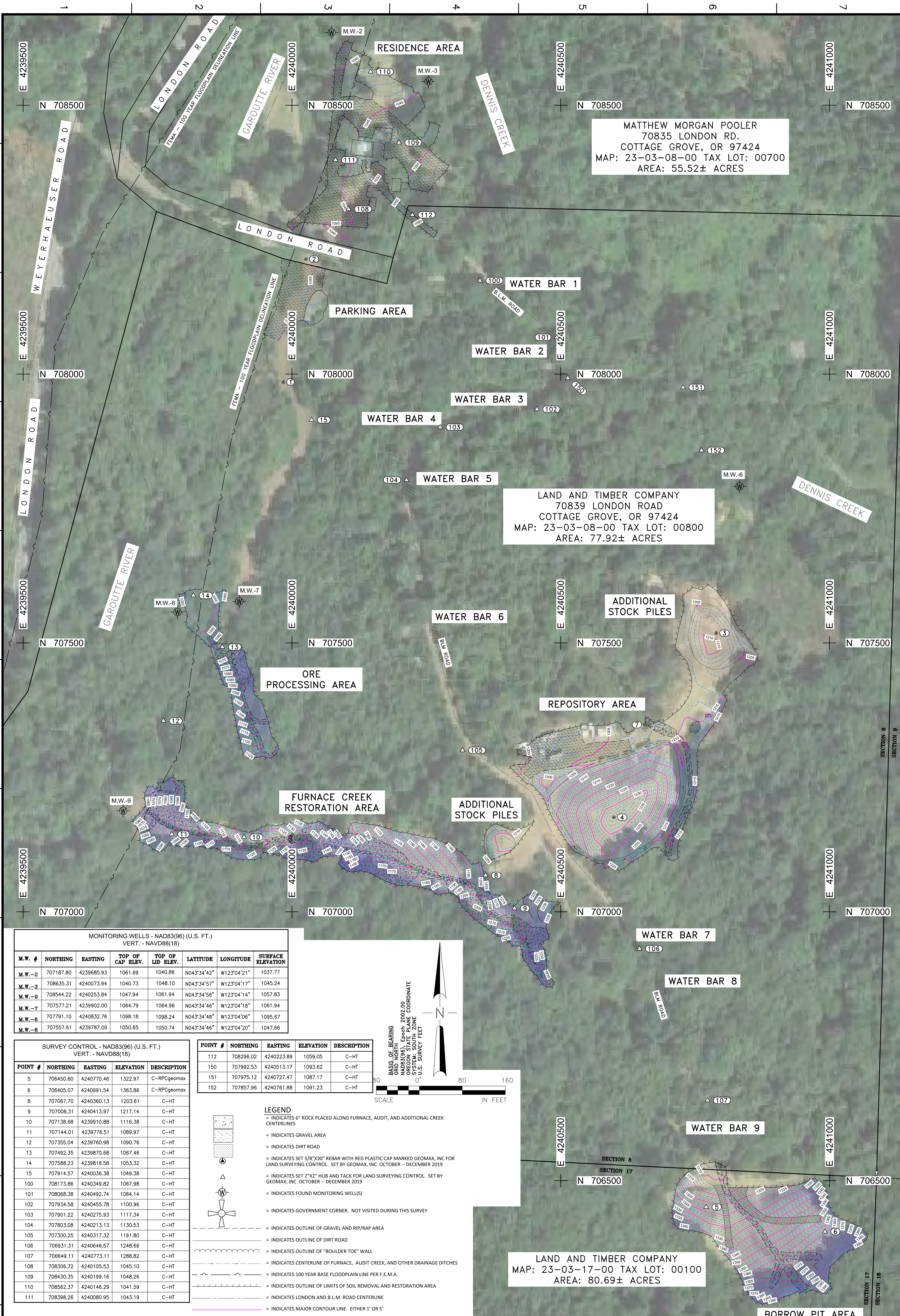
General Notes*:

1. Regrade eroded area into existing hillside at maximum 2H:1V slope (3H:1V slopes preferred, if possible) and stabilize with logs and woody debris.
2. Install rock-lined stormwater channels to convey water from exposed seep locations. Stormwater channel locations shall be determined by field engineer and shall tie into existing rock-lined channel. Field engineer should verify that stormwater channels are constructed to drain and contain no high points.
3. Perform maintenance on the bench area / access road as shown on Sheet C10 of the OPWA Implementation Plan Figures.

*These notes provide general construction guidance based on field observations; final construction decisions to be made by the OSC.

H Final Record Drawings Survey

This page intentionally left blank.



MONITORING WELLS - NAD83(96) (U.S. FT.)
VERT. - NAVD88(18)

M.W. #	NORTHING	EASTING	TOP OF CAP ELEV.	TOP OF LID ELEV.	LATITUDE	LONGITUDE	SURFACE ELEVATION
M.W.-2	707187.80	4239685.93	1061.69	1040.86	N043°34'42"	W123°04'21"	1037.77
M.W.-3	708635.31	4240073.94	1040.73	1048.10	N043°34'57"	W123°04'17"	1045.24
M.W.-9	708544.22	4240253.84	1047.94	1061.94	N043°34'56"	W123°04'14"	1057.83
M.W.-7	707577.21	4239902.00	1064.79	1064.96	N043°34'46"	W123°04'18"	1061.94
M.W.-6	707791.10	4240832.76	1098.18	1098.24	N043°34'48"	W123°04'06"	1095.67
M.W.-8	707557.61	4239787.09	1050.65	1050.74	N043°34'46"	W123°04'20"	1047.66

SURVEY CONTROL - NAD83(96) (U.S. FT.)
VERT. - NAVD88(18)

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
5	706450.60	4240770.46	1322.97	C-RPCgeomax
6	706405.07	4240991.54	1363.86	C-RPCgeomax
8	707067.70	4240360.13	1203.61	C-HT
9	707006.31	4240413.97	1217.14	C-HT
10	707138.68	4239910.88	1116.38	C-HT
11	707144.01	4239776.51	1089.97	C-HT
12	707355.04	4239760.98	1090.76	C-HT
13	707492.35	4239870.68	1067.46	C-HT
14	707588.23	4239816.58	1053.32	C-HT
15	707914.57	4240036.38	1049.38	C-HT
100	708173.86	4240349.82	1067.98	C-HT
101	708068.38	4240492.74	1084.14	C-HT
102	707934.58	4240455.78	1100.96	C-HT
103	707901.22	4240275.93	1117.34	C-HT
104	707803.08	4240213.13	1130.53	C-HT
105	707300.25	4240317.32	1191.80	C-HT
106	706931.31	4240646.57	1248.66	C-HT
107	706649.11	4240773.11	1288.82	C-HT
108	708306.72	4240105.53	1045.10	C-HT
109	708430.35	4240199.16	1048.26	C-HT
110	708562.37	4240146.29	1041.59	C-HT
111	708398.26	4240080.95	1043.19	C-HT

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
112	708296.02	4240223.89	1059.05	C-HT
150	707992.53	4240513.17	1093.62	C-HT
151	707975.12	4240727.47	1087.17	C-HT
152	707857.96	4240761.88	1091.23	C-HT

LEGEND

= INDICATES 6" ROCK PLACED ALONG FURNACE, AUDIT, AND ADDITIONAL CREEK CENTERLINES

= INDICATES GRAVEL AREA

= INDICATES DIRT ROAD

= INDICATES SET 5/8"X30" REBAR WITH RED PLASTIC CAP MARKED GEOMAX, INC FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019

= INDICATES SET 2"X2" HUB AND TACK FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019

= INDICATES FOUND MONITORING WELL(S)

= INDICATES GOVERNMENT CORNER. NOT VISITED DURING THIS SURVEY

= INDICATES OUTLINE OF GRAVEL AND RIP/RAP AREA

= INDICATES OUTLINE OF DIRT ROAD

= INDICATES OUTLINE OF "BOULDER TOE" WALL

= INDICATES CENTERLINE OF FURNACE, AUDIT CREEK, AND OTHER DRAINAGE DITCHES

= INDICATES 100 YEAR BASE FLOODPLAIN LINE PER F.E.M.A.

= INDICATES OUTLINE OF LIMITS OF SOIL REMOVAL AND RESTORATION AREA

= INDICATES LONDON AND B.L.M. ROAD CENTERLINE

= INDICATES MAJOR CONTOUR LINE. EITHER 1' OR 5'

= INDICATES MINOR CONTOUR LINE. EITHER 0.2' OR 1'

SHEET NO. S1
PROJECT NO. T124
FILE NO. T124-BLACK BUTTE_US SURVEY.DWG
CHECKED BY M.C.W.
DRAFTER M.C.W.
DATE 12/13/2019

AS-BUILT SURVEY OF:

BLACK BUTTE MINE SUPERFUND SITE

S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

FOR:

ENVIRONMENTAL QUALITY MANAGEMENT, INC

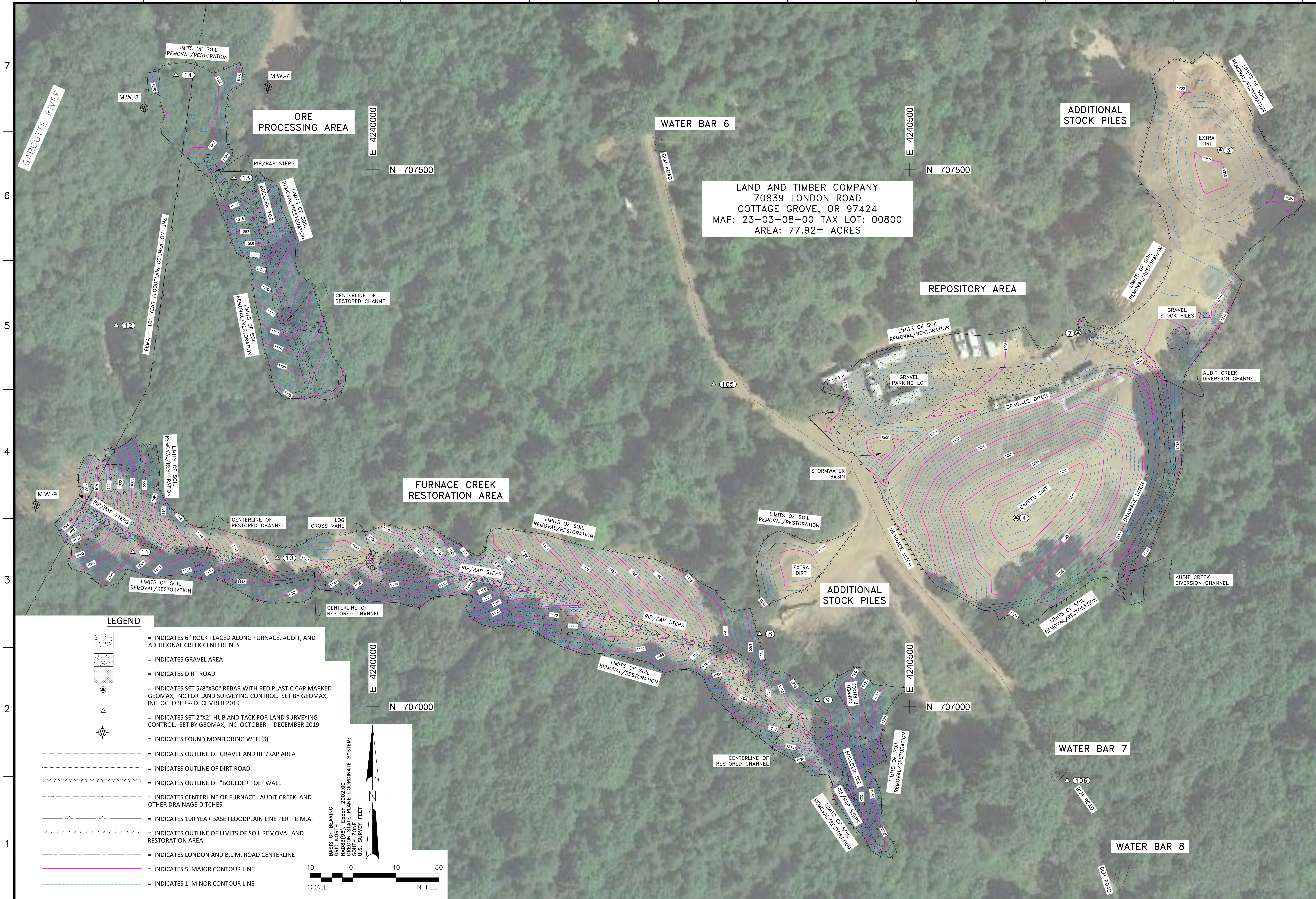
PURCHASE ORDER: 023159

Geomax INC.

ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE- (541) 942-0126 FAX- (541) 942-7935

REVISIONS:

REGISTERED PROFESSIONAL LAND SURVEYOR
PRELIMINARY
NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR
OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224
RENEWS: JUNE 30, 2020



REGISTERED PROFESSIONAL LAND SURVEYOR

PRELIMINARY

NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR

OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224

RENEWS: JUNE 30, 2020

REVISIONS:

Geomax INC.

ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE- (541) 942-0126 FAX- (541) 942-7935

AS-BUILT SURVEY OF:

BLACK BUTTE MINE SUPERFUND SITE

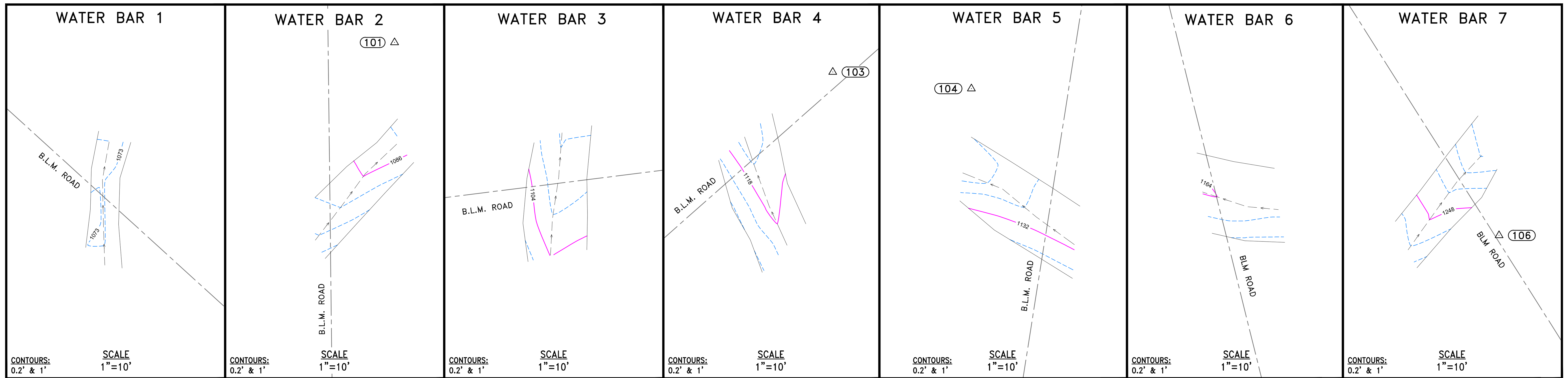
S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

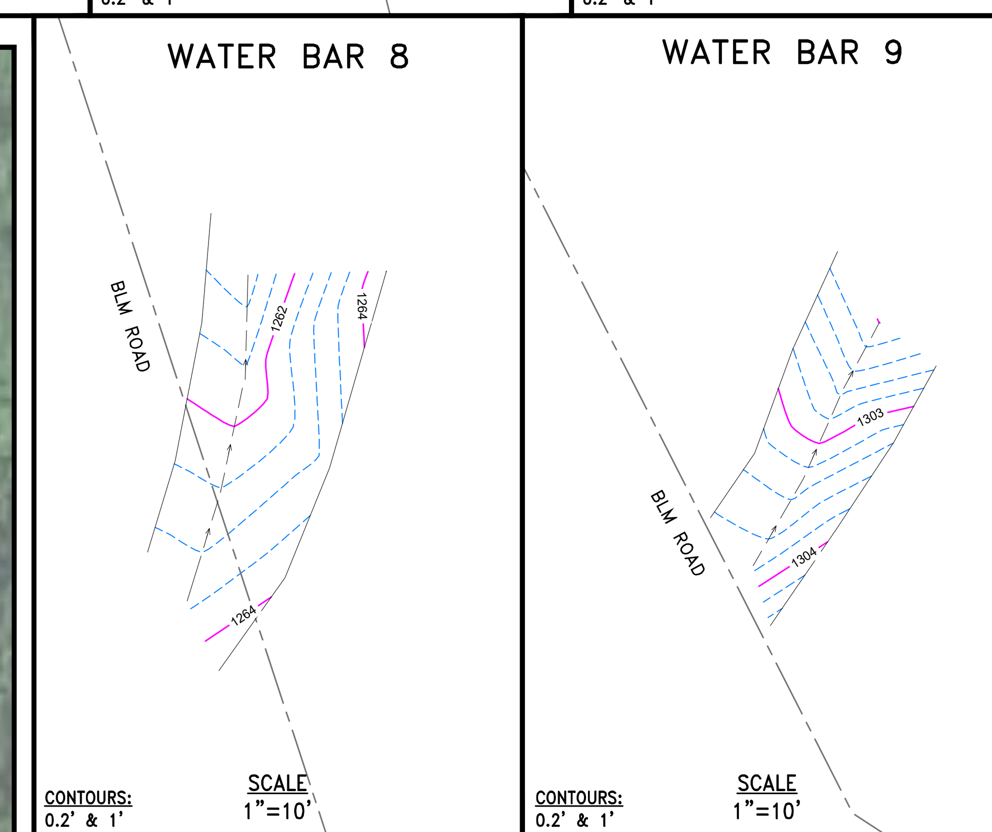
FOR:

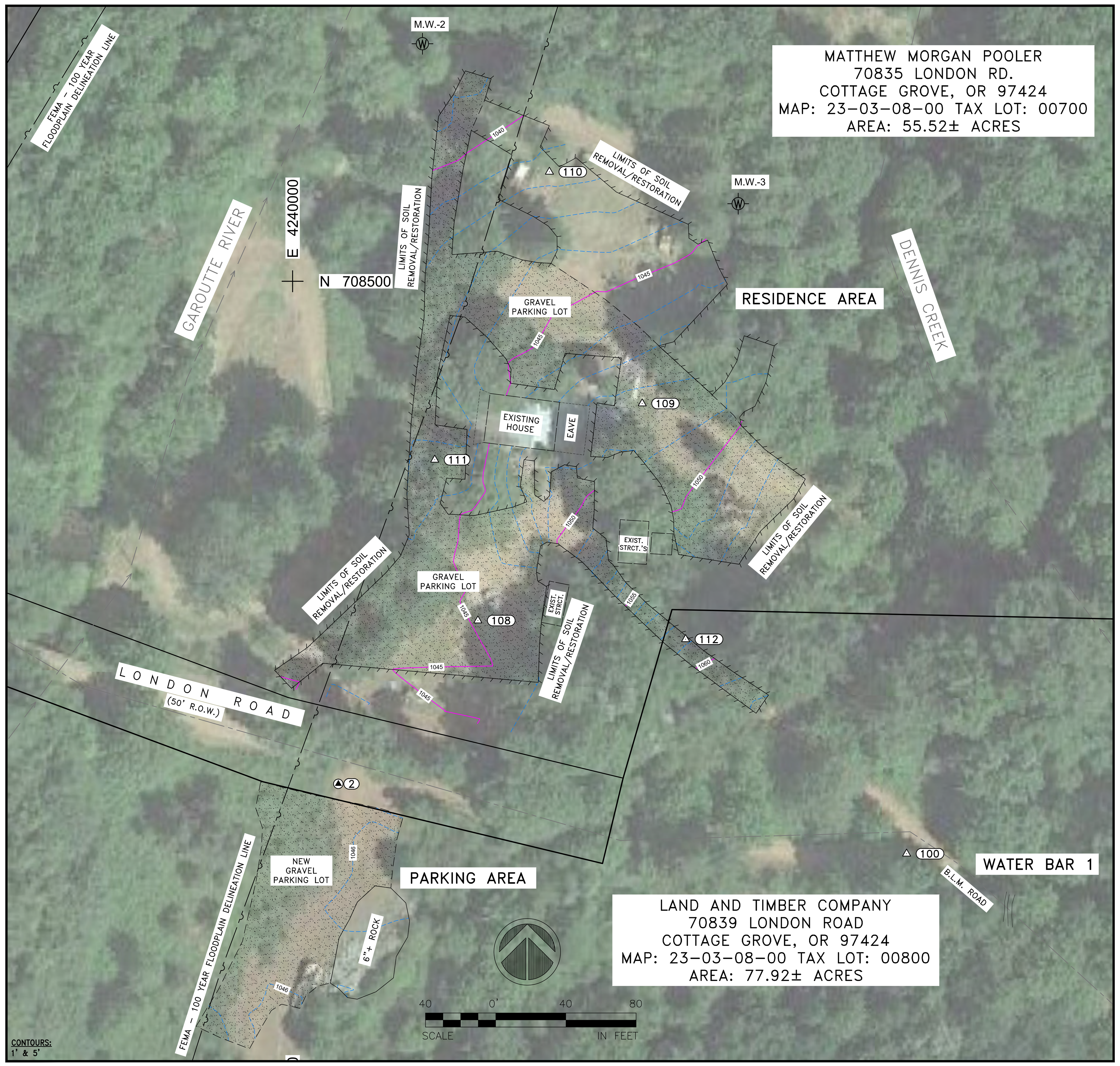
ENVIRONMENTAL QUALITY MANAGEMENT, INC

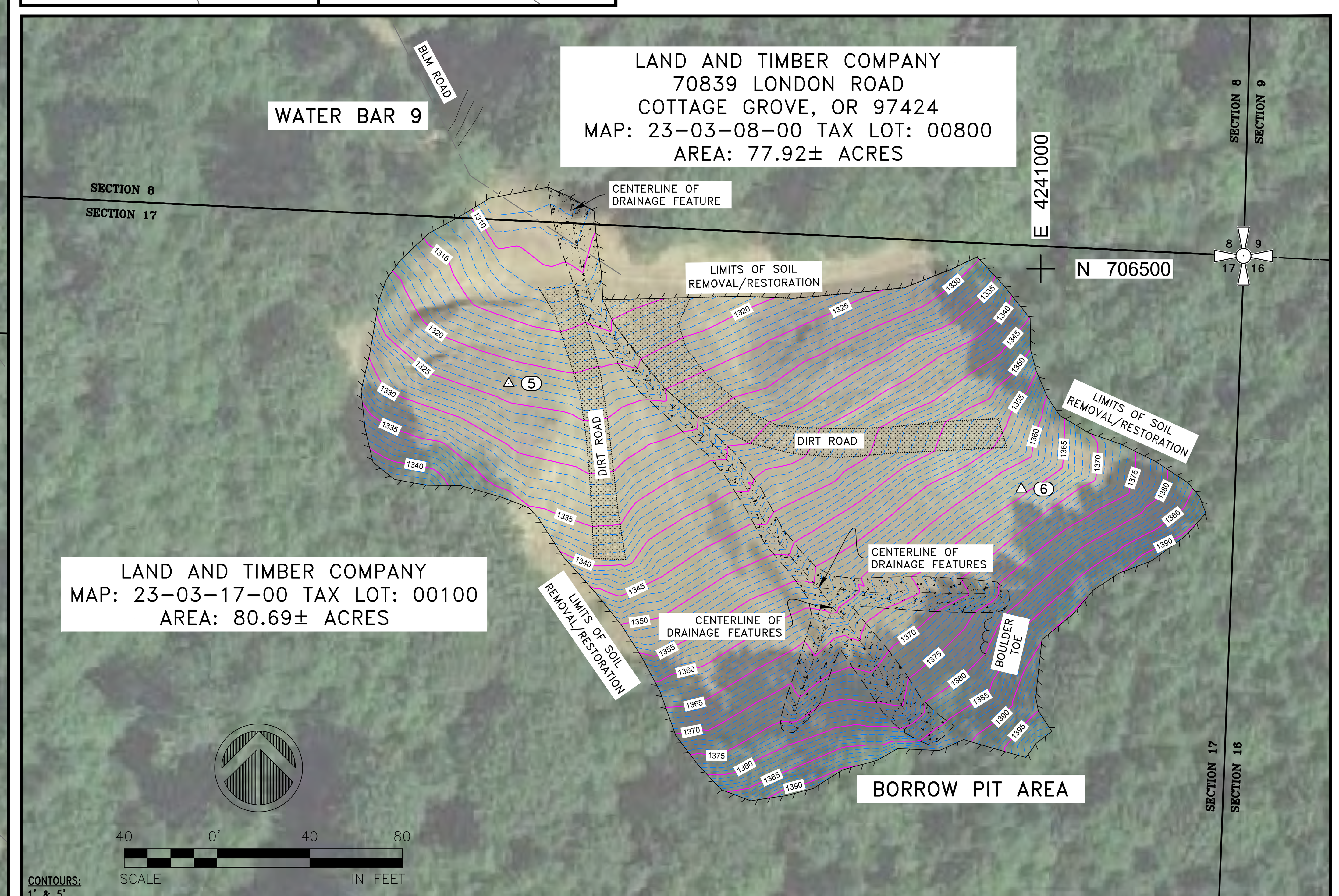
PURCHASE ORDER: 023159

DATE	12/16/2019
DRAFTER	M.C.W.
CHECKED BY	M.C.W.
FILE NO.	T124-BLACK BUTTE_US SURVEY.DWG
PROJECT NO.	T124
SHEET NO.	S2









LEGEND

- = INDICATES 6" ROCK PLACED ALONG FURNACE, AUDIT, AND ADDITIONAL CREEK CENTERLINES
- = INDICATES GRAVEL AREA
- = INDICATES DIRT ROAD
- = INDICATES SET 5/8"X30" REBAR WITH RED PLASTIC CAP MARKED GEOMAX, INC FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019
- = INDICATES SET 2"X2" HUB AND TACK FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019
- = INDICATES FOUND MONITORING WELL(S)
- = INDICATES GOVERNMENT CORNER. NOT VISITED DURING THIS SURVEY
- = INDICATES OUTLINE OF GRAVEL AND RIP/RAP AREA
- = INDICATES OUTLINE OF DIRT ROAD
- = INDICATES OUTLINE OF "BOULDER TOE" WALL
- = INDICATES CENTERLINE OF FURNACE, AUDIT CREEK, AND OTHER DRAINAGE DITCHES
- = INDICATES 100 YEAR BASE FLOODPLAIN LINE PER F.E.M.A.
- = INDICATES OUTLINE OF LIMITS OF SOIL REMOVAL AND RESTORATION AREA
- = INDICATES LONDON AND B.L.M. ROAD CENTERLINE
- = INDICATES MAJOR CONTOUR LINE. EITHER 1' OR 5'
- = INDICATES MINOR CONTOUR LINE. EITHER 0.2' OR 1'

REGISTERED PROFESSIONAL LAND SURVEYOR
PRELIMINARY
NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR
OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224
RENEWS: JUNE 30, 2020

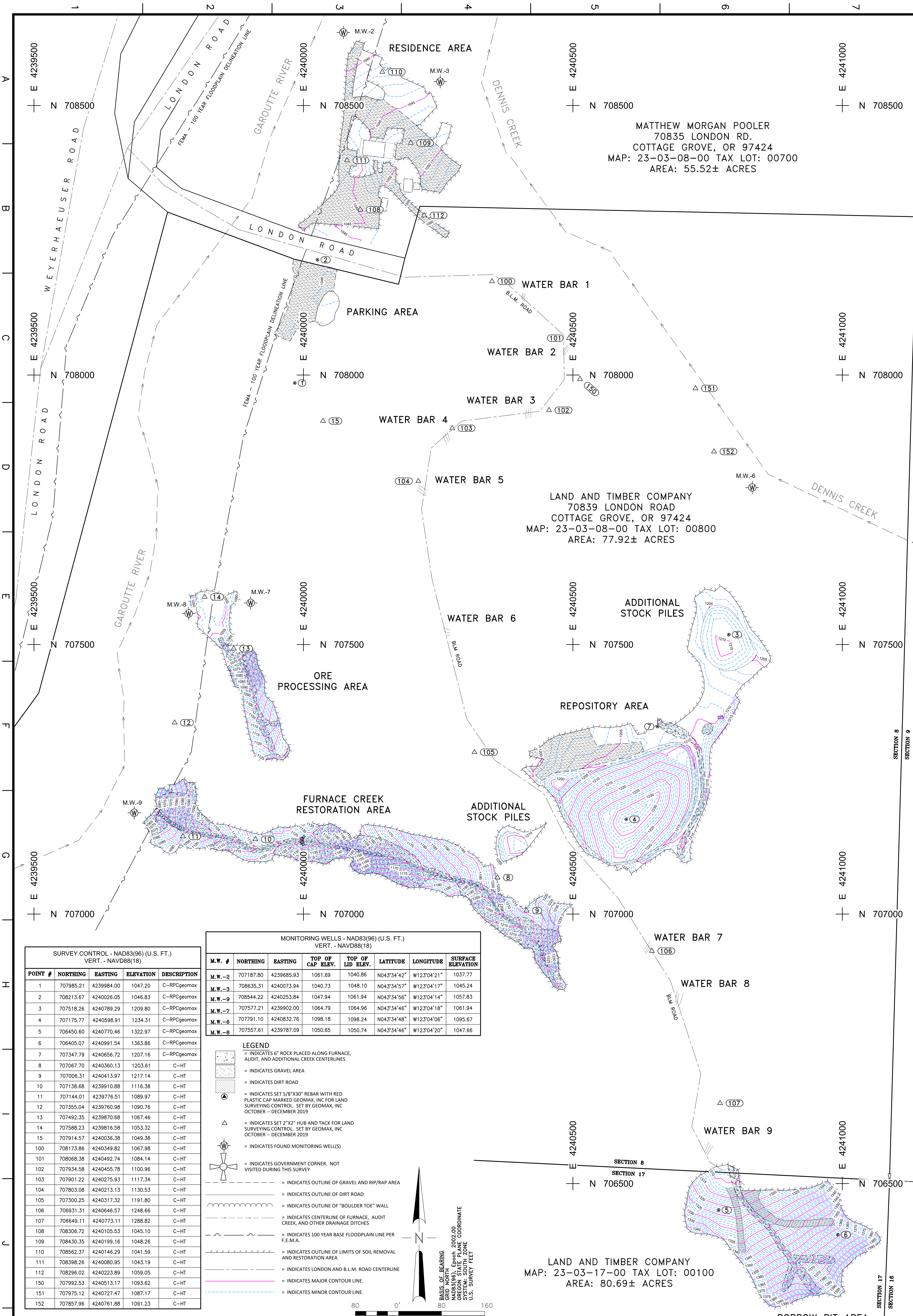
REVISIONS:

Geomax INC.
ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE:- (541) 942-0126 FAX:- (541) 942-7935

AS-BUILT SURVEY OF:
BLACK BUTTE MINE SUPERFUND SITE
S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

FOR:
ENVIRONMENTAL QUALITY MANAGEMENT, INC
PURCHASE ORDER: 023159

DATE	12/16/2019
DRAFTER	M.C.W.
CHECKED BY	M.C.W.
FILE NO.	T124-BLACK BUTTE_US SURVEY.DWG
PROJECT NO.	T124
SHEET NO.	S3



SURVEY CONTROL - NAD83(96) (U.S. FT.)
VERT. - NAVD88(18)

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	707985.21	4239984.00	1047.20	C-RPCgeomax
2	708213.67	4240026.05	1046.83	C-RPCgeomax
3	707518.26	4240789.29	1209.80	C-RPCgeomax
4	707175.77	4240598.91	1234.31	C-RPCgeomax
5	706450.60	4240770.46	1322.97	C-RPCgeomax
6	706405.07	4240991.54	1363.86	C-RPCgeomax
7	707347.79	4240656.72	1207.16	C-RPCgeomax
8	707067.70	4240360.13	1203.61	C-HT
9	707006.31	4240413.97	1217.14	C-HT
10	707138.68	4239910.88	1116.38	C-HT
11	707144.01	4239776.51	1089.97	C-HT
12	707355.04	4239760.98	1090.76	C-HT
13	707492.35	4239870.68	1067.46	C-HT
14	707588.23	4239816.58	1053.32	C-HT
15	707914.57	4240036.38	1049.38	C-HT
100	708173.86	4240349.82	1067.98	C-HT
101	708068.38	4240492.74	1084.14	C-HT
102	707934.58	4240455.78	1100.96	C-HT
103	707901.22	4240275.93	1117.34	C-HT
104	707803.08	4240213.13	1130.53	C-HT
105	707300.25	4240317.32	1191.80	C-HT
106	706931.31	4240646.57	1248.66	C-HT
107	706649.11	4240773.11	1288.82	C-HT
108	708306.72	4240105.53	1045.10	C-HT
109	708430.35	4240199.16	1048.26	C-HT
110	708562.37	4240146.29	1041.59	C-HT
111	708398.26	4240080.95	1043.19	C-HT
112	708296.02	4240223.89	1059.05	C-HT
150	707992.53	4240513.17	1093.62	C-HT
151	707975.12	4240727.47	1087.17	C-HT
152	707857.96	4240761.88	1091.23	C-HT

MONITORING WELLS - NAD83(96) (U.S. FT.)
VERT. - NAVD88(18)

M.W. #	NORTHING	EASTING	TOP OF CAP ELEV.	TOP OF LID ELEV.	LATITUDE	LONGITUDE	SURFACE ELEVATION
M.W.-2	707187.80	4239685.93	1061.69	1040.86	N043°34'42"	W123°04'21"	1037.77
M.W.-3	708635.31	4240073.94	1040.73	1048.10	N043°34'57"	W123°04'17"	1045.24
M.W.-9	708544.22	4240253.84	1047.94	1061.94	N043°34'56"	W123°04'14"	1057.83
M.W.-7	707577.21	4239902.00	1064.79	1064.96	N043°34'46"	W123°04'18"	1061.94
M.W.-6	707791.10	4240832.76	1098.18	1098.24	N043°34'48"	W123°04'06"	1095.67
M.W.-8	707557.61	4239787.09	1050.65	1050.74	N043°34'46"	W123°04'20"	1047.66

LEGEND

= INDICATES 6" ROCK PLACED ALONG FURNACE, AUDIT, AND ADDITIONAL CREEK CENTERLINES

= INDICATES GRAVEL AREA

= INDICATES DIRT ROAD

= INDICATES SET 5/8"X30" REBAR WITH RED PLASTIC CAP MARKED GEOMAX, INC FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019

= INDICATES SET 2"X2" HUB AND TACK FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019

= INDICATES FOUND MONITORING WELL(S)

= INDICATES GOVERNMENT CORNER. NOT VISITED DURING THIS SURVEY

= INDICATES OUTLINE OF GRAVEL AND RIP/RAP AREA

= INDICATES OUTLINE OF DIRT ROAD

= INDICATES OUTLINE OF "BOULDER TOE" WALL

= INDICATES CENTERLINE OF FURNACE, AUDIT CREEK, AND OTHER DRAINAGE DITCHES

= INDICATES 100 YEAR BASE FLOODPLAIN LINE PER F.E.M.A.

= INDICATES OUTLINE OF LIMITS OF SOIL REMOVAL AND RESTORATION AREA

= INDICATES LONDON AND B.L.M. ROAD CENTERLINE

= INDICATES MAJOR CONTOUR LINE.

= INDICATES MINOR CONTOUR LINE.

SHEET NO. S1

PROJECT NO. T124

FILE NO. T124-BLACK BUTTE_AS SURVEY.DWG

CHECKED BY M.C.W.

DRAFTER M.C.W.

DATE 12/13/2019

AS-BUILT SURVEY OF:

BLACK BUTTE MINE SUPERFUND SITE

S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

FOR:

ENVIRONMENTAL QUALITY MANAGEMENT, INC

PURCHASE ORDER: 023159

Geomax INC.

ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE- (541) 942-0126 FAX- (541) 942-7935

REVISIONS:

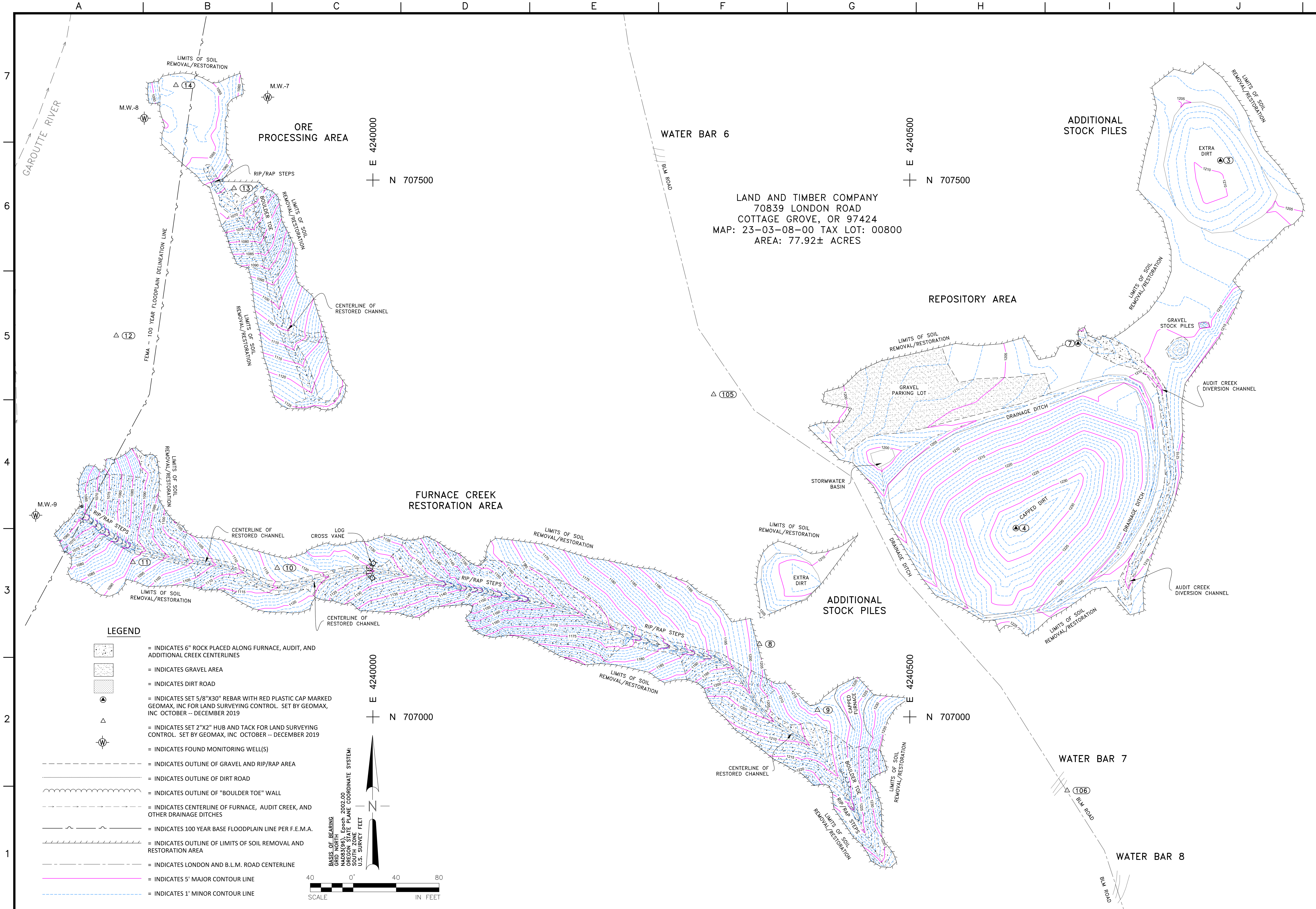
REGISTERED PROFESSIONAL LAND SURVEYOR

PRELIMINARY

NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR

OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224

RENEWS: JUNE 30, 2020



REGISTERED PROFESSIONAL LAND SURVEYOR

PRELIMINARY

NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR

OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224

RENEWS: JUNE 30, 2020

REVISIONS:

Geomax INC.

ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE- (541) 942-0126 FAX- (541) 942-7935

AS-BUILT SURVEY OF:
BLACK BUTTE MINE SUPERFUND SITE
S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

FOR:
ENVIRONMENTAL QUALITY MANAGEMENT, INC
PURCHASE ORDER: 023159

DATE 12/16/2019

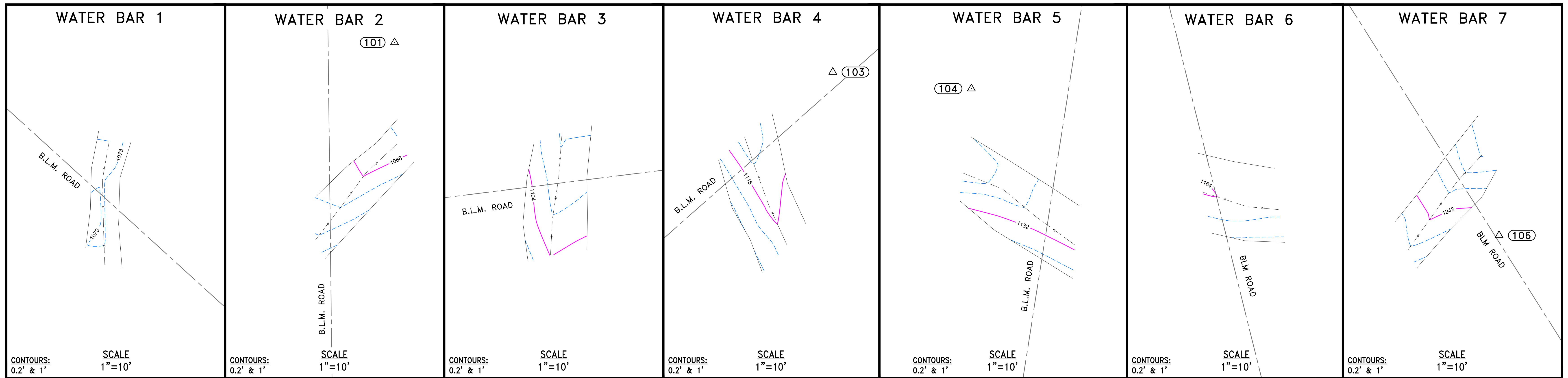
DRAFTER M.C.W.

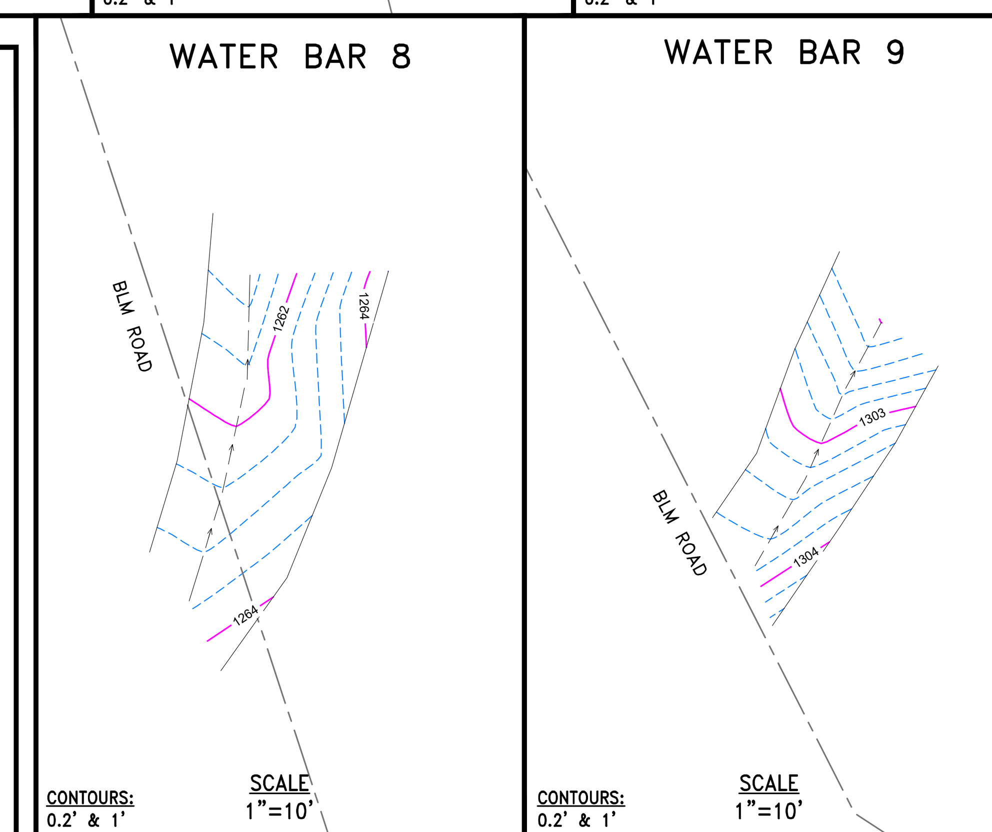
CHECKED BY M.C.W.

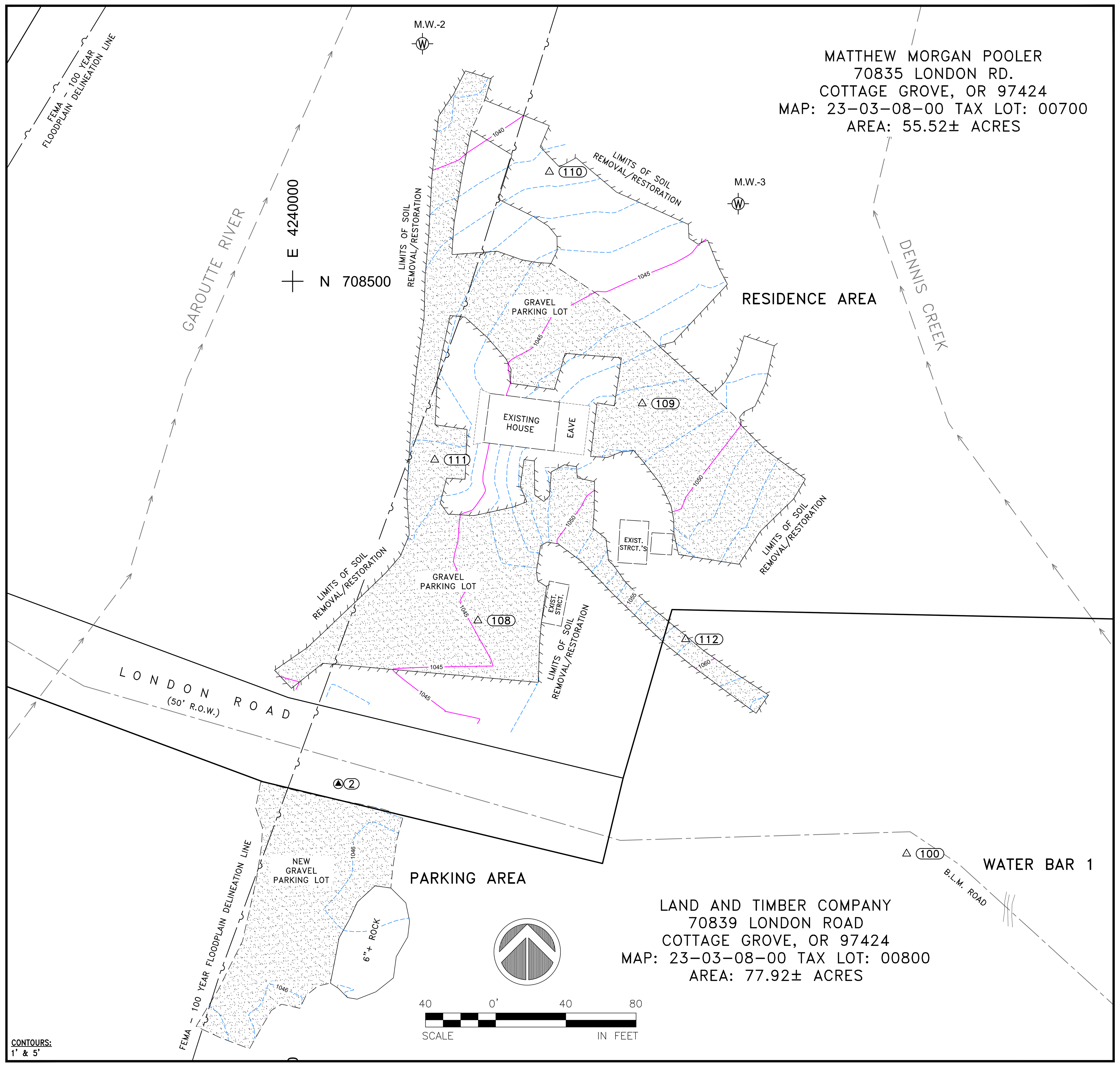
FILE NO. T124-BLACK BUTTE_US SURVEY.DWG

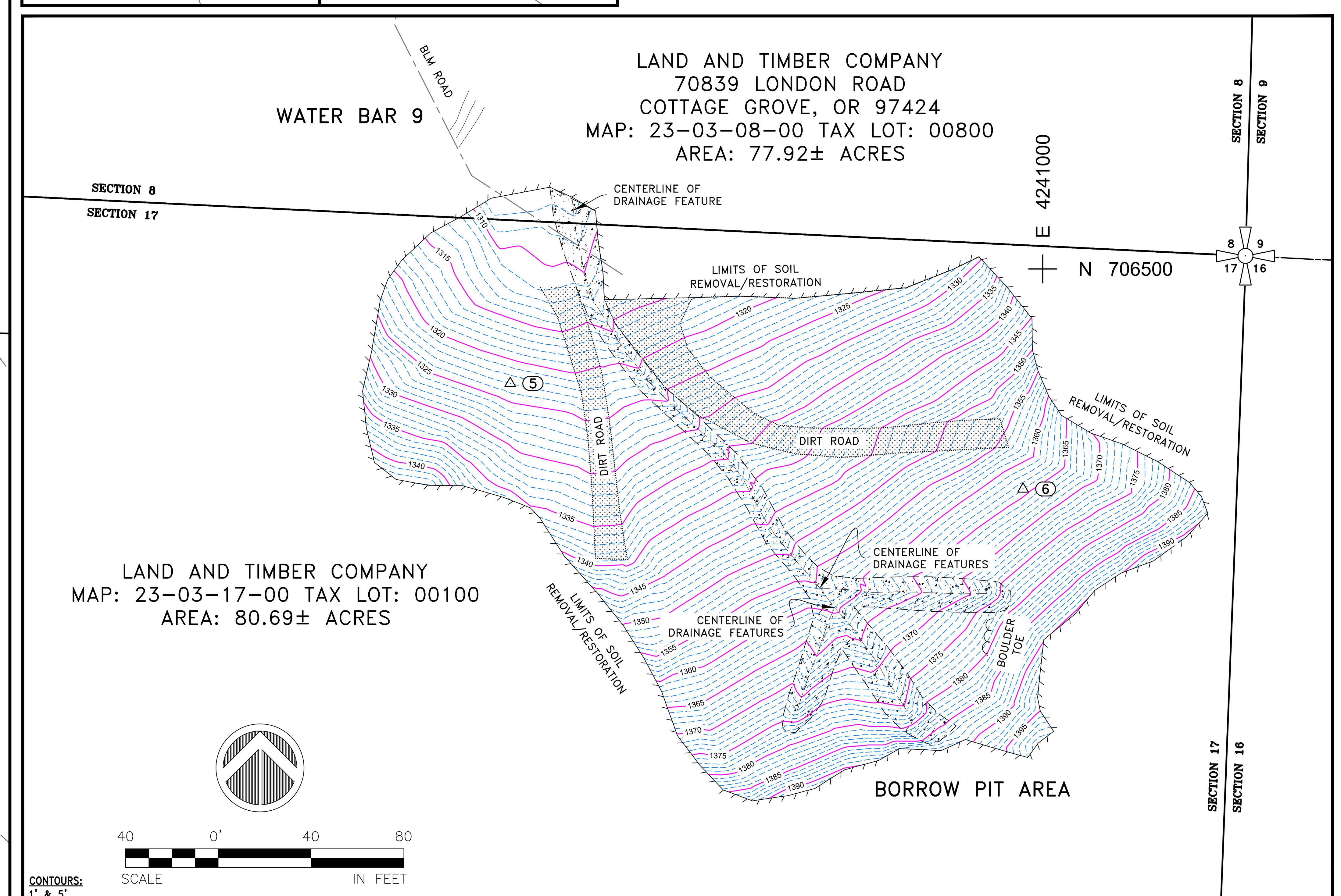
PROJECT NO. T124

SHEET NO. S2









LEGEND

- = INDICATES 6" ROCK PLACED ALONG FURNACE, AUDIT, AND ADDITIONAL CREEK CENTERLINES
- = INDICATES GRAVEL AREA
- = INDICATES DIRT ROAD
- = INDICATES SET 5/8"X30" REBAR WITH RED PLASTIC CAP MARKED GEOMAX, INC FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019
- = INDICATES SET 2"X2" HUB AND TACK FOR LAND SURVEYING CONTROL. SET BY GEOMAX, INC OCTOBER -- DECEMBER 2019
- = INDICATES FOUND MONITORING WELL(S)
- = INDICATES GOVERNMENT CORNER. NOT VISITED DURING THIS SURVEY
- = INDICATES OUTLINE OF GRAVEL AND RIP/RAP AREA
- = INDICATES OUTLINE OF DIRT ROAD
- = INDICATES OUTLINE OF "BOULDER TOE" WALL
- = INDICATES CENTERLINE OF FURNACE, AUDIT CREEK, AND OTHER DRAINAGE DITCHES
- = INDICATES 100 YEAR BASE FLOODPLAIN LINE PER F.E.M.A.
- = INDICATES OUTLINE OF LIMITS OF SOIL REMOVAL AND RESTORATION AREA
- = INDICATES LONDON AND B.L.M. ROAD CENTERLINE
- = INDICATES MAJOR CONTOUR LINE. EITHER 1' OR 5'
- = INDICATES MINOR CONTOUR LINE. EITHER 0.2' OR 1'

REGISTERED PROFESSIONAL LAND SURVEYOR
PRELIMINARY
NO COPIES SHALL BE MADE OR DISTRIBUTED WITHOUT APPROVAL OF THIS SURVEYOR
OREGON
DECEMBER 06, 2011
MACKENZIE C. WYNTERGREEN
84224
RENEWS: JUNE 30, 2020

REVISIONS:

Geomax INC.
ENGINEERING, LAND SURVEYING, BUILDING DESIGN
806 N. NINTH STREET COTTAGE GROVE, OREGON 97424
TELEPHONE:- (541) 942-0126 FAX:- (541) 942-7935

AS-BUILT SURVEY OF:
BLACK BUTTE MINE SUPERFUND SITE
S.E. 1/4 SEC. 8 & N.E. 1/4 SEC.17, T.23S., R.03W., W.M.

FOR:
ENVIRONMENTAL QUALITY MANAGEMENT, INC
PURCHASE ORDER: 023159

DATE: 12/16/2019
DRAFTER: M.C.W.
CHECKED BY: M.C.W.
FILE NO.: T124-BLACK BUTTE_US SURVEY.DWG
PROJECT NO.: T124
SHEET NO.: S3

December 16, 2019

Geomax INC.
PROFESSIONAL ENGINEERS
LAND SURVEYORS
BUILDING DESIGNERS
806 N. NINTH STREET COTTAGE GROVE, OR 97424
PHONE (541)942-0126 FAX (541)942-7935
EMAIL: geomax@geomax.us

Attn: Bryan Chernick, Response Manager
Environmental Quality Management, Inc
18939 120th Avenue NE, Suite 103
Bothell, Washington 98011

Re: As-built of Black Butte Mine Superfund Restoration Site – OU1 Areas
70839 London Road
Cottage Grove, Oregon 97424
Map: S.E. ¼ Section 8, Township 23 South, Range 3 West, Williamette Meridian. Tax Lot: 800
Map: N.E. ¼ Section 17, Township 23 South, Range 3 West, Williamette Meridian. Tax Lot: 100
Date of field work: October 21st through December 9th, 2019

Dear Bryan:

The intent of this report is to outline the process and procedures used throughout the As-Built Topographic Survey of the Black Butte Mine Superfund Site by Geomax, Inc. On October 21st, 2019 Purchase Order number 023159 was issued to Geomax, Inc for the field work and mapping as outlined in Environmental Quality Management, Inc's (E.Q.M.) request for proposal (R.F.P.). The R.F.P. described items to be field surveyed and mapped for seven (7) areas and eight (8) Monitoring Wells within the "OU1" site.

Party Chief Nick Romano under the supervision of Professional Land Surveyor (OR PLS-84224) Mackenzie (Mick) Wyntergreen collected field data from October 21st through December 9th, 2019. During these multiple site visits the weather was the usual Pacific Northweset rain and overcast, with temperatures ranging from 40°-60°F. No major spikes or weather events were observed during the seven weeks needed to collect the necessary as-built data. In order to accurately show all features and break lines Party Chief Nick Romano single handedly took over 2500 topographic measurements from 31 control points. Geomax control points consisted of seven (7) 5/8"x30" rebar with red plastic cap marked "Geomax, Inc", with the remaining twenty four (24) control points being standard 2"x2" hub and tack.

Primary control coordinates were brought onto site from Continuous Operating Reference Station's (C.O.R.S.'s) having published coordinates by the National Geodetic Survey (N.G.S.). N.G.S. maintains the C.O.R.S. to ensure their accuracy and provide access to the U.S. National Spatial Reference System (N.S.R.S.). This project held C.O.R.S. for both horizontal and vertical control. Initial baselines were established via 45 minute static observations which were post processed utilizing N.G.S.'s On-line Positioning User Service - Rapid Static (OPUS-RS). Adjusted coordinates from OPUS-RS were in the NAD83(11), Epoch 2010.00 horizontal and NAVD(18) vertical datum. Per the R.F.P. instructions the coordinates were then translated to the NAD83(96), 2002.00 horizontal datum and projected to the Oregon State Plane - South Zone (3602), with U.S. Survey feet as the units.
Three (3) closed Terrestrial traverses were run to lay out control throughout the site. The initial open ended traverse utilized two baselines, starting from the northwest parking lot and closing into the

borrow area in the southeast. During the course of this survey three un-adjusted terrestrial traverses all had linear mis-closures better than 1/10,000, which were then adjusted using the "Compass Rule" method.

After site control had been established and adjusted, radial side-shots were collected in the following seven (7) areas, as outlined in the R.F.P.:

1. Furnace Creek restoration area, including an additional area "capped furnace"
2. Repository and constructed Adit Creek diversion channel area
3. Former Ore Processing Wastewater area
4. Borrow area
5. Mine Residence removal area, including the Parking area utilized for this survey
6. Nine (9) Water Diversion areas
7. Recent Soil Stockpile areas, near Furnace Creek and near Adit Creek
8. Six (6) Monitoring Wells, with measurements taken at the inside lid, ground surface, and on the top of lid per directions from E.Q.M. Per the R.F.P. monitoring well numbers 4 and 5 were to be part of this survey, but were not found during the course of the field work.

After December 9th, all topographic data was drafted in Autocad Civil 3D (2013), with multiple TIN surfaces created and displayed as 1' minor and 5' major contours. Point tables for site control and found monitoring wells were also created and displayed using Autocad Civil 3D.

Geomax, Inc regularly checks the level bubbles on the tripod tribrauch's and bi-pod rods, and compares E.D.M. measurements to known N.G.S. baselines for all equipment that is used in the collection of field data. A Topcon SR (#1209-12055) dual frequency GNSS receiver and Topcon PS103A (#AF0120) robotic instrument with a Topcon FC-5000 (#182812) tablet data collector was used throughout this project.

Geomax, Inc and I appreciate the opportunity to have worked on and deliver all products attached with this report, as well as the field work that has already been accomplished. This has been a really interesting project with a rich history behind it.

Sincerely,

Mackenzie (Mick) Wyntergreen, P.L.S. - 84224

REGISTERED
PROFESSIONAL
LAND SURVEYOR

DRAFT

OREGON
DECEMBER 6, 2011
MACKENZIE C. WYNTERGREEN
84224
RENEWS: 06/30/2020

The following tables show the control and monitoring wells established or found during Geomax, Inc's as-built survey of the Black Butte Mine Superfund Restoration Site.

MONITORING WELLS - NAD83(96) (U.S. FT.) VERT. - NAVD88(18)							
M.W. #	NORTHING	EASTING	TOP OF CAP ELEV.	TOP OF LID ELEV.	LATITUDE	LONGITUDE	SURFACE ELEVATION
M.W.-2	707187.80	4239685.93	1061.69	1040.86	N043°34'42"	W123°04'21"	1037.77
M.W.-3	708635.31	4240073.94	1040.73	1048.10	N043°34'57"	W123°04'17"	1045.24
M.W.-9	708544.22	4240253.84	1047.94	1061.94	N043°34'56"	W123°04'14"	1057.83
M.W.-7	707577.21	4239902.00	1064.79	1064.96	N043°34'46"	W123°04'18"	1061.94
M.W.-6	707791.10	4240832.76	1098.18	1098.24	N043°34'48"	W123°04'06"	1095.67
M.W.-8	707557.61	4239787.09	1050.65	1050.74	N043°34'46"	W123°04'20"	1047.66

SURVEY CONTROL - NAD83(96) (U.S. FT.) VERT. - NAVD88(18)				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	707985.21	4239984.00	1047.20	C-RPCgeomax
2	708213.67	4240026.05	1046.83	C-RPCgeomax
3	707518.26	4240789.29	1209.80	C-RPCgeomax
4	707175.77	4240598.91	1234.31	C-RPCgeomax
5	706450.60	4240770.46	1322.97	C-RPCgeomax
6	706405.07	4240991.54	1363.86	C-RPCgeomax
7	707347.79	4240656.72	1207.16	C-RPCgeomax
8	707067.70	4240360.13	1203.61	C-HT
9	707006.31	4240413.97	1217.14	C-HT
10	707138.68	4239910.88	1116.38	C-HT
11	707144.01	4239776.51	1089.97	C-HT
12	707355.04	4239760.98	1090.76	C-HT
13	707492.35	4239870.68	1067.46	C-HT
14	707588.23	4239816.58	1053.32	C-HT
15	707914.57	4240036.38	1049.38	C-HT
100	708173.86	4240349.82	1067.98	C-HT
101	708068.38	4240492.74	1084.14	C-HT
102	707934.58	4240455.78	1100.96	C-HT
103	707901.22	4240275.93	1117.34	C-HT
104	707803.08	4240213.13	1130.53	C-HT
105	707300.25	4240317.32	1191.80	C-HT
106	706931.31	4240646.57	1248.66	C-HT
107	706649.11	4240773.11	1288.82	C-HT
108	708306.72	4240105.53	1045.10	C-HT
109	708430.35	4240199.16	1048.26	C-HT
110	708562.37	4240146.29	1041.59	C-HT
111	708398.26	4240080.95	1043.19	C-HT
112	708296.02	4240223.89	1059.05	C-HT
150	707992.53	4240513.17	1093.62	C-HT
151	707975.12	4240727.47	1087.17	C-HT
152	707857.96	4240761.88	1091.23	C-HT

This page intentionally left blank.

I Validation Memoranda

This page intentionally left blank.

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: June 25, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of two soil samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Coarse Fragments (ASA Monograph No. 9, Part 1, Method 15-5), Soil Reactivity (pH - ASA Monograph No. 9, Part 2, Method 10-3.2), Electrical Conductivity (EC, mmhos/cm - ASA Monograph No. 9, Part 2, Method 10-3), Sodium Adsorption Ratio (SAR - ASA Monograph No. 9, Part 2, Method 10-3.4.45), Saturation Percent (USDA Handbook 60, Method 27a), Organic Matter Content, ASA Monograph No. 9, Part 1, Method 29-3), and Available Water Holding Capacity (Soil Science Society of America, Part 4) analyses were performed by A&L Western Laboratories, Inc., Portland, Oregon. All sample analyses were evaluated following EPA's Stage 2 Data Validation Manual Process (S2VM).

The samples were numbered: BS001 BS002

Data Qualifications:

The samples were collected on June 13, 2018, and were analyzed by June 21, 2018.

A total of 38 results were validated in this data memorandum. The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

173
OR-166-024

SOIL SAMPLE INFORMATION SHEET

A & L WESTERN AGRICULTURAL LABORATORIES, INC.

MODESTO OFFICE
1311 WOODLAND AVENUE, SUITE #1 • MODESTO, CA 95351 • (209) 529-4080 FAX (209) 529-4736

PORTLAND OFFICE
10220 S.W. NIMBUS AVE., BLDG K-9 • PORTLAND, OR 97223 • (503) 968-9225 FAX (503) 598-7702

LAB. USE ONLY

Please print S10 Est. H2O cap.

N / W / E / S

CUSTOMER	GROWER	SUBMITTED BY
TestAmerica / Kris Allen		E&E / Steve Hall
5755 8th St. E		720 Third Ave, Ste 1700
Tacoma, WA 98424		Seattle, WA 98104
PHONE NO: 253-922-2310 4290	PHONE NO:	PHONE NO: 206-920-1739

☐ Graphics Report ($1.00 per sample) ☐ Fax Report ( ) ☑ Email Report (email address required) sghall@ene.com

SAMPLE ID (5 CHARACTERS)	S1B	S1BN	S2	S2N	S3C	S10C	TEXTURE	NEMATODE	OTHER ANALYSES	CROP OR PLANT TYPE	PREVIOUS CROP OR PLANT TYPE	PLANTING DATES	SAMPLE DEPTH	AMENDMENTS APPLIED	METHOD OF IRRIGATION
BS001 59831							✓		S10; OM; Water Holding Capacity 58A						

CHECK BOX IF RECOMMENDATIONS REQUIRED ☐ LBS PER ACRE ☐ LBS PER 1,000 SQ FT ☐

EXPLANATION OF TESTS (SUBMIT ABOUT TWO CUPS OF SOIL PER SAMPLE)

S1B: BASIC SOIL ANALYSIS. Organic matter estimated nitrogen release, phosphorus (weak Bray and sodium bicarbonate-P), potassium, magnesium, calcium, sodium, sulfate-sulfur, soil pH, buffer pH, C.E.C. and percent cation saturation (computed).
S1BN: BASIC SOIL ANALYSIS plus nitrate-nitrogen.
S2: BASIC SOIL ANALYSIS plus soluble salts and excess lime.
S2N: BASIC SOIL ANALYSIS plus soluble salts, excess lime, and nitrate-nitrogen.
S3C: COMPLETE ANALYSIS. BASIC SOIL ANALYSIS (plus soluble salts, excess lime, nitrate-nitrogen, Zn, Mn, Fe, Cu, and B).
S10C: COMPLETE ANALYSIS plus saturation percentage, SAR, ESP, carbonate, bicarbonate, chloride, and saturated paste boron.
NOTE: Strong Bray Phosphorus may be substituted for Sodium Bicarbonate Phosphorus in S1B package. Ask for package S1A.

NO_3-N = Nitrate - N
SO_4-S = Sulfate - S
Zn = Zinc
Mn = Manganese
Fe = Iron
Cu = Copper
B = Boron
Mo = Molybdenum
Cl = Chloride

PRINT NAME OF SAMPLER Steve Hall
SIGNATURE OF SAMPLER [signature]
DATE SAMPLES SUBMITTED 6/13/2018

06/21/2018

OR-166-025 174

SOIL SAMPLE INFORMATION SHEET

A & L WESTERN AGRICULTURAL LABORATORIES, INC.

MODESTO OFFICE
1311 WOODLAND AVENUE, SUITE #1 • MODESTO, CA 95351 • (209) 529-4080 FAX (209) 529-4736

PORTLAND OFFICE
10220 S.W. NIMBUS AVE., BLDG K-9 • PORTLAND, OR 97223 • (503) 968-9225 FAX (503) 598-7702

LAB USE ONLY

Please print S10 Est H_2O Cap.

W E S

CUSTOMER	GROWER	SUBMITTED BY
TestAmerica / Kris Allen		E&E / Steve Hall
5755 8th St. E		720 Third Ave, Ste 1700
Tacoma, WA 98424		Seattle, WA 98104
PHONE NO: 253-922-2310 4290	PHONE NO:	PHONE NO: 206-920-1739

☐ Graphics Report ($1.00 per sample) ☐ Fax Report (____) ☑ Email Report (email address required) sghall@ene.com

SAMPLE ID (5 CHARACTERS)	S1B	S1BN	S2	S2N	S3C	S10C	TEXTURE	NEMATODE	OTHER ANALYSES 5*9	CROP OR PLANT TYPE	PREVIOUS CROP OR PLANT TYPE	PLANTING DATES	SAMPLE DEPTH	AMENDMENTS APPLIED	METHOD OF IRRIGATION
56 BS002	59832						✓		S10; Om; Water Holding Capacity 58*						

CHECK BOX IF RECOMMENDATIONS REQUIRED ☐ LBS PER ACRE ☐ LBS PER 1,000 SQ FT ☐

EXPLANATION OF TESTS (SUBMIT ABOUT TWO CUPS OF SOIL PER SAMPLE)

S1B: BASIC SOIL ANALYSIS. Organic matter estimated nitrogen release, phosphorus (weak Bray and sodium bicarbonate-P), potassium, magnesium, calcium, sodium, sulfate-sulfur, soil pH, buffer pH, C.E.C. and percent cation saturation (computed).
S1BN: BASIC SOIL ANALYSIS plus nitrate-nitrogen.
S2: BASIC SOIL ANALYSIS plus soluble salts and excess lime.
S2N: BASIC SOIL ANALYSIS plus soluble salts, excess lime, and nitrate-nitrogen.
S3C: COMPLETE ANALYSIS. BASIC SOIL ANALYSIS (plus soluble salts, excess lime, nitrate-nitrogen, Zn, Mn, Fe, Cu, and B).
S10C: COMPLETE ANALYSIS plus saturation percentage, SAR, ESP, carbonate, bicarbonate, chloride, and saturated paste boron.
NOTE: Strong Bray Phosphorus may be substituted for Sodium Bicarbonate Phosphorus in S1B package. Ask for package S1A.

NO_3-N = Nitrate - N
SO_4-S = Sulfate - S
Zn = Zinc
Mn = Manganese
Fe = Iron
Cu = Copper
B = Boron
Mo = Molybdenum
Cl = Chloride

PRINT NAME OF SAMPLER Steve Hall
SIGNATURE OF SAMPLER [signature]
DATE SAMPLES SUBMITTED 6/13/2018

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 18-166-173

CLIENT: 4290

SUBMITTED BY: E&E/STEVE HALL

SEND TO: TESTAMERICA ANALTRICAL TEST CORP
5755 8TH ST E
TACOMA, WA 98424

GROWER: KRIS ALLEN

DATE OF REPORT: 06/20/18

SOIL ANALYSIS REPORT

Sample ID	Lab Number		Estimated Water Holding Capacity (%)	Estimated Available Water (inches/foot)				
BS001	59831		53.8	1.6				

NOTES: Estimated water holding capacity multiplied by 0.03 approximates the available water in inches per foot depth of soil.

Estimated available water capacity is that held between field capacity and wilting point in inches per foot depth of soil.

MW 6-25-18

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 18-166-174 **CLIENT:** 4290

SUBMITTED BY: E&E/STEVE HALL

SEND TO: TESTAMERICA ANALTRICAL TEST CORP
5755 8TH ST E
TACOMA, WA 98424

GROWER: KRIS ALLEN

DATE OF REPORT: 06/20/18

SOIL ANALYSIS REPORT

Sample ID	Lab Number		Estimated Water Holding Capacity (%)	Estimated Available Water (inches/foot)				
BS002	59832		53.0	1.6				

NOTES: Estimated water holding capacity multiplied by 0.03 approximates the available water in inches per foot depth of soil.

Estimated available water capacity is that held between field capacity and wilting point in inches per foot depth of soil.

MW 6-25-18

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

06/21/2018

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 18-166-173 **CLIENT:** 4290

SUBMITTED BY: KRIS ALLEN

SEND TO: TESTAMERICA ANALYTICAL TEST CORP
5755 8TH STREET EAST
TACOMA, WA 98242

GROWER: E&E STEVE HALL

DATE OF REPORT: 06/20/18

SOIL SALINITY ANALYSIS REPORT

PAGE: 1

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
BS001	59831	0.1	< 0.1	0.1	1.1	0.5	6.0	0.0	0.8	0.3	0.4	0.1	57.5

NOTES:

MW 6-25-18

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

A&L LABORATORIES AGRICULTURAL • ENVIRONMENTAL • INDUSTRIAL

REPORT NUMBER: 18-166-174 **CLIENT:** 4290

SUBMITTED BY: KRIS ALLEN

SEND TO: TESTAMERICA ANALYTICAL TEST CORP
5755 8TH STREET EAST
TACOMA, WA 98242

GROWER: E&E STEVE HALL

DATE OF REPORT: 06/20/18

SOIL SALINITY ANALYSIS REPORT

PAGE: 1

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
BS002	59832	0.2	< 0.1	0.2	0.8	0.3	5.4	0.0	0.8	0.2	0.1	0.1	54.8

NOTES:

MW 6-25-18

Rogell Rogers
Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

10220 S.W. NIMBUS AVE | BUILDING K-9 | PORTLAND, OREGON 97223 | (503) 968-9225 | FAX (503) 598-7702

A&L LABORATORIES AGRICULTURAL • ENVIRONMENTAL • INDUSTRIAL

REPORT NUMBER: 18-166-173

CLIENT NO:

SEND TO: TESTAMERICA ANALYTICAL TESTING CORP
5755 8TH STREET EAST
TACOMA, WA 98424-

SUBMITTED BY: KRIS ALLEN

GROWER: E&E STEVE HALL

DATE OF REPORT: 06/20/18

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter * % Rating	Organic Matter ** ENR lbs/A	Phosphorus P1 (Weak Bray) **** * ppm	Phosphorus $NaHCO_3$-P (OlsenMethod) **** * ppm	Potassium K ***** * ppm	Magnesium Mg *** * ppm	Calcium Ca *** * ppm	Sodium Na *** * ppm	pH Soil pH	pH Buffer Index	Hydrogen H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	PERCENT CATION SATURATION (COMPUTED) K %	Mg %	Ca %	H %	Na %
BS001	59831	8.8VH	207															

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
BS001												47	34	19	LOAM

MW 6-25-18

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC

A & L WESTERN AGRICULTURAL LABORATORIES

10220 S.W. NIMBUS AVE | BUILDING K-9 | PORTLAND, OREGON 97223 | (503) 968-9225 | FAX (503) 598-7702

A&L LABORATORIES AGRICULTURAL • ENVIRONMENTAL • INDUSTRIAL

REPORT NUMBER: 18-166-174

CLIENT NO:

SEND TO: TESTAMERICA ANALYTICAL TESTING CORP
5755 8TH STREET EAST
TACOMA, WA 98424-

SUBMITTED BY: KRIS ALLEN

GROWER: E&E STEVE HALL

DATE OF REPORT: 06/20/18

SOIL ANALYSIS REPORT

PAGE: 1

SAMPLE ID	LAB NUMBER	Organic Matter * % Rating	Organic Matter ** ENR lbs/A	Phosphorus P1 (Weak Bray) **** * ppm	Phosphorus NaHCO3-P (OlsenMethod) **** * ppm	Potassium K ***** * ppm	Magnesium Mg *** * ppm	Calcium Ca *** * ppm	Sodium Na *** * ppm	pH Soil pH	pH Buffer Index	Hydrogen H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	PERCENT CATION SATURATION (COMPUTED) K %	Mg %	Ca %	H %	Na %
BS002	59832	6.5VH	159															

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
BS002												41	34	25	LOAM

MW 6/25/18

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEPTH

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: July 12, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of one soil sample collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Organic Matter Content, Available Water Holding Capacity, Soil Salinity, and Particle Size analyses were performed by A&L Western Laboratories, Inc., Portland, Oregon, and Modesto, California. All sample analyses were evaluated following EPA's Stage 1 Data Validation Manual Process (S1VM).

The sample was numbered: BS83C

Data Qualifications:

The sample was collected on July 2, 2018, and was analyzed by July 6, 2018.

A total of 18 results were validated in this data memorandum. The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

78705

SOIL SAMPLE INFORMATION SHEET

A & L WESTERN AGRICULTURAL LABORATORIES, INC.

MODESTO OFFICE
1311 WOODLAND AVENUE, SUITE #1 • MODESTO, CA 95351 • (209) 529-4080 FAX (209) 529-4736
PORTLAND OFFICE
10220 S.W. NIMBUS AVE., BLDG K-9 • PORTLAND, OR 97223 • (503) 968-9225 FAX (503) 598-7702

LAB USE ONLY

CUSTOMER	GROWER	SUBMITTED BY
Test America / Kris Allen		E&E / Maren Fulton
5755 8th St. E		720 Third Ave, Ste 1700
Tacoma, WA 98424		Seattle, WA 98104
PHONE NO: 253-922-2310	PHONE NO:	PHONE NO: 206-920-1739

N / W / E / S

☐ Graphics Report ($1.00 per sample) ☐ Fax Report (____) ☐ Email Report (email address required)

CHECK BOX IF RECOMMENDATIONS REQUIRED ☐ LBS PER ACRE ☐ LBS PER 1,000 SQ FT ☐

SAMPLE ID (5 CHARACTERS)	S1B	S1BN	S2	S2N	S3C	S10C	TEXTURE	NEMATODE	OTHER ANALYSES	CROP OR PLANT TYPE	PREVIOUS CROP OR PLANT TYPE	PLANTING DATES	SAMPLE DEPTH	AMENDMENTS APPLIED	METHOD OF IRRIGATION
B583C							✓		S10; Om Water Holding Capacity						

EXPLANATION OF TESTS (SUBMIT ABOUT TWO CUPS OF SOIL PER SAMPLE)

- S1B: BASIC SOIL ANALYSIS. Organic matter estimated nitrogen release, phosphorus (weak Bray and sodium bicarbonate-P), potassium, magnesium, calcium, sodium, sulfate-sulfur, soil pH, buffer pH, C.E.C. and percent cation saturation (computed).
- S1BN: BASIC SOIL ANALYSIS plus nitrate-nitrogen.
- S2: BASIC SOIL ANALYSIS plus soluble salts and excess lime.
- S2N: BASIC SOIL ANALYSIS plus soluble salts, excess lime, and nitrate-nitrogen.
- S3C: COMPLETE ANALYSIS. BASIC SOIL ANALYSIS (plus soluble salts, excess lime, nitrate-nitrogen, Zn, Mn, Fe, Cu, and B).
- S10C: COMPLETE ANALYSIS plus saturation percentage, SAR, ESP, carbonate, bicarbonate, chloride, and saturated paste boron.

NOTE: Strong Bray Phosphorus may be substituted for Sodium Bicarbonate Phosphorus in S1B package. Ask for package S1A

NO_3-N = Nitrate - N
SO_4-S = Sulfate - S
Zn = Zinc
Mn = Manganese
Fe = Iron
Cu = Copper
B = Boron
Mo = Molybdenum
Cl = Chloride

PRINT NAME OF SAMPLER: Maren Fulton
SIGNATURE OF SAMPLER: [signature]
DATE SAMPLES SUBMITTED: 7/2/18

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 18-184-124

CLIENT: 99999-D

SUBMITTED BY: KRIS ALLEN

SEND TO: TEST AMERICA ANALYTICAL TEST CORP
5755 8TH STREET EAST
TACOMA, WA 98242

GROWER: E & E/MAREN FULTON

DATE OF REPORT: 06/20/18

SOIL ANALYSIS REPORT

Sample ID	Lab Number		Estimated Water Holding Capacity (%)	Estimated Available Water (inches/foot)				
BS83C	58104		45.5	1.4				

8-2-18 MW

NOTES: Estimated water holding capacity multiplied by 0.03 approximates the available water in inches per foot depth of soil.

Estimated available water capacity is that held between field capacity and wilting point in inches per foot depth of soil.

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

A&L LABORATORIES AGRICULTURAL • ENVIRONMENTAL • INDUSTRIAL

REPORT NUMBER: 18-184-124 **CLIENT:** 4290

SUBMITTED BY: KRIS ALLEN

SEND TO: TESTAMERICA ANALYTICAL TEST CORP
5755 8TH STREET EAST
TACOMA, WA 98242

GROWER: E & E/MAREN FULTON

DATE OF REPORT: 07/06/18

SOIL SALINITY ANALYSIS REPORT

PAGE: 1

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
BS83C	58104	0.4	~~<~~ 0.1U	0.2	0.2	0.2	5.2	0.0	0.5	0.1	0.2	0.1	48.5

NOTES:

MW 7-12-18

Rogell Rogers
Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

07/10/2018

A & L WESTERN AGRICULTURAL LABORATORIES

10220 S.W. NIMBUS AVE I BUILDING K-9 I PORTLAND, OREGON 97223 I (503) 968-9225 I FAX (503) 598-7702

REPORT NUMBER: 18-184-124

CLIENT NO:

SEND TO: TESTAMERICA ANALYTICAL TESTING CORP
5755 8TH STREET EAST
TACOMA, WA 98424-

SUBMITTED BY: KRIS ALLEN

GROWER: E & E/MAREN FULTON

DATE OF REPORT: 07/06/18

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter * % Rating	Organic Matter ** ENR lbs/A	Phosphorus P1 (Weak Bray) **** * ppm	Phosphorus $NaHCO_3$-P (OlsenMethod) **** * ppm	Potassium K ***** * ppm	Magnesium Mg *** * ppm	Calcium Ca *** * ppm	Sodium Na *** * ppm	pH Soil pH	pH Buffer Index	Hydrogen H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	PERCENT CATION SATURATION (COMPUTED) K %	Mg %	Ca %	H %	Na %
BS83C	58104	5.2H	133															

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
BS83C												37	34	29	CLAY LOAM

MW 7/24/18

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Rogell Rogers

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: June 4, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 41 soil samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic and mercury analyses (EPA Methods 6010 and 7471) were performed by Environmental Monitoring and Technologies, Inc., Morton Grove, Illinois. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Electronic and/or Manual Process (S2B/4VE/M).

The samples were numbered:

18050003	18050005	18050006	18050009	18050013
18050014	18050015	18050016	18050017	18050020
18050021	18050022	18050025	18050033	18050037
18050038	18050040	18050043	18050046	18050046
18050047	18050048	18050049	18050053	18050054
18050057	18050058	18050059	18050060	18050062
18050064	18050065	18050066	18050070	18050073
18050076	18050077	18050078	18050080	18050081
18050082				

Data Qualifications:

1. **Sample Holding Times: Acceptable.**

The samples were maintained at < 6°C (only applies to mercury). The samples were collected between May 21 and 23, 2018, and were analyzed by May 31, 2018, therefore meeting QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. **Initial and Continuing Calibration: Acceptable.**

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All applicable mid-level ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995.

3. **Blanks: Acceptable.**

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any blanks.

4. **ICP Interference Check Sample: Acceptable.**

An Interference Check Sample (ICS) was analyzed at the beginning of each sequence. All applicable ICS (solution AB) results were within QC limits of 80% - 120% recovery.

5. **Precision and Bias Determination: Not Performed.**

Samples necessary to determine precision and bias were not provided to the laboratory. All results were flagged "PND" (Precision Not Determined) and "RND" (Recovery Not Determined), although the flags do not appear on the data sheets.

6. **Performance Evaluation Sample Analysis: Not Provided.**

Performance evaluation samples were not provided to the laboratory.

7. **ICP Serial Dilution: Acceptable.**

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All serial dilution results were within QC limits.

8. **Matrix Spike Analysis: Satisfactory.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits except arsenic with low recoveries associated with samples 18050009, 18050013, 18050014, 18050015, 18050016, 18050017, 18050020, 18050021, 18050066, 18050070, 18050073, 18050076, 18050077, 18050078, 18050080, 18050081, and18050082; associated positive results and sample quantitation limits were qualified as estimated quantities with a low bias (JL or UJL).

9. **Duplicate Analysis: Acceptable.**

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

10. **Laboratory Control Sample Analysis: Acceptable.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

11. **Overall Assessment of Data for Use**

A total of 82 results were validated in this data memorandum. No sample results were qualified as estimated quantities based on duplicate precision outliers, holding time outliers, incorrect sample containers, or sample temperature outliers, or serial dilution outliers. A total of 17 sample results were qualified as estimated quantities (J) based on spike accuracy outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the OSWER Guidance Document "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures" (EPA/540/G-90/004), the analytical method(s), the EPA Region 10 Emergency Management

Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

CHAIN OF CUSTODY R[E] 18E0844 No: 10-052418-115553-0001

PM: Eva Gaya
Ecology and Environment, Inc.
1004530.0025.001.01

Site #: 10ZZ

5/24/18
Eva Gaya
847-324-3309

Bryan Ciecko
503-308-3264

Lab #	Location	Sample #	Analyses	Matrix	Collected	Sample Time	Preservative	Lab QC	Sampler
	RC03SS	18050003	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/21/2018	15:59	4 C		Ciecko
	RC05SS	18050005	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/21/2018	16:03	4 C		Ciecko
	RC06SS	18050006	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/21/2018	16:07	4 C		Ciecko
	RC09SS	18050009	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/21/2018	16:18	4 C		Ciecko
	RC13SS	18050013	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	08:14	4 C		Fulton
	RC14SS	18050014	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	08:21	4 C		Fulton
	RC15SS	18050015	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	08:32	4 C		Fulton
	RC16SS	18050016	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	09:05	4 C		Fulton
	RC17SS	18050017	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	09:12	4 C		Ciecko
	RC20SS	18050020	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	09:23	4 C		Fulton
	BS02SB02	18050021	EPA 6010 (As) and 7471 (Hg)	Soil Subsurface	5/22/2018	12:57	4 C		Ciecko
	BS03SB04	18050022	EPA 6010 (As) and 7471 (Hg)	Soil Subsurface	5/22/2018	13:00	4 C		Ciecko
	BS05SS	18050025	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	13:17	4 C		Ciecko
	FC01SS	18050033	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	14:35	4 C		Fulton
	FC05SS	18050037	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	14:55	4 C		Fulton
	FC06SS	18050038	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	15:02	4 C		Fulton
	FC08SS	18050040	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	15:11	4 C		Fulton
	FC11SS	18050043	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	15:50	4 C		Fulton

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	[signature] on behalf of EPA	5/24/18 14:00			
			[signature] EMT	5/25/18 1000	3.9° C

55/632

CHAIN OF CUSTODY RECORD

Site #: 10ZZ

No: 10-052418-115553-0001

5/24/18
Eva Gaya
847-324-3309

Bryan Ciecko
503-308-3264

Lab #	Location	Sample #	Analyses	Matrix	Collected	Sample Time	Preservative	Lab QC	Sampler
	FC14SS	18050046	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/22/2018	16:20	4 C		Fulton
	FC15SS	18050047	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	07:42	4 C		Fulton
	FC16SS	18050048	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	07:45	4 C		Ciecko
	FC17SS	18050049	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	07:50	4 C		Ciecko
	FC21SS	18050053	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:05	4 C		Ciecko
	FC22SS	18050054	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:07	4 C		Ciecko
	FC25SS	18050057	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:12	4 C		Ciecko
	FC26SS	18050058	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:20	4 C		Ciecko
	FC27SS	18050059	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:22	4 C		Ciecko
	FC28SS	18050060	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:30	4 C		Ciecko
	FC30SS	18050062	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:35	4 C		Ciecko
	FC32SS	18050064	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:37	4 C		Ciecko
	FC33SS	18050065	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:40	4 C		Ciecko
	FC34SS	18050066	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	08:48	4 C		Fulton
	FC38SS	18050070	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	09:05	4 C		Ciecko
	BS13SS	18050073	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	11:37	4 C		Silvertooth
	BS16SS	18050076	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	11:48	4 C		Fulton
	BS17SS	18050077	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	11:52	4 C		Silvertooth
	BS18SS	18050078	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	11:56	4 C		Fulton

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	[signature] on behalf of EPA	5/24/18 1400			
			[signature] EMT	5/29/18 1000	3.9° C

CHAIN OF CUSTODY RECORD

Site #: 10ZZ

No: 10-052418-115553-0001

5/24/18
Eva Gaya
847-324-3309

Bryan Ciecko
503-308-3264

Lab #	Location	Sample #	Analyses	Matrix	Collected	Sample Time	Preservative	Lab QC	Sampler
	BS20SS	18050080	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	13:08	4 C		Fulton
	BS21SS	18050081	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	13:14	4 C		Fulton
	BS22SS	18050082	EPA 6010 (As) and 7471 (Hg)	Soil Surface	5/23/2018	13:24	4 C		Fulton

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	[signature] on behalf of EPA	5/24/18 1400			
			[signature] EMT	5/29/18 1000	3.9°C

57/632

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

Client:	Ecology and Environment, Inc.		**Client Sample ID:**	18050003
Project:	1004530.0025.001.01		**Report Date:**	06/01/2018
	Site#:10ZZ		**Collection Date:**	05/21/2018 15:59
SDG:	18E0844		**Matrix:**	Soil
			Lab ID:	18E0844-01

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**52.9**	1.40		mg/Kg dry		0.505	1.12	05/29/18 21:14	B8E0987	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**8.31**	6.80	~~D~~	mg/Kg dry		2.27	4.53	05/29/18 10:14	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**87.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:25	B8E0942	TB2	1

mw 6418

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050005
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/21/2018 16:03
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-02

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**98.7**	1.33		mg/Kg dry		0.479	1.06	05/29/18 21:35	B8E0987	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1.68**	0.062		mg/Kg dry		0.021	0.041	05/29/18 10:17	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**88.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:27	B8E0942	TB2	1

Jw 6478

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050006
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/21/2018 16:07
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-03

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**75.1**	1.44		mg/Kg dry		0.517	1.15	05/29/18 21:40	B8E0987	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**7.17**	6.82	~~D~~	mg/Kg dry		2.27	4.55	05/29/18 10:23	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:29	B8E0942	TB2	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client: Ecology and Environment, Inc.
Project: 1004530.0025.001.01
Site#:10ZZ
SDG: 18E0844

Client Sample ID: 18050009
Report Date: 06/01/2018
Collection Date: 05/21/2018 16:18
Matrix: Soil
Lab ID: 18E0844-04

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**161** JL	1.38		mg/Kg dry		0.498	1.11	05/29/18 22:00	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**2.60**	0.637	~~D~~	mg/Kg dry		0.212	0.425	05/29/18 10:28	B8E0983	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**89.7**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:31	B8E0942	TB2	1

MW 6/4/18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050013
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 08:14
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-05

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	79.8 JL	1.40		mg/Kg dry		0.504	1.12	05/29/18 22:04	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**19.1**	6.83	~~D~~ MW	mg/Kg dry		2.28	4.55	05/29/18 10:34	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**85.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:33	B8E0942	TB2	1

MW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050014
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/22/2018 08:21
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-06

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**96.1**	1.43	JL	mg/Kg dry		0.515	1.14	05/29/18 22:09	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1.99**	0.069		mg/Kg dry		0.023	0.046	05/29/18 10:37	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.5**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:35	B8E0942	TB2	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050015
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 08:32
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-07

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	56.9	1.44	JL	mg/Kg dry		0.518	1.15	05/29/18 22:13	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	38.3	6.93	~~D~~ mw	mg/Kg dry		2.31	4.62	05/29/18 10:50	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	86.4	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:37	B8E0942	TB2	1

mw 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050016
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/22/2018 09:05
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-08

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**70.1**	1.42	JL	mg/Kg dry		0.510	1.13	05/29/18 22:34	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**15.0**	6.76		mg/Kg dry		2.25	4.51	05/29/18 10:55	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**87.4**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:39	B8E0942	TB2	1

Jlw 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050017
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/22/2018 09:12
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-09

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**105**	1.37	J	mg/Kg dry		0.494	1.10	05/29/18 22:38	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1.16**	0.065		mg/Kg dry		0.022	0.044	05/29/18 10:58	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:41	B8E0942	TB2	1

JLW 6-4-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050020
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 09:23
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-10

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**98.9**	1.44	JL	mg/Kg dry		0.520	1.15	05/29/18 22:42	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**0.656**	0.069		mg/Kg dry		0.023	0.046	05/29/18 11:01	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.0**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:43	B8E0942	TB2	1

JLM 6-4-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050021
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 15:27
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-11

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**14.4**	1.71	JL	mg/Kg dry		0.617	1.37	05/29/18 23:04	B8E1009	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**0.143**	0.082		mg/Kg dry		0.027	0.055	05/29/18 11:04	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	72.7	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:45	B8E0942	TB2	1

JAN 6/4/18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050022
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 13:00
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-12

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**13.7**	1.57		mg/Kg dry		0.565	1.25	05/30/18 17:51	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**0.122**	0.070		mg/Kg dry		0.023	0.047	05/29/18 11:07	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**77.6**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:47	B8E0942	TB2	1

JW 6-4-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050025
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/22/2018 13:17
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-13

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**8.90**	1.79		mg/Kg dry		0.644	1.43	05/30/18 17:55	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**15.9**	0.859	~~D~~	mg/Kg dry		0.286	0.572	05/29/18 11:16	B8E0983	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**69.0**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:49	B8E0942	TB2	1

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050033
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 14:35
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-14

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**2.22**	1.74		mg/Kg dry		0.626	1.39	05/30/18 18:00	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1.92**	0.083		mg/Kg dry		0.028	0.055	05/29/18 11:18	B8E0983	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**71.3**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:51	B8E0942	TB2	1

Mw 6448

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050037
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 14:55
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-15

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**576**	1.65		mg/Kg dry		0.596	1.32	05/30/18 18:04	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1350**	72.2	~~D~~	mg/Kg dry		24.1	48.1	05/29/18 11:34	B8E0983	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**74.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:53	B8E0942	TB2	1

JW648

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050038
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 15:02
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-16

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**103**	1.62		mg/Kg dry		0.583	1.29	05/30/18 18:09	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1020**	756	~~D~~	mg/Kg dry		252	504	05/29/18 11:50	B8E0983	GSB	10000
Wet Chemistry											
Method: SM2540G											
Total Solids	**72.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:55	B8E0942	TB2	1

JW 6/4/18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050040
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/22/2018 15:11
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-17

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**6.78**	1.56		mg/Kg dry		0.561	1.25	05/30/18 18:30	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**101**	7.77	~~D~~ J	mg/Kg dry		2.59	5.18	05/29/18 13:16	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**72.2**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:57	B8E0942	TB2	1

6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050043
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/22/2018 15:50
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-18

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**239**	1.27		mg/Kg dry		0.457	1.02	05/30/18 18:34	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**237**	66.3	Pmw	mg/Kg dry		22.1	44.2	05/29/18 13:26	B8E0983	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**89.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 14:59	B8E0942	TB2	1

MW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client: Ecology and Environment, Inc.
Project: 1004530.0025.001.01
Site#:10ZZ
SDG: 18E0844

Client Sample ID: 18050046
Report Date: 06/01/2018
Collection Date: 05/22/2018 16:20
Matrix: Soil
Lab ID: 18E0844-19

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**304**	1.51		mg/Kg dry		0.544	1.21	05/30/18 18:38	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**841**	72.2	~~D~~ W	mg/Kg dry		24.1	48.1	05/29/18 13:51	B8E0983	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**80.1**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:01	B8E0942	TB2	1

JW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050047
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 07:42
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-20

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**5.06**	1.74		mg/Kg dry		0.626	1.39	05/30/18 18:43	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**14.1**	8.20	~~D~~ MW	mg/Kg dry		2.73	5.47	05/29/18 13:54	B8E0983	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**70.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:03	B8E0942	TB2	1

MW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050048
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 07:45
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-21

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	< 1.38 U	1.73	~~U~~	mg/Kg dry		0.622	1.38	05/30/18 18:47	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**8.10**	8.73	J, ~~D~~	mg/Kg dry		2.91	5.82	05/31/18 12:49	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**67.7**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:20	B8E0947	TB2	1

JAW 6448

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050049
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 07:50
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-22

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	42.4	1.81		mg/Kg dry		0.653	1.45	05/30/18 18:52	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**160**	8.72	~~D~~ AV	mg/Kg dry		2.91	5.82	05/31/18 12:52	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**67.6**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:22	B8E0947	TB2	1

Uw 6418

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050053
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:05
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-23

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**211**	1.41		mg/Kg dry		0.507	1.13	05/30/18 18:56	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**225**	69.8	~~D~~	mg/Kg dry		23.3	46.5	05/31/18 12:56	B8E1086	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	84.7	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:24	B8E0947	TB2	1

JAW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050054
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:07
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-24

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**4.19**	1.55		mg/Kg dry		0.559	1.24	05/30/18 19:01	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**85.6**	8.28	~~D~~ MW	mg/Kg dry		2.76	5.52	05/31/18 13:06	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**71.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:26	B8E0947	TB2	1

MW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050057
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:12
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-25

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**118**	1.45		mg/Kg dry		0.522	1.16	05/30/18 19:05	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**184**	7.54	~~D~~ PW	mg/Kg dry		2.51	5.03	05/31/18 13:08	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**79.0**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:28	B8E0947	TB2	1

JAW6448

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050058
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/23/2018 08:20
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-26

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**243**	1.41		mg/Kg dry		0.508	1.13	05/30/18 19:10	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**260**	66.4	~~D~~	mg/Kg dry		22.1	44.3	05/31/18 13:13	B8E1086	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**87.1**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:30	B8E0947	TB2	1

MW 6/4/18

experts at providing environmental testing solutions
water • soil • waste • product • sampling

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050059
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:22
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-27

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**223**	1.59		mg/Kg dry		0.571	1.27	05/30/18 19:30	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**418**	750	J, ~~D~~ QA	mg/Kg dry		250	500	05/31/18 13:18	B8E1086	GSB	10000
Wet Chemistry											
Method: SM2540G											
Total Solids	**75.5**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:32	B8E0947	TB2	1

JMW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050060
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/23/2018 08:30
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-28

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**118**	1.52		mg/Kg dry		0.546	1.21	05/30/18 19:35	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**116**	7.49	~~D~~	mg/Kg dry		2.50	5.00	05/31/18 13:21	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**77.3**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:34	B8E0947	TB2	1

JMW 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050062
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:35
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-29

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	336	1.56		mg/Kg dry		0.563	1.25	05/30/18 19:39	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	561	75.1	~~D~~	mg/Kg dry		25.0	50.1	05/31/18 13:25	B8E1086	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	79.4	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:36	B8E0947	TB2	1

llw 6/4/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050064
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:37
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-30

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**6.36**	1.66		mg/Kg dry		0.597	1.33	05/30/18 19:43	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**42.6**	8.27	~~D~~	mg/Kg dry		2.76	5.51	05/31/18 13:28	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**71.4**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:38	B8E0947	TB2	1

Jun 6418

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050065
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 08:40
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-31

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**222**	1.75		mg/Kg dry		0.630	1.40	05/30/18 19:48	B8E1034	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1080**	83.5	~~D~~	mg/Kg dry		27.8	55.7	05/31/18 13:32	B8E1086	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**71.3**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:40	B8E0947	TB2	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050066
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/23/2018 08:48
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-32

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**139**	1.56	JL	mg/Kg dry		0.563	1.25	05/30/18 21:03	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**186**	7.52	~~D~~	mg/Kg dry		2.51	5.01	05/31/18 13:34	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**78.2**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:42	B8E0947	TB2	1

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050070
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 09:05
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-33

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**36.4**	1.67	JL	mg/Kg dry		0.601	1.34	05/30/18 21:07	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**74.6**	7.96		mg/Kg dry		2.65	5.31	05/31/18 13:37	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**73.0**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:44	B8E0947	TB2	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050073
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 11:37
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-34

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**12.0** JL	1.66		mg/Kg dry		0.596	1.32	05/30/18 21:28	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	< 5.25 U	7.88	~~U~~	mg/Kg dry		2.63	5.25	05/31/18 13:44	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**74.9**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:46	B8E0947	TB2	1

JLW 6/4/18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050076
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 11:48
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-35

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**17.3**	2.32	JL	mg/Kg dry		0.834	1.85	05/30/18 21:33	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**32.9**	11.1	~~D~~	mg/Kg dry		3.70	7.41	05/31/18 13:47	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**53.6**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:48	B8E0947	TB2	1

MW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050077
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 11:52
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-36

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**13.4**	1.57	JL	mg/Kg dry		0.565	1.26	05/30/18 21:37	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**11.1**	8.28	~~D~~	mg/Kg dry		2.76	5.52	05/31/18 13:49	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**72.0**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:50	B8E0947	TB2	1

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050078
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 11:56
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-37

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**12.4**	1.83	JL	mg/Kg dry		0.660	1.47	05/30/18 21:41	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**6.72**	8.68	J, D	mg/Kg dry		2.89	5.79	05/31/18 13:51	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**67.2**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:52	B8E0947	TB2	1

JMW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050080
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 13:08
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-38

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**10.3**	1.70	JL	mg/Kg dry		0.613	1.36	05/30/18 21:46	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**14.0**	8.23	~~D~~	mg/Kg dry		2.74	5.49	05/31/18 13:54	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**72.5**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:54	B8E0947	TB2	1

JW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050081
Project:	1004530.0025.001.01 Site#:10ZZ	**Report Date:**	06/01/2018
		Collection Date:	05/23/2018 13:14
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-39

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**4.35** JL	1.66		mg/Kg dry		0.597	1.33	05/30/18 21:50	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**6.82**	7.89	J, ~~D~~ Q	mg/Kg dry		2.63	5.26	05/31/18 13:56	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**70.6**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:56	B8E0947	TB2	1

MW 6-4-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18050082
Project:	1004530.0025.001.01	**Report Date:**	06/01/2018
	Site#:10ZZ	**Collection Date:**	05/23/2018 13:24
SDG:	18E0844	**Matrix:**	Soil
		Lab ID:	18E0844-40

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**9.16**	1.70	JL	mg/Kg dry		0.612	1.36	05/30/18 21:54	B8E1035	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**10.2**	8.61	~~D~~	mg/Kg dry		2.87	5.74	05/31/18 13:59	B8E1086	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**68.8**	0.100		% (Percent)		0.00500	0.0200	05/25/18 15:58	B8E0947	TB2	1

jaw 6-4-18

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE:	July 16, 2018
TO:	Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon
FROM:	Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW
SUBJ:	**Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**
REF	TD: TO-25-T3-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 34 air filter samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic (NIOSH Method 7303), mercury (OSHA Method ID-145), and mercury (NIOSH Method 6009) analyses were performed by Test America, Inc., Phoenix, Arizona. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Electronic and/or Manual Process (S2B/4VE/M).

The samples were numbered (field blanks are *italicized*):

18060401	18060402	18060403	18060404	*18060407*
18060408	*18060409*	18060410	18060411	18060412
18060413	18060414	18060415	*18060416*	*18060417*
18060418	18060419	18060420	18060421	18060422
18060423	18060424	*18060425*	*18060426*	*18060427*
18060428	18060429	18060430	18060431	18060432
18060433	*18060434*	*18060435*	*18060436*	

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained at < 25°C which applies to NIOSH Method 6009 mercury (no temperature limits are listed for the other methods). The samples were collected between June 6 and 11, 2018, and were analyzed by June 15, 2018, therefore meeting QC criteria of less than 30 days between collection, extraction, and analysis for NIOSH Method 6009 (no holding times are listed for the other methods).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995.

3. Blanks: Satisfactory.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level.

Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any laboratory blanks. There were no detections in the field and/or media blanks except NIOSH Method 6009 mercury in field blank samples 18060409 (0.0810 ug/sample) and 18060427 (0.0227 ug/sample). These positive blank results were subtracted from associated positive mercury sample results according to the analytical method by the data reviewer.

4. Duplicate Analysis: Acceptable.

A laboratory spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All spike duplicate results were within QC limits.

5. Laboratory Control Sample (LCS) and LCS Duplicate (LCSD) Analysis: Acceptable.

A LCS and LCSD were analyzed per SDG per matrix. All LCS and LCSD results were within the established control limits.

6. Overall Assessment of Data for Use

A total of 36 results were validated in this data memorandum. No sample results were qualified as estimated quantities (J) based on duplicate precision outliers, spike accuracy outliers, holding time outliers, incorrect sample containers, or sample temperature outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks. The following potential contaminant of concern was detected in the field and/or media blanks: NIOSH Method 6009 mercury.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

Test America Phoenix
Lab: TestAmerica Phoenix
Lab Address: 4625 E Cotton Center Blvd
Lab_Address2: #189

104319

CHAIN OF CUSTODY REC(
Site #: 10EK
Lab Phone: 602-437-334(
Lab_State: AZ

550-104319 Chain of Custody

10-061218-085148-0002
DateShipped: 6/12/2018
Contact Name: Steve Hall
Contact Phone: 206-920-1739

Lab #	Sample #	Location	Analyses	Matrix	Media_Type	Collected	Volume	Vol Units	Total_Time	Avg_Flow	Flow_Units
-01	18060401	FC01P_As	As by 7303	air	MCE cassette	6/6/2018	450.213	L	206	2.1855	L/min
-02	18060402	FC02P_Hg	Hg by ID-145	air	MCE cassette	6/6/2018	64.0458	L	238	0.2691	L/min
-03	18060403	FC02V_Hg	Hg by 6009	air	sorbent tube	6/6/2018	64.0458	L	238	0.2691	L/min
-04	18060404	FC03P_As	As by 7303	air	MCE cassette	6/6/2018	474.99	L	223	2.13	L/min
-05	18060405	RC01P_Hg	Hg by ID-145	air	MCE cassette	6/6/2018		L			L/min
-06	18060406	RC01V_Hg	Hg by 6009	air	sorbent tube	6/6/2018		L			L/min
-07	18060407	QC01P_As	As by 7303	air	MCE cassette	6/6/2018		L			L/min
-08	18060408	QC02P_Hg	Hg by ID-145	air	MCE cassette	6/6/2018		L			L/min
-09	18060409	QC02V_Hg	Hg by 6009	air	sorbent tube	6/6/2018		L			L/min
-10	18060410	FC04P_As	As by 7303	air	MCE cassette	6/7/2018	433.466	L	209	2.074	L/min
-11	18060411	FC05P_Hg	Hg by ID-145	air	MCE cassette	6/7/2018	57.06	L	225	0.2536	L/min
-12	18060412	FC05V_Hg	Hg by 6009	air	sorbent tube	6/7/2018	57.06	L	225	0.2536	L/min

Special Instructions: Please analyze w/ 48-hr TAT. TA-PHX	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
All	[signature]	6/12/2018 09:45	[signature] TA-PHX	6/13/18 9:30	

Amb
no Ice

Test America Phoenix
Lab: TestAmerica Phoenix
Lab Address: 4625 E Cotton Center Blvd
Lab_Address2: #189

104319

CHAIN OF CUSTODY RECORD
Site #: 10EK
Lab Phone: 602-437-3340
Lab_State: AZ

No: 10-061218-085148-0002
DateShipped: 6/12/2018
Contact Name: Steve Hall
Contact Phone: 206-920-1739

Lab #	Sample #	Location	Analyses	Matrix	Media_Type	Collected	Volume	Vol Units	Total_Time	Avg_Flow	Flow_Units
-13	18060413	FC06P_As	As by 7303	air	MCE cassette	6/7/2018	425.8	L	200	2.129	L/min
-14	18060414	RC02P_Hg	Hg by ID-145	air	MCE cassette	6/7/2018	46.9365	L	195	0.2407	L/min
-15	18060415	RC02V_Hg	Hg by 6009	air	sorbent tube	6/7/2018	46.9365	L	195	0.2407	L/min
-16	18060416	QC03P_As	As by 7303	air	MCE cassette	6/7/2018		L			L/min
-17	18060417	QC04P_Hg	Hg by ID-145	air	MCE cassette	6/7/2018		L			L/min
-18	18060418	QC04V_Hg	Hg by 6009	air	sorbent tube	6/7/2018		L			L/min
-19	18060419	FC07P_As	As by 7303	air	MCE cassette	6/8/2018	349.8825	L	165	2.1205	L/min
-20	18060420	FC08P_Hg	Hg by ID-145	air	MCE cassette	6/8/2018	49.0364	L	166	0.2954	L/min
-21	18060421	FC08V_Hg	Hg by 6009	air	sorbent tube	6/8/2018	49.0364	L	166	0.2954	L/min
-22	18060422	FC09P_As	As by 7303	air	MCE cassette	6/8/2018	310.176	L	144	2.154	L/min
-23	18060423	RC03P_Hg	Hg by ID-145	air	MCE cassette	6/8/2018	39.13105	L	161	0.24305	L/min
-24	18060424	RC03V_Hg	Hg by 6009	air	sorbent tube	6/8/2018	39.13105	L	161	0.24305	L/min

Special Instructions: Please analyze w/ 48-hr TAT.

SAMPLES TRANSFERRED FROM
CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
All	Steve Hall	6/12/2018 09:45	TA-PHX	6/13/18 9:30	

Amb no Fee

Test America Phoenix
Lab: TestAmerica Phoenix
Lab Address: 4625 E Cotton Center Blvd
Lab_Address2: #189

104319

CHAIN OF CUSTODY RECORD
Site #: 10EK
Lab Phone: 602-437-3340
Lab_State: AZ

No: 10-061218-085148-0002
DateShipped: 6/12/2018
Contact Name: Steve Hall
Contact Phone: 206-920-1739

Lab #	Sample #	Location	Analyses	Matrix	Media_Type	Collected	Volume	Vol Units	Total_Time	Avg_Flow	Flow_Units
-25	18060425	QC05P_As	As by 7303	air	MCE cassette	6/8/2018		L			L/min
-26	18060426	QC06P_Hg	Hg by ID-145	air	MCE cassette	6/8/2018		L			L/min
-27	18060427	QC06V_Hg	Hg by 6009	air	sorbent tube	6/8/2018		L			L/min
-28	18060428	BS01P_As	As by 7303	air	MCE cassette	6/11/2018	379.407	L	178	2.138	L/min
-29	18060429	BS02P_Hg	Hg by ID-145	air	MCE cassette	6/11/2018	45.428	L	164	0.2764	L/min
-30	18060430	BS02V_Hg	Hg by 6009	air	sorbent tube	6/11/2018	45.428	L	164	0.2764	L/min
-31	18060431	BS03P_As	As by 7303	air	MCE cassette	6/11/2018	363.893	L	167	2.179	L/min
-32	18060432	BS04P_Hg	Hg by ID-145	air	MCE cassette	6/11/2018	43.9089	L	174	0.2973	L/min
-33	18060433	BS04V_Hg	Hg by 6009	air	sorbent tube	6/11/2018	43.9089	L	174	0.2973	L/min
-34	18060434	QC07P_As	As by 7303	air	MCE cassette	6/11/2018		L			L/min
-35	18060435	QC08P_Hg	Hg by ID-145	air	MCE cassette	6/11/2018		L			L/min

Special Instructions: Please analyze w/ 48-hr TAT

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
All	Steve Hall	6/12/2018 09:45	TA-PHX	6/13/18 9130	

Amb no Ice

Test America Phoenix
Lab: TestAmerica Phoenix
Lab Address: 4625 E Cotton Center Blvd
Lab_Address2: #189

104319

CHAIN OF CUSTODY RECORD
Site #: 10EK
Lab Phone: 602-437-3340
Lab_State: AZ

No: 10-061218-085148-0002
DateShipped: 6/12/2018
Contact Name: Steve Hall
Contact Phone: 206-920-1739

Lab #	Sample #	Location	Analyses	Matrix	Media_Type	Collected	Volume	Vol Units	Total_Time	Avg_Flow	Flow_Units
-36	18060436	QC08V_Hg	Hg by 6009	air	sorbent tube	6/11/2018		L			L/min

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #
Please analyze w/ 48-hr TAT	

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
All	Steve Hall	6/12/2018 09:45	[signature] TA-PHX	6/13/18 9:30	

Amb no Ice

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060401

Lab Sample ID: 550-104319-1

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000167 U	0.000167	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060402

Lab Sample ID: 550-104319-2

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	0.0000877	0.000015 6	mg/m3			1	145
7439-97-6	Hg	0.00562	0.00100	ug/Samp le			1	145

Jmw 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060403

Lab Sample ID: 550-104319-3

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.0148 ~~0.0155~~	0.000355	mg/m3			1	6009
7439-97-6	Mercury	~~0.995~~ MW	0.0227	ug/Sample			1	6009

0.914

MW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060404

Lab Sample ID: 550-104319-4

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000158 U	0.000158	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

Mw 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060407

Lab Sample ID: 550-104319-7

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MM 7/16/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060408

Lab Sample ID: 550-104319-8

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/06/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

JM 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060409 | Lab Sample ID: 550-104319-9

Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1

SDG ID.:

Matrix: Air | Date Sampled: 06/06/2018 00:00

Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.0810	0.0227	ug/Sample			1	6009

JMW 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060410 Lab Sample ID: 550-104319-10

Lab Name: TestAmerica Phoenix Job No.: 550-104319-1

SDG ID.:

Matrix: Air Date Sampled: 06/07/2018 00:00

Reporting Basis: WET Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000173 U	0.000173	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7/6/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060411 | Lab Sample ID: 550-104319-11
Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1
SDG ID.:
Matrix: Air | Date Sampled: 06/07/2018 00:00
Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000175 U	0.0000175	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

MW 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060412

Lab Sample ID: 550-104319-12

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.00292	0.000398	mg/m3			1	6009
7439-97-6	Mercury	0.167	0.0227	ug/Sample			1	6009

MW 7/6/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060413

Lab Sample ID: 550-104319-13

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000176 U	0.000176	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060414

Lab Sample ID: 550-104319-14

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000213 U	0.0000213	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

MW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060415

Lab Sample ID: 550-104319-15

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.000913	0.000484	mg/m3			1	6009
7439-97-6	Mercury	0.0429	0.0227	ug/Sample			1	6009

MW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060416

Lab Sample ID: 550-104319-16

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060417

Lab Sample ID: 550-104319-17

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

MW 7/16/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060418

Lab Sample ID: 550-104319-18

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/07/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0227 U	0.0227	ug/Sample			1	6009

Mw 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060419 | Lab Sample ID: 550-104319-19

Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1

SDG ID.:

Matrix: Air | Date Sampled: 06/08/2018 00:00

Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000214 U	0.000214	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060420

Lab Sample ID: 550-104319-20

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/08/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000204 U	0.0000204	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

JAW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060421 | Lab Sample ID: 550-104319-21

Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1

SDG ID.:

Matrix: Air | Date Sampled: 06/08/2018 00:00

Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.00173 ~~0.00220~~ MW	0.000463	mg/m3			1	6009
7439-97-6	Mercury	~~0.108~~ MW 0.0853	0.0227	ug/Sample			1	6009

MW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060422 | Lab Sample ID: 550-104319-22

Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1

SDG ID.:

Matrix: Air | Date Sampled: 06/08/2018 00:00

Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000241 U	0.000241	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

JMW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060424 Lab Sample ID: 550-104319-24

Lab Name: TestAmerica Phoenix Job No.: 550-104319-1

SDG ID.:

Matrix: Air Date Sampled: 06/08/2018 00:00

Reporting Basis: WET Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.00691 ~~0.00749~~ mu	0.000581	mg/m3			1	6009
7439-97-6	Mercury	~~0.293~~ mu 0.2703	0.0227	ug/Sample			1	6009

mw 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060423

Lab Sample ID: 550-104319-23

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/08/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000256 U	0.0000256	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

MW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060425

Lab Sample ID: 550-104319-25

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/08/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7/6/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060426

Lab Sample ID: 550-104319-26

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/08/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

JMW 7-16-18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060427

Lab Sample ID: 550-104319-27

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/08/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.0227	0.0227	ug/Sample			1	6009

MW 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060428

Lab Sample ID: 550-104319-28

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000198 U	0.000198	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

JAW 7/16/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060429

Lab Sample ID: 550-104319-29

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000220 U	0.0000220	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

MW 7/6/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060430

Lab Sample ID: 550-104319-30

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.000560	0.000500	mg/m3			1	6009
7439-97-6	Mercury	0.0254	0.0227	ug/Sample			1	6009

law 7/6/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060431 | Lab Sample ID: 550-104319-31

Lab Name: TestAmerica Phoenix | Job No.: 550-104319-1

SDG ID.:

Matrix: Air | Date Sampled: 06/11/2018 00:00

Reporting Basis: WET | Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000206 U	0.000206	mg/m3			1	7303
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060432

Lab Sample ID: 550-104319-32

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.0000228 U	0.0000228	mg/m3			1	145
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

Jmw 7/16/18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060433 Lab Sample ID: 550-104319-33

Lab Name: TestAmerica Phoenix Job No.: 550-104319-1

SDG ID.:

Matrix: Air Date Sampled: 06/11/2018 00:00

Reporting Basis: WET Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.000518 U	0.000518	mg/m3			1	6009
7439-97-6	Mercury	<0.0227 U	0.0227	ug/Sample			1	6009

MW 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060434

Lab Sample ID: 550-104319-34

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample			1	7303

MW 7/6/18

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060435

Lab Sample ID: 550-104319-35

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Hg	<0.00100 U	0.00100	ug/Sample			1	145

Jmw 7-16-18

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 18060436

Lab Sample ID: 550-104319-36

Lab Name: TestAmerica Phoenix

Job No.: 550-104319-1

SDG ID.:

Matrix: Air

Date Sampled: 06/11/2018 00:00

Reporting Basis: WET

Date Received: 06/13/2018 09:30

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0227 U	0.0227	ug/Sample			1	6009

JMW 7-16-18

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: July 19, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 9 soil samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic and mercury analyses (EPA Methods 6010C and 7471B) were performed by Environmental Monitoring and Technologies, Inc., Morton Grove, Illinois. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Electronic and/or Manual Process (S2B/4VE/M).

The samples were numbered:

18060009	18060136	18060139	18060144	18060217
18060224	18060228	18060231	18060232	

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained at < 6°C (only applies to mercury). The samples were collected between June 15 and 22, 2018, and were analyzed by July 13, 2018, therefore meeting QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All applicable mid-level ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995. All performance evaluation results were within QC limits.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any blanks.

4. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All applicable serial dilution results were within QC limits.

5. **Matrix Spike Analysis: Acceptable.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits.

6. **Duplicate Analysis: Acceptable.**

A laboratory spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

7. **Laboratory Control Sample Analysis: Acceptable.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

8. **Overall Assessment of Data for Use**

A total of 18 results were validated in this data memorandum. No sample results were qualified as estimated quantities based on spike accuracy, duplicate precision outliers, holding time outliers, incorrect sample containers, or sample temperature outliers, or serial dilution outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

18G0375

CHAIN OF CUSTODY RECOR

PM: Eva Gaya
Ecology and Environment, Inc.
1004530.0025.001.01

0-071018-074537-0004

Lab: EMT Laboratory
Lab Address: 8100 N. Austin Avenue
Lab_Address2:

Site #: 10EK
Lab Phone: 847-324-3309
Lab_State: IL

DateShipped: 7/10/2018
Contact Name: Bryan
Contact Phone: Ciecko

Lab #	Sample #	Location	Matrix	Collected	Sample Time	Numb Cont	Container	Preservative	Analyses	Lab QC	
	18060009	RS09SS	Soil	6/18/2018	09:20	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	01A
	18060136	BS76SB02	Soil	6/21/2018	15:25	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	02A
	18060139	BS79SS	Soil	6/21/2018	15:43	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	03A
	18060144	BS76SB02	Soil	6/21/2018	15:25	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	04A
	18060217	FL400-450	Soil	6/15/2018	15:00	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	05A
	18060224	LB300-350	Soil	6/18/2018	10:40	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	06A
	18060228	LB500-550	Soil	6/22/2018	11:30	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	07A
	18060231	LB500-550	Soil	6/22/2018	11:30	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N	08A
	18060232	LB550-600	Soil	6/22/2018	14:05	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	Y	09A

Special Instructions: Some samples may contain mercury levels as high as 1,500 ppm.

SAMPLES TRANSFERRED FROM
CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	[signature] EBE	7/10/2018 0930			
			Keith Wessel	7/11/18 1003	Temp 4.0

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

Client:	Ecology and Environment, Inc.		Client Sample ID:	18060009
Project:	1004530.0025.001.01 Site #: 10EK		Report Date:	07/17/2018
			Collection Date:	06/18/2018 09:20
Work Order:	18G0375		Matrix:	Soil
			Lab ID:	18G0375-01

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	153	1.47		mg/Kg dry		0.530	1.18	07/12/18 17:56	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	302	66.4	~~D~~ mw	mg/Kg dry		22.1	44.2	07/13/18 13:36	B8G0398	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	81.0	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:20	B8G0338	MKP	1

mw 7/19/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060136
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/21/2018 15:25
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-02

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**2.69**	1.45		mg/Kg dry		0.523	1.16	07/12/18 18:01	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**0.121**	0.072		mg/Kg dry		0.024	0.048	07/13/18 14:00	B8G0398	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	**82.1**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:22	B8G0338	MKP	1

MW 7-19-18

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060139
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/21/2018 15:43
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-03

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**6.06**	1.48		mg/Kg dry		0.532	1.18	07/12/18 18:21	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**5.60**	0.678	D	mg/Kg dry		0.226	0.452	07/13/18 14:33	B8G0398	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**83.1**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:24	B8G0338	MKP	1

MW 7/9/18

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060144
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/21/2018 15:25
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-04

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	1.76	1.38		mg/Kg dry		0.497	1.10	07/12/18 18:26	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	0.173	0.067		mg/Kg dry		0.022	0.045	07/13/18 14:40	B8G0398	GSB	1
Wet Chemistry											
Method: SM2540G											
Total Solids	82.0	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:26	B8G0338	MKP	1

MW 7/19/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060217
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/15/2018 15:00
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-05

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**106**	1.58		mg/Kg dry		0.570	1.27	07/12/18 18:30	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**517**	72.4	~~H, B~~ MW	mg/Kg dry		24.1	48.3	07/13/18 15:00	B8G0398	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**77.8**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:28	B8G0338	MKP	1

MW 7-19-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060224
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/18/2018 10:40
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-06

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**20.9**	1.63		mg/Kg dry		0.587	1.30	07/12/18 18:34	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**10.2**	7.59	~~D~~	mg/Kg dry		2.53	5.06	07/13/18 15:02	B8G0398	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**75.1**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:30	B8G0338	MKP	1

MN 7-19-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060228
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/22/2018 11:30
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-07

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**24.0**	1.61		mg/Kg dry		0.579	1.29	07/12/18 18:38	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**91.7**	7.42	~~D~~ mw	mg/Kg dry		2.47	4.95	07/13/18 15:05	B8G0398	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**75.7**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:32	B8G0338	MKP	1

mw 7-19-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060231
Project:	1004530.0025.001.01	**Report Date:**	07/17/2018
	Site #: 10EK	**Collection Date:**	06/22/2018 11:30
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-08

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**24.8**	1.52		mg/Kg dry		0.547	1.22	07/12/18 18:43	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**92.0**	7.31	~~D~~ J MW	mg/Kg dry		2.44	4.88	07/13/18 15:07	B8G0398	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**80.7**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:34	B8G0338	MKP	1

MW 7-19-18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18060232
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/17/2018
		Collection Date:	06/22/2018 14:05
Work Order:	18G0375	**Matrix:**	Soil
		Lab ID:	18G0375-09

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**6.01**	1.60		mg/Kg dry		0.577	1.28	07/12/18 18:47	B8G0347	MLB	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**1.63**	0.766	Jmw	mg/Kg dry		0.255	0.511	07/13/18 15:14	B8G0398	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**76.4**	0.100	H	% (Percent)		0.00500	0.0200	07/11/18 16:36	B8G0338	MKP	1

Jmw 7-19-18

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: July 30, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington. MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 13 soil samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic and mercury, Toxicity Characteristic Leaching Procedure (TCLP) mercury, and Synthetic Precipitate Leaching Procedure (SPLP) mercury analyses (EPA Methods 1311, 1312, 6010C and/or 7471B) were performed by Environmental Monitoring and Technologies, Inc., Morton Grove, Illinois. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2B/4VM).

The samples were numbered:

18070005	18070007	18070201	18070202	18070205
18070208	18070211	18070213	18070105	18070106
18070214	18070217	18070501		

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained at < 6°C (only applies to mercury). The samples were collected between July 10 and 19, 2018, and were TCLP and SPLP extracted and analyzed by July 27, 2018, therefore meeting QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All applicable mid-level ICP recoveries were within the QC limits. All applicable AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995. All performance evaluation results were within QC limits.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any blanks that affected sample results.

4. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All applicable serial dilution results were within QC limits.

5. Matrix Spike Analysis: Satisfactory.

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits except a low arsenic MSD result in sample 18070106 (associated positive results and sample quantitation limits were qualified as estimated quantities with a low bias [JL or UJL]), high mercury MS and MSD results in sample 18070106 (associated positive results were qualified as estimated quantities with a high bias [JH]), and a low mercury TCLP MSD result (associated positive results and sample quantitation limits were qualified as estimated quantities with a low bias [JL or UJL]).

6. Duplicate Analysis: Satisfactory.

A laboratory spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits except the mercury TCLP spike duplicate; the associated positive sample result was qualified as an estimated quantity with an unknown bias (JK).

7. Laboratory Control Sample Analysis: Acceptable.

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

8. Overall Assessment of Data for Use

A total of 27 results were validated in this data memorandum. A total of 22 sample results (approximately 81.4% of the data) were qualified as estimated quantities based on spike accuracy outliers. One sample result (approximately 3.7% of the data) were qualified as estimated quantities based on duplicate precision outliers. No sample results were qualified as estimated quantities based on holding time outliers, incorrect sample containers, sample temperature outliers, or serial dilution outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks that potentially affected sample results.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

18G0606

OF CUSTODY RECORD

No: 10-071918-132653-0005

Lab: EMT Laboratory
Lab Address: 8100 N. Austin Aven
Lab_Address2:

PM: Eva Gaya
Ecology and Environment, Inc.
1004530.0025.001.01

Site #: 10EK
Phone: 847-324-3309
Lab_State: IL

DateShipped: 7/19/2018
Contact Name: Mark Woodke
Contact Phone: 206 624 9537
TK# 78193838 8589

Lab #	Sample #	Location	Matrix	Collected	Numb Cont	Container	Preservative	Analyses	Lab QC
	18070005	RS27SS	Soil	7/11/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070007	RS27SS	Soil	7/11/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	Y
	18070201	RB800-850	Soil	7/10/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070202	FL800-850	Soil	7/10/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070205	FL850-900	Soil	7/10/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070208	FL200-250	Soil	7/11/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070211	FL100-150	Soil	7/14/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070213	RB50-100	Soil	7/18/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070105	BS88TS	Soil	7/12/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070106	BS88TS	Soil	7/12/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	Y
	18070214	FL50-100	Soil	7/14/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070217	FL0-50	Soil	7/14/2018	1	4 oz jar	4 C	EPA 6010 (As) and 7471 (Hg)	N
	18070501	RS01HT	Soil	7/19/2018	8	4 oz jar	4 C	SPLP As, Hg [1 Week TAT]	N

Special Instructions: Sample 18070501 has Hg concentrations above 1,500 mg/kg

SAMPLES TRANSFERRED FROM
CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
Samples/ Analyses	E&E/START	7-19-18/1421		7/20/18 9:40	4.2
			~~Nicole Rey~~ 7/20 MR	~~7-20-18 9~~	

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

Client:	Ecology and Environment, Inc.	Client Sample ID:	18070005
Project:	1004530.0025.001.01 Site #: 10EK	Report Date:	07/27/2018
		Collection Date:	07/11/2018 00:00
Work Order:	18G0606	Matrix:	Soil
		Lab ID:	18G0606-01

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	109 JL	1.42		mg/Kg dry		0.512	1.14	07/23/18 14:39	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	465 JH	66.8	D	mg/Kg dry		22.3	44.6	07/20/18 12:31	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											Notes: H
Total Solids	87.2	0.100		% (Percent)		0.00500	0.0200	07/20/18 11:59	B8G0670	MKP	1

MW 7-30-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070007
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/11/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-02

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	88.8 J	1.43		mg/Kg dry		0.515	1.14	07/23/18 14:43	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	346 JH	68.4	[illegible]	mg/Kg dry		22.8	45.6	07/20/18 12:36	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											Notes: H
Total Solids	85.2	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:01	B8G0670	MKP	1

7-30-18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070201
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/10/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-03

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	55.3 JL	1.40		mg/Kg dry		0.503	1.12	07/23/18 15:04	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	121 JH	64.6	D	mg/Kg dry		21.5	43.1	07/20/18 12:55	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											Notes: H
Total Solids	85.4	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:03	B8G0670	MKP	1

7-30-18

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070202
Project:	1004530.0025.001.01	**Report Date:**	07/27/2018
	Site #: 10EK	**Collection Date:**	07/10/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-04

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**20.6** J	1.41		mg/Kg dry		0.509	1.13	07/23/18 15:08	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.84** JH	0.642		mg/Kg dry		0.214	0.428	07/20/18 13:02	B8G0661	GSB	10
Wet Chemistry											
Method: SM2540G											**Notes: H**
Total Solids	**86.7**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:05	B8G0670	MKP	1

JMW 7-30-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070205
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/10/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-05

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**48.8** JL	1.38		mg/Kg dry		0.495	1.10	07/23/18 15:13	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**41.5** JH	6.50		mg/Kg dry		2.17	4.33	07/20/18 13:07	B8G0661	GSB	100
Wet Chemistry											
Method: SM2540G											**Notes: H**
Total Solids	**88.2**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:07	B8G0670	MKP	1

MW
7-30-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070208
Project:	1004530.0025.001.01	**Report Date:**	07/27/2018
	Site #: 10EK	**Collection Date:**	07/11/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-06

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	32.7 JL	1.55		mg/Kg dry		0.556	1.24	07/23/18 15:34	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	318 JH	72.0	D	mg/Kg dry		24.0	48.0	07/20/18 13:13	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											**Notes: H**
Total Solids	**80.1**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:09	B8G0670	MKP	1

MW 7-30-18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070211
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/14/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-07

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	17.6 JL	1.83		mg/Kg dry		0.661	1.47	07/23/18 19:51	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	21.6 JH	9.49	~~D~~	mg/Kg dry		3.16	6.33	07/20/18 13:18	B8G0661	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	60.8	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:11	B8G0670	MKP	1

7-30-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070213
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/18/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-08

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	63.2 JL	1.34		mg/Kg dry		0.482	1.07	07/23/18 19:56	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	631 JH	65.7	~~D~~ MW	mg/Kg dry		21.9	43.8	07/20/18 13:21	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	91.3	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:13	B8G0670	MKP	1

MW
7-30-18

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070105
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/12/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-09

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	7.79	1.29		mg/Kg dry		0.464	1.03	07/23/18 15:46	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	5.73	6.68	J, D	mg/Kg dry		2.23	4.46	07/20/18 13:25	B8G0661	GSB	100
Wet Chemistry											
Method: SM2540G											Notes: H
Total Solids	89.4	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:15	B8G0670	MKP	1

MW
7-2018

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070106
Project:	1004530.0025.001.01	**Report Date:**	07/27/2018
	Site #: 10EK	**Collection Date:**	07/12/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-10

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**5.42** JL	1.39		mg/Kg dry		0.500	1.11	07/23/18 15:51	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	< 4.34 U	6.52	U	mg/Kg dry		2.17	4.34	07/20/18 13:30	B8G0661	GSB	100
Wet Chemistry											
Method: SM2540G											**Notes: H**
Total Solids	**89.5**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:17	B8G0670	MKP	1

MW 7-2018

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070214
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/14/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-11

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**29.6**	1.66	JL	mg/Kg dry		0.596	1.32	07/23/18 16:12	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	**108**	81.0	JH ~~D~~ mw	mg/Kg dry		27.0	54.0	07/20/18 13:47	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	73.2	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:19	B8G0670	MKP	1

MW
7-30-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070217
Project:	1004530.0025.001.01 Site #: 10EK	**Report Date:**	07/27/2018
		Collection Date:	07/14/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-12

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**15.6** JL	1.61		mg/Kg dry		0.578	1.28	07/23/18 16:33	B8G0665	KJ1	1
Mercury by CVAA											
Method: SW7471B											
Mercury	4.53 ~~J+~~ MW	8.16	J, ~~D~~ Q MW	mg/Kg dry		2.72	5.44	07/20/18 13:59	B8G0661	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**68.2**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:21	B8G0670	MKP	1

MW
7-30-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18070501
Project:	1004530.0025.001.01	**Report Date:**	07/27/2018
	Site #: 10EK	**Collection Date:**	07/19/2018 00:00
Work Order:	18G0606	**Matrix:**	Soil
		Lab ID:	18G0606-13

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Mercury by CVAA											
Method: SW7470A / SW1311											
Mercury, TCLP	**0.0119**	0.00500	J	mg/L		0.00100	0.00250	07/25/18 13:13	B8G0781	TB2	10
Method: SW7470A / SW1312											
Mercury, SPLP	**0.00586**	0.00050		mg/L		0.00010	0.00025	07/27/18 12:29	B8G0876	TB2	1
Method: SW7471B											
Mercury	**1580**	68.6	JH ~~D~~	mg/Kg dry		22.9	45.7	07/20/18 14:01	B8G0661	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**85.8**	0.100		% (Percent)		0.00500	0.0200	07/20/18 12:23	B8G0670	MKP	1

MW 7-30-18

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: October 9, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 28 samples (5 water and 23 soil) collected from the Black-Butte Mine site in Lane County, Oregon, has been completed. Arsenic and mercury analyses (EPA Methods 6010C and 7471B) were performed by Environmental Monitoring and Technologies, Inc., Morton Grove, Illinois. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2B/4VM).

The samples were numbered:

18091001	18091002	18091003	18091004	18091005
18091006	18091007	18091008	18091009	18091010
18091011	18091012	18091013	18091014	18091015
18091016	18091017	18091018	18091019	18091020
18091021	18091022	18091023	18091024	18091025
18091026	18091027	18091028		

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained at < 6°C (only applies to mercury in soil). The samples were collected between September 25 and 26, 2018, and were analyzed by October 4, 2018, therefore meeting QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All applicable mid-level ICP recoveries were within the QC limits. All applicable AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995. All performance evaluation results were within QC limits.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any blanks that affected sample results.

4. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All applicable serial dilution results were within QC limits.

5. **Matrix Spike Analysis: Satisfactory.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits except high arsenic MSD results in samples 18091008 and 18091009 (associated positive results were qualified as estimated quantities with a high bias [JH]) and a low arsenic MSD result in sample 18091018 (associated positive results and sample quantitation limits were qualified as estimated quantities with a low bias [JL or UJL]).

6. **Duplicate Analysis: Satisfactory.**

A laboratory spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All spike duplicate results were within QC limits except in sample 18091009. Associated positive sample results and sample quantitation limits were qualified as estimated quantities with an unknown bias (JK or UJK).

7. **Laboratory Control Sample Analysis: Acceptable.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

8. **Overall Assessment of Data for Use**

A total of 56 results were validated in this data memorandum. A total of 22 sample results (approximately 39% of the data) were qualified as estimated quantities based on spike accuracy outliers. 17 sample results (approximately 30% of the data) were qualified as estimated quantities based on duplicate precision outliers. No sample results were qualified as estimated quantities based on holding time outliers, incorrect sample containers, sample temperature outliers, or serial dilution outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks that potentially affected sample results.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

<u>Data Qualifiers and Definitions</u>

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091026
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-01

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**98.6** JK	6.63	~~D~~	mg/Kg dry		2.39	5.30	10/01/18 20:43	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**125**	59.9	~~D~~ MW	mg/Kg dry		20.0	39.9	10/02/18 11:30	B8J0060	GSB	1000
Wet Chemistry											
Method: SM2540G											
Total Solids	**92.8**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:30	B8J0001	MKP	1

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091027
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Water
		Lab ID:	18I0900-02

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3015											
Arsenic	< 0.200 U	0.250		mg/L		0.100	0.200	10/02/18 23:10	B8J0082	KJ1	5
Mercury by CVAA											
Method: SW7470A											
Mercury	< 0.00025 U	0.00050		mg/L		0.00010	0.00025	10/03/18 12:30	B8J0113	GSB	1

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091028
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Water
		Lab ID:	18I0900-03

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3015											
Arsenic	< 0.200 U	0.250		mg/L		0.100	0.200	10/02/18 23:15	B8J0082	KJ1	5
Mercury by CVAA											
Method: SW7470A											
Mercury	< 0.00025 U	0.00050		mg/L		0.00010	0.00025	10/03/18 12:32	B8J0113	GSB	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091001
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-04

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**68.5**	J 7.03	~~D~~	mg/Kg dry		2.53	5.63	10/01/18 20:47	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	11.7	0.663	~~D~~ mw	mg/Kg dry		0.221	0.442	10/02/18 11:36	B8J0060	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**88.8**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:32	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091002
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-05

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**50.6**	JK 7.16	D	mg/Kg dry		2.58	5.72	10/01/18 20:52	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**13.7**	6.83	D	mg/Kg dry		2.28	4.56	10/02/18 11:38	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.8**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:34	B8J0001	MKP	1

MW 10/9/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091003
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-06

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**29.8**	JK 7.15	D	mg/Kg dry		2.57	5.72	10/01/18 20:56	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.86**	0.682	D	mg/Kg dry		0.227	0.454	10/02/18 11:47	B8J0060	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**85.8**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:36	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091004
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-07

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**37.3**	JK 7.02	~~D~~	mg/Kg dry		2.53	5.62	10/01/18 21:00	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**5.46**	6.58	J, ~~D~~ Q	mg/Kg dry		2.19	4.39	10/02/18 12:08	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**88.2**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:38	B8J0001	MKP	1

JM 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client: Ecology and Environment, Inc.
Project: 1004530.0025.001.01
Black Butte Mine-Furnace Creek Removal/OR
Work Order: 18I0900

Client Sample ID: 18091005
Report Date: 10/05/2018
Collection Date: 09/25/2018 00:00
Matrix: Soil
Lab ID: 18I0900-08

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**109**	JK 7.08	~~D~~	mg/Kg dry		2.55	5.66	10/01/18 21:04	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**13.7**	6.60	~~D~~ Mw	mg/Kg dry		2.20	4.40	10/02/18 12:26	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**88.3**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:40	B8J0001	MKP	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091006
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-09

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**121**	6.92	D	mg/Kg dry		2.49	5.54	10/01/18 21:08	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**26.8**	6.39	D	mg/Kg dry		2.13	4.26	10/02/18 12:29	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**89.4**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:42	B8J0001	MKP	1

JK

MW 10/9/18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091007
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-10

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**70.2**	JK 6.85	D	mg/Kg dry		2.46	5.48	10/01/18 21:29	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**14.6**	6.42	D mw	mg/Kg dry		2.14	4.28	10/02/18 12:50	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**90.0**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:44	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091008
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-11

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**97.3**	6.69	D	mg/Kg dry		2.41	5.35	10/01/18 21:33	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**9.04**	6.35	D	mg/Kg dry		2.12	4.24	10/02/18 12:32	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**92.9**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:46	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 **P** 847.967.6666 800.246.0663 **F** 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091009
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-12

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**79.9**	JK 6.85	~~D~~	mg/Kg dry		2.47	5.48	10/01/18 21:54	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**6.32**	6.51	J, ~~D~~ Q	mg/Kg dry		2.17	4.34	10/02/18 13:25	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**91.0**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:48	B8J0001	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results
(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091010
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-13

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**58.8**	JK 6.74	~~D~~ MW	mg/Kg dry		2.43	5.39	10/01/18 22:31	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.91**	6.52	J, ~~D~~ Q	mg/Kg dry		2.17	4.35	10/02/18 12:52	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**91.8**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:50	B8J0001	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091011
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-14

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**33.1**	7.01	D	mg/Kg dry		2.53	5.61	10/01/18 22:35	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**8.49**	6.75	D	mg/Kg dry		2.25	4.50	10/02/18 12:54	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**87.7**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:52	B8J0001	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091012
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-15

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	37.7	JK 7.08	D	mg/Kg dry		2.55	5.67	10/01/18 22:39	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**19.1**	6.82	D MW	mg/Kg dry		2.27	4.55	10/02/18 12:56	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**87.0**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:54	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091013
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-16

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**58.8**	J 6.94	~~D~~	mg/Kg dry		2.50	5.55	10/01/18 22:43	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.31**	6.36	J, ~~D~~	mg/Kg dry		2.12	4.24	10/02/18 12:59	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**89.4**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:56	B8J0001	MKP	1

MW 10/9/18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 **P** 847.967.6666 800.246.0663 **F** 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091014
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-17

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**60.3**	6.92	~~D~~	mg/Kg dry		2.49	5.54	10/01/18 22:48	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**6.11**	6.60	J, ~~D~~	mg/Kg dry		2.20	4.40	10/02/18 13:02	B8J0060	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**89.1**	0.100		% (Percent)		0.00500	0.0200	10/01/18 05:58	B8J0001	MKP	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091015
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-18

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**80.1**	6.81	D	mg/Kg dry		2.45	5.45	10/01/18 22:52	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	3.33	0.655	D	mg/Kg dry		0.218	0.437	10/02/18 13:34	B8J0061	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**90.3**	0.100		% (Percent)		0.00500	0.0200	10/01/18 06:00	B8J0001	MKP	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091016
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-19

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**97.7**	6.91	D	mg/Kg dry		2.49	5.53	10/01/18 22:56	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**6.83**	6.61	D	mg/Kg dry		2.20	4.41	10/02/18 13:36	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**90.2**	0.100		% (Percent)		0.00500	0.0200	10/01/18 06:02	B8J0001	MKP	1

JK

MW 10-9-18

experts at providing environmental testing solutions
water · soil · waste · product · sampling

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091017
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Fumace Creek Removal/OR	**Collection Date:**	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-20

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**72.8**	JK 6.63	D	mg/Kg dry		2.39	5.30	10/01/18 23:00	B8J0008	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.95**	0.627	D	mg/Kg dry		0.209	0.418	10/02/18 13:41	B8J0061	GSB	10
Wet Chemistry											
Method: SM2540G											
Total Solids	**92.6**	0.100		% (Percent)		0.00500	0.0200	10/01/18 06:04	B8J0001	MKP	1

MW

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091018
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-21

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**58.8**	6.54	JL	mg/Kg dry		2.35	5.23	10/01/18 23:37	B8J0011	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**5.01**	6.08	J, ~~D~~	mg/Kg dry		2.03	4.05	10/02/18 13:44	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**94.2**	0.100		% (Percent)		0.00500	0.0200	10/01/18 09:35	B8J0009	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client: Ecology and Environment, Inc.
Project: 1004530.0025.001.01
Black Butte Mine-Fumace Creek Removal/OR
Work Order: 18I0900

Client Sample ID: 18091019
Report Date: 10/05/2018
Collection Date: 09/26/2018 00:00
Matrix: Soil
Lab ID: 18I0900-22

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**67.7** JL	6.54	D	mg/Kg dry		2.35	5.23	10/01/18 23:58	B8J0011	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**13.8**	6.26	D	mg/Kg dry		2.09	4.17	10/02/18 13:51	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**95.0**	0.100		% (Percent)		0.00500	0.0200	10/01/18 09:37	B8J0009	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   P 847.967.6666   800.246.0663   F 847.967.6735   www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091020
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-23

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	81.2 J	6.79	D	mg/Kg dry		2.44	5.43	10/02/18 00:02	B8J0011	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**15.4**	6.55	D	mg/Kg dry		2.18	4.37	10/02/18 14:05	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**90.9**	0.100		% (Percent)		0.00500	0.0200	10/01/18 09:39	B8J0009	MKP	1

MW

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091021
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-24

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**74.0**	J 6.69	~~D~~	mg/Kg dry		2.41	5.35	10/02/18 00:23	B8J0011	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**4.30**	6.29	J, ~~D~~ Q	mg/Kg dry		2.10	4.19	10/02/18 14:12	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**93.0**	0.100		% (Percent)		0.00500	0.0200	10/01/18 09:41	B8J0009	MKP	1

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091022
Project:	1004530.0025.001.01	**Report Date:**	10/05/2018
	Black Butte Mine-Furnace Creek Removal/OR	**Collection Date:**	09/26/2018 00:00
Work Order:	18I0900	**Matrix:**	Soil
		Lab ID:	18I0900-25

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**31.7** JL	7.20	D	mg/Kg dry		2.59	5.76	10/02/18 00:27	B8J0011	KJ1	5
Mercury by CVAA											
Method: SW7471B											
Mercury	**8.96**	6.51	D	mg/Kg dry		2.17	4.34	10/02/18 14:15	B8J0061	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**86.2**	0.100		% (Percent)		0.00500	0.0200	10/01/18 09:43	B8J0009	MKP	1

MW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091023
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Water
		Lab ID:	18I0900-26

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3015											
Arsenic	< 0.200 U	0.250		mg/L		0.100	0.200	10/02/18 23:19	B8J0082	KJ1	5
Mercury by CVAA											
Method: SW7470A											
Mercury	< 0.00025 U	0.00050		mg/L		0.00010	0.00025	10/03/18 12:43	B8J0113	GSB	1

MW 10-9-18

Environmental Monitoring and Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091024
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Water
		Lab ID:	18I0900-27

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3015											
Arsenic	< 0.200 U	0.250		mg/L		0.100	0.200	10/02/18 23:23	B8J0082	KJ1	5
Mercury by CVAA											
Method: SW7470A											
Mercury	< 0.00025 U	0.00050		mg/L		0.00010	0.00025	10/03/18 12:45	B8J0113	GSB	1

NW 10-9-18

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue Morton Grove, IL 60053-3203 P 847.967.6666 800.246.0663 F 847.967.6735 www.emt.com

Client Sample Results

(Continued)

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18091025
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/05/2018
		Collection Date:	09/25/2018 00:00
Work Order:	18I0900	**Matrix:**	Water
		Lab ID:	18I0900-28

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3015											
Arsenic	< 0.200 U	0.250		mg/L		0.100	0.200	10/02/18 23:27	B8J0082	KJ1	5
Mercury by CVAA											
Method: SW7470A											
Mercury	< 0.00025 U	0.00050		mg/L		0.00010	0.00025	10/03/18 12:47	B8J0113	GSB	1

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: October 25, 2018

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 1 soil sample collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic and mercury analyses (EPA Methods 6010C and 7471B) and Synthetic Precipitate Leaching Procedure (SPLP) mercury analyses (EPA Methods 1312 and 7470A) were performed by Environmental Monitoring and Technologies, Inc., Morton Grove, Illinois. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2B/4VM).

The sample was numbered: 18100003

Data Qualifications:

1. Sample Holding Times: Acceptable.

The sample was maintained at < 6°C (only applies to mercury in soil). The sample was collected on October 12, 2018, was extracted on October 22, 2018, and was analyzed by October 24, 2018, therefore meeting QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All applicable mid-level ICP recoveries were within the QC limits. All applicable AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995. All performance evaluation results were within QC limits.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any blanks that affected sample results.

4. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All applicable serial dilution results were within QC limits.

5. Matrix Spike Analysis: Satisfactory.

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits except a low mercury MS result and a high arsenic MSD result. No actions were taken based on these outliers as the original sample result was more than four times the spiked amount.

6. Duplicate Analysis: Satisfactory.

A laboratory spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All spike duplicate results were within QC limits except the arsenic result associated with the MS/MSD. No actions were taken based on this outlier as noted above.

7. Interference Check Sample (ICS) Analysis: Acceptable.

An ICS was analyzed at the appropriate frequency. All ICS (solution AB) results were within the established control limits.

8. Laboratory Control Sample Analysis: Acceptable.

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

9. Overall Assessment of Data for Use

A total of three results were validated in this data memorandum. No sample results were qualified as estimated quantities based on spike accuracy outliers, duplicate precision outliers, holding time outliers, incorrect sample containers, sample temperature outliers, or serial dilution outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the laboratory blanks that potentially affected sample results.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

Environmental
Monitoring and
Technologies, Inc.

8100 N. Austin Avenue   Morton Grove, IL 60053-3203   **P** 847.967.6666   800.246.0663   **F** 847.967.6735   www.emt.com

Client Sample Results

Client:	Ecology and Environment, Inc.	**Client Sample ID:**	18100003
Project:	1004530.0025.001.01 Black Butte Mine-Furnace Creek Removal/OR	**Report Date:**	10/25/2018
		Collection Date:	10/12/2018 00:00
Work Order:	18J0695	**Matrix:**	Soil
		Lab ID:	18J0695-01

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	MDL	LOD	Date/Time Analyzed	Batch	Analyst	DF
Metals by ICP-AES											
Method: SW6010C / SW3050											
Arsenic	**57.6**	13.8	~~D~~ MW	mg/Kg dry		4.98	11.1	10/19/18 18:11	B8J0711	KJ1	10
Mercury by CVAA											
Method: SW7470A / SW1312											
Mercury, SPLP	**0.00093**	0.00050		mg/L		0.00010	0.00025	10/23/18 14:16	B8J0833	GSB	1
Method: SW7471B											
Mercury	**16.1**	7.01	~~D~~ MW	mg/Kg dry		2.34	4.67	10/24/18 11:19	B8J0888	GSB	100
Wet Chemistry											
Method: SM2540G											
Total Solids	**84.7**	0.100		% (Percent)		0.00500	0.0200	10/18/18 13:15	B8J0691	MKP	1

MW 10-25-18

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537

MEMORANDUM

DATE: December 23, 2019

TO: Bryan Ciecko, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 15 air filter samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic (NIOSH Method 7303) and mercury (OSHA Method ID-145 and NIOSH Method 6009) analyses were performed by Test America, Inc., Phoenix, Arizona. All sample analyses were evaluated following EPA's Stage 2B and/or 4 Data Validation Manual Process (S2B/4VM). Note: this memo was revised to update the results for sample 19072017.

The samples were numbered (*field blanks are italicized*):

19072001	19072002	*19072003*	*19072004*	*19072005*
19072009	19072010	*19072011*	*19072012*	*19072013*
19072017	19072018	*19072019*	*19072020*	*19072021*

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained and received at the laboratory within QC temperature limits (only applies to NIOSH 6009 mercury; no temperature limits are listed for the other methods). The samples were collected on July 9 through 11, 2019, and were extracted and/or analyzed by July 25, 2019, therefore meeting QC criteria of less than 30 days between collection, extraction, and analysis for NIOSH Method 6009 (no holding times are listed for the other methods).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any laboratory or field blanks.

4. Duplicate Analysis: Satisfactory.

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits except as noted below for the Laboratory Control Sample; no actions were taken based on these outliers.

5. Laboratory Control Sample Analysis: Satisfactory.

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits except the arsenic LCS and LCS duplicates were inadvertently not spiked; no actions were taken based on these outliers as all other arsenic QC results were within QC limits.

6. Overall Assessment of Data for Use

A total of 15 results were validated in this data memorandum. No sample results were qualified as estimated quantities (J) based on duplicate precision outliers, spike accuracy outliers, holding time outliers, incorrect sample containers, or sample temperature outliers. No sample results were rejected (R).

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2017". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

<u>Data Qualifiers and Definitions</u>

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

L - The sample result is biased low.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072001

Lab Sample ID: 550-126247-1

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/09/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~<~~0.000969 U	0.000969	mg/m3			1	PE-MET-019
7439-97-6	Mercury	~~<~~0.0500 U	0.0500	ug/Sample			1	PE-MET-019

MW 8/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072001 | Lab Sample ID: 550-126247-2

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/09/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.000441 U	0.000441	mg/m3			1	PE-MET-013
7439-97-6	Mercury	<0.0227 U	0.0227	ug/Sample			1	PE-MET-013

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072002 | Lab Sample ID: 550-126247-3

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/09/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000187 U	0.000187	mg/m3		*	1	PE-MET-012
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample		*	1	PE-MET-012

Mw 8/1/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072003 Lab Sample ID: 550-126247-4

Lab Name: Eurofins TestAmerica, Phoenix Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air Date Sampled: 07/09/2019 00:00

Reporting Basis: WET Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~<~~0.0227 U	0.0227	ug/Sample			1	PE-MET-013

FORM IB-IN

mw 8-1-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072004

Lab Sample ID: 550-126247-5

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/09/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~<~~0.0500 U	0.0500	ug/Sample			1	PE-MET-019

MW 8/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072005

Lab Sample ID: 550-126247-6

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/09/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	~~<~~0.0750 U	0.0750	ug/Sample		^ *	1	PE-MET-012

MW 8/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072009

Lab Sample ID: 550-126247-10

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/10/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~<~~0.000377 U	0.000377	mg/m3			1	PE-MET-013
7439-97-6	Mercury	~~<~~0.0227 U	0.0227	ug/Sample			1	PE-MET-013

MM 8/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072009 Lab Sample ID: 550-126247-11

Lab Name: Eurofins TestAmerica, Phoenix Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air Date Sampled: 07/10/2019 00:00

Reporting Basis: WET Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~0.000830~~ U	0.000830	mg/m3			1	PE-MET-019
7439-97-6	Mercury	~~0.0500~~ U	0.0500	ug/Sample			1	PE-MET-019

FORM IB-IN

MN 8-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072010 | Lab Sample ID: 550-126247-12

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/10/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.000148 U	0.000148	mg/m3		*	1	PE-MET-012
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample		*	1	PE-MET-012

MW

FORM IB-IN

MW 8/1/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072011 | Lab Sample ID: 550-126247-13

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/10/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample		^ *	1	PE-MET-012

MW 8/1/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072012

Lab Sample ID: 550-126247-14

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/10/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0500 U	0.0500	ug/Sample			1	PE-MET-019

FORM IB-IN

MW 8/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072013 | Lab Sample ID: 550-126247-15

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/10/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	~~<~~0.0227 U	0.0227	ug/Sample			1	PE-MET-013

MW 8-4-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072017

Lab Sample ID: 550-126247-19

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/11/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.00200	0.000341	mg/m3			1	PE-MET-013
7439-97-6	Mercury	0.133	0.0227	ug/Sample			1	PE-MET-013

mw 8-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072017 Lab Sample ID: 550-126247-20

Lab Name: Eurofins TestAmerica, Phoenix Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air Date Sampled: 07/11/2019 00:00

Reporting Basis: WET Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0500 U	0.0500	mg/m3			1	PE-MET-019
7439-97-6	Mercury	<0.0500 U	0.0500	ug/Sample			1	PE-MET-019

FORM IB-IN

mw 8/1/19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072018 | Lab Sample ID: 550-126247-21

Lab Name: Eurofins TestAmerica, Phoenix | Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air | Date Sampled: 07/11/2019 00:00

Reporting Basis: WET | Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	~~<~~0.000131 U	0.000131	mg/m3		*	1	PE-MET-012
7440-38-2	Arsenic	~~<~~0.0750 U	0.0750	ug/Sample		*	1	PE-MET-012

mw 8-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072019

Lab Sample ID: 550-126247-22

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/11/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0500 U	0.0500	ug/Sample			1	PE-MET-019

Mw 8-1-19

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072020

Lab Sample ID: 550-126247-23

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/11/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7439-97-6	Mercury	<0.0227 U	0.0227	ug/Sample			1	PE-MET-013

MA 10/8/19

FORM IB-IN

1B-IN
INORGANIC ANALYSIS DATA SHEET
IH - METALS

Client Sample ID: 19072021

Lab Sample ID: 550-126247-24

Lab Name: Eurofins TestAmerica, Phoenix

Job No.: 550-126247-1

SDG ID.: 10-071519-123305-0004

Matrix: Air

Date Sampled: 07/11/2019 00:00

Reporting Basis: WET

Date Received: 07/17/2019 09:45

CAS No.	Analyte	Result	RL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	<0.0750 U	0.0750	ug/Sample		^ *	1	PE-MET-012

MW 8-1-19

FORM IB-IN

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: August 19, 2019

TO: Maren Fulton, START-IV Project Manager, E & E, Portland, Oregon

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington MW

SUBJ: **Inorganic Data Quality Assurance Review, Black Butte Mine Site, Lane County, Oregon**

REF: TO: TO-25-T1-SS1 PAN: 1004530.0025.001.01

The data quality assurance review of 6 soil samples collected from the Black Butte Mine site in Lane County, Oregon, has been completed. Arsenic (EPA Method 6010) and mercury (EPA Method 7471) analyses were performed by GEL Laboratories, LLC, Charleston, South Carolina. All sample analyses were evaluated following EPA's Stage 2B and/or 4 Data Validation Manual Process (S2B/4VM).

The samples were numbered:

19072101	19072102	19072103	19072104	19072105
19072106				

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained and received at the laboratory within QC temperature limits. The samples were collected on July 15, 2019, and were extracted and/or analyzed by August 8, 2019, therefore meeting QC criteria of less than 6 months between collection and analysis (28 days for mercury).

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. All ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections in any laboratory blanks.

4. Duplicate Analysis: Acceptable.

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

4. ICP Interference Check Sample: Acceptable.

An Interference Check Sample (ICS) was analyzed at the beginning of each sequence or at least twice every 8 hours, whichever was more frequent. All applicable ICS (solution AB) results were within QC limits of 80% - 120% recovery.

5. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All serial dilution results were within QC limits.

6. Matrix Spike Analysis: Acceptable.

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits or were not applicable due to the high sample concentrations in the native sample.

7. Duplicate Analysis: Acceptable.

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

8. Overall Assessment of Data for Use

A total of 12 results were validated in this data memorandum. No sample results were qualified as estimated quantities (J) based on duplicate precision outliers, spike accuracy outliers, holding time outliers, incorrect sample containers, or sample temperature outliers. No sample results were rejected (R).

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2017". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

<u>Data Qualifiers and Definitions</u>

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R - The data is rejected and unusable. The analyte may or may not be present in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ - The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

METALS

-1-

INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259001 **CLIENT ID:** 19072101

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 80

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	35300	ug/kg			P	619	1	AVIO1	080819-1
7439-97-6	Mercury	30200	ug/kg			AV	446	100	HG5	080719S1-2

***Analytical Methods:**

AV	SW846 7471B
P	SW846 3050B/6010D

JMW 8-19-19

METALS

-1-

INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259002 **CLIENT ID:** 19072102

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 79

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	50100	ug/kg			P	606	1	AVIO1	080819-1
7439-97-6	Mercury	50900	ug/kg			AV	484	100	HG5	080719S1-2

***Analytical Methods:**

AV **SW846 7471B**

P **SW846 3050B/6010D**

mw 8-19-19

METALS
-1-
INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259003 **CLIENT ID:** 19072103

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 85

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	43400	ug/kg			P	551	1	AVIO1	080819-1
7439-97-6	Mercury	132000	ug/kg			AV	9260	2000	HG5	080719S1-2

***Analytical Methods:**

AV	**SW846 7471B**
P	**SW846 3050B/6010D**

MW 8-19-19

METALS
-1-
INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259004 **CLIENT ID:** 19072104

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 84

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	53100	ug/kg			P	565	1	AVIO1	080819-1
7439-97-6	Mercury	62500	ug/kg			AV	8730	2000	HG5	080719S1-2

***Analytical Methods:**

AV	**SW846 7471B**
P	**SW846 3050B/6010D**

8/9/19

METALS
-1-
INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259005 **CLIENT ID:** 19072105

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 89

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	64300	ug/kg			P	531	1	AVIO1	080819-1
7439-97-6	Mercury	99600	ug/kg			AV	8920	2000	HG5	080719S1-2

***Analytical Methods:**

AV	**SW846 7471B**
P	**SW846 3050B/6010D**

mw 8/9/19

METALS
-1-
INORGANICS ANALYSIS DATA PACKAGE

SDG No: 485259 **METHOD TYPE:** SW846

SAMPLE ID: 485259006 **CLIENT ID:** 19072106

CONTRACT: ECOL01019

MATRIX: Soil **DATE RECEIVED** 19-JUL-19 **LEVEL:** Low **%SOLIDS:** 90

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440-38-2	Arsenic	57500	ug/kg			P	529	1	AVIO1	080819-1
7439-97-6	Mercury	87300	ug/kg			AV	8730	2000	HG5	080719S1-2

***Analytical Methods:**

AV	**SW846 7471B**
P	**SW846 3050B/6010D**

Mw 8-19-19

This page intentionally left blank.