Engineering Evaluation Cost Analysis (EE/CA)

Furnace Creek Area of Operable Unit 1
Black Butte Mine Superfund Site
Cottage Grove, Oregon

Prepared for:

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Acronyms

BBM	Black Butte Mine
bgs	below ground surface
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CFW	Coast Fork Willamette River
CSO	conceptual site model
DEQ	Oregon Department of Environmental Quality
DMA	Demonstration of Methods Applicability
EE/CA	evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HRS	Hazard Ranking System
LiDAR	light detection and ranging
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/L	nanograms per liter
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
NTCRA	non-time-critical removal action
OU	operable unit
PRAO	preliminary removal action objective
PRSC	post-removal site controls
RI	remedial investigation
Site	OU1 of Black Butte Mine Superfund Site
SPLP	Synthetic Precipitation Leaching Procedure
TCRA	time-critical removal action
TMM	tailings and mine materials
TSS	total suspended solids
UFC	Upper Furnace Creek
USGS	U.S Geological Survey
XRF	X-ray fluorescence

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Executive Summary

Introduction and Purpose

This engineering evaluation/cost analysis (EE/CA) for the Furnace Creek area at Operable Unit (OU) 1 of the Black Butte Mine (BBM) Superfund Site (Site) was prepared to support the selection of a removal action alternative for implementation as a non-time-critical removal action (NTCRA). An EE/CA approval memorandum (EPA 2016) was prepared by the U.S. Environmental Protection Agency (EPA) that summarizes the rationale for initiation of an NTCRA for the Furnace Creek area of OU1 and that the NCP criteria for initiating an NTCRA for the Furnace Creek area of OU1 were met. Section 300.415 (b)(4)(i) of the NCP requires completion of an EE/CA for all NTCRAs.

The purpose of the EE/CA is to document the environmental review and removal action selection process and provide a framework for evaluating and selecting alternative technologies. The EE/CA identifies preliminary removal action objectives (PRAOs) of the NTCRA and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the PRAOs. The results of the EE/CA, along with EPA's response decision, will be summarized in an Action Memorandum after review and response to public comments on the EE/CA.

This EE/CA report was prepared for EPA Region 10 by EA Engineering, Science, and Technology, Inc. (EA) and CDM Federal Programs Corporation (CDM Smith) under Task Order 0103-RICO-10EK for Architectural and Engineering Services (AES10) Contract Number EP-W-06-004. The EE/CA was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and *Guidance on Conducting Non-Time Critical Removal Actions under CERCLA* (EPA 1993). In addition, the cost estimates for each removal action alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000).

Site Description

The Site is located in a rural area approximately 10 miles south of Cottage Grove in Lane County, Oregon. The Site is located in an area of rugged topography at the end of London Road on the east side of Garoutte Creek. Elevations in the area range from approximately 1,000 feet North American Vertical Datum of 1988 (NAVD88) adjacent to Garoutte Creek to approximately 2,600 feet NAVD88 at the top of Black Butte. The Site is located within the watersheds of Dennis Creek and Furnace Creek, which are tributaries to Garoutte Creek. Much of the Site and most of the Furnace Creek watershed is covered by thick vegetation, which makes Site access challenging.

The Site is accessible by paved roads and several natural surface roads from Cottage Grove, Oregon. The Site is accessed by traveling approximately 10 miles south to the end of London Road, which leads south from the city of Cottage Grove. The lower Furnace Creek drainage is accessible via an undeveloped foot path from the Weyerhaeuser Road adjacent to the West side of Garoutte Creek or from an overgrown dirt road that runs along the east side of Garoutte Creek.

The upper Furnace Creek drainage is accessible through dense vegetation off of the south side of the main dirt road that runs adjacent to Furnace Creek through the tailings impoundment.

Previous Removal Actions at the Black Butte Mine

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 TCRA, the following activities were completed:

- Tailings were removed from Dennis Creek, and the tailings slope above the creek was stabilized to limit erosion of materials into Dennis Creek.
- Mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil and tailings removed from the Dennis Creek drainage that were determined to have low mercury concentrations.
- Tailings removed during the TCRA activities that had high concentrations of mercury were placed in a repository located at the Main Tailings Pile and capped with soil having low mercury concentrations.

In 2009, EPA Region 10 completed a Hazard Ranking System (HRS) evaluation for BBM (Ecology and Environment 2009). Based on the results of the overland discharge/flood component of the evaluation, the Site was added to the National Priorities List (NPL) on March 5, 2010.

In 2012, EPA completed a Site optimization review (EPA 2012), which evaluated conditions and identified optimal approaches for conducting the remedial investigation (RI) at the Site. In the optimization review (EPA 2012), a preliminary site-wide CSM was developed that identified several key areas contributing to transport of mercury from the Site to Cottage Grove Lake, including:

- Black Butte Mine
- Coast Fork Willamette River (CFW) and Garoutte Creek
- Cottage Grove Lake Wetland Exposed Low Pool
- Cottage Grove Lake

Based on these defined areas, three operable units were established as follows:

- Operable unit 1 (OU1): The Black Butte Mine area and vicinity
- Operable unit 2 (OU2): The CFW from Big River confluence to Cottage Grove Lake
- Operable unit 3 (OU3): Cottage Grove Lake

The optimization review (EPA 2012) identified that Furnace Creek may be the largest source of mercury to the downstream watershed. Results of the ongoing OU1 RI, completed between November 2012 and June 2015, document that Furnace Creek is an ongoing and dominant source of mercury from OU1 to the downstream watershed of Garoutte Creek and the CFW (OU2) and

Cottage Grove Lake (OU3). Mercury within sediment of Cottage Grove Lake and the associated dissolved fraction is an ongoing source of mercury available for methylation, which results in elevated mercury in fish tissue. These finding prompted EPA to proceed with an NTCRA to address mercury source material at the Furnace Creek area of OU1.

Determination of Removal Action Scope

The scope of the removal action 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. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek are the dominant source of mercury 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.

The following PRAOs have been developed for the Furnace Creek removal action:

1. 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

2. Reduce the migration of Furnace Creek mercury to Garoutte Creek

Tailings co-mingled with soils and sediments would be primarily targeted for removal action to meet the above-mentioned PRAOs. The performance of the removal action will be measured by:

- Visual confirmation:
  - No visual evidence of tailings are found after they have been removed or capped for removal action alternatives involving excavation or containment
  - Tailings have relatively coarse texture (sandy gravel to gravel) and a characteristic pink to red color as compared to the underlying native material. Native material will have no evidence of tailings co-mingled with soils and sediments.
- Analytical confirmation:
  - Analytical confirmation can be determined by using field XRF or other reliable tool
  - During removal design, reliable indicators to identify tailings would be developed such as identification of inorganic constituents (e.g., arsenic) within soils/sediments
- Comparison of pre- and post-removal action annual mercury loading in surface water of Furnace Creek at the confluence with Garoutte Creek.

No components to directly address dissolved mercury in surface water and shallow alluvial groundwater underlying Furnace Creek will be included in the removal action because the contribution of dissolved mercury from these sources to the total annual load is low. However, removal action components to address particulate mercury in Furnace Creek are also expected to reduce dissolved mercury concentrations in Furnace Creek.

Identification and Description of Removal Action Alternatives

Removal action alternatives were identified and developed to address the mercury source material within the Furnace Creek catchment area, which consists of furnace wastes associated with the Old Furnace (i.e., tailings) and mercury-impacted soil and sediment within the bed of Furnace Creek that is co-mingled with tailings. Mercury source material is subject to erosion into the channel of Furnace Creek, which can then migrate to Garoutte Creek. The following removal action alternatives were recommended and approved by U.S. Environmental Protection Agency (EPA) in the Final EE/CA Planning Memorandum for evaluation in the Final EE/CA for Furnace Creek:

- Alternative RA1: Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures
- Alternative RA2: In-Place Containment of Mercury Source Material using Covers
- Alternative RA3: Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

A brief description of each removal action alternative is presented in the following subsections.

Alternative RA1

Alternative RA1 uses retention of sediments within the Furnace Creek using stormwater detention basins and erosion control measures for sheet flow and channelized flow on the side slopes and banks within the Furnace Creek catchment area along with implementing best management practices (BMPs) during construction and post-removal site control (PRSC) as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes both the contact of stormwater run-on with tailings and contaminated soils/sediments and mobilization and control of particulate-bound mercury entering Furnace Creek by retaining mercury source material within the Furnace Creek catchment area. This alternative also minimizes mobilization of particulate-bound mercury entering Furnace Creek from migrating to Garoutte Creek. However, these approaches would minimally reduce the potential for leaching of mercury into groundwater and surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.

The retention of sediments within Furnace Creek removes particulate-bound mercury in Furnace Creek stormwater prior to entry in Garoutte Creek. This will require installation of multiple in-line stormwater detention basins with particulate/sediment filtration mechanism within the Furnace Creek. Erosion control measures for sheet flow would be implemented within upland areas of tailings and co-mingled contaminated soils areas, which have the potential of erosion. This would require minimal re-contouring and revegetation as well as limited surficial treatment of highly contaminated soils using chemical agents such as magnesium chloride to control dust or soil tackifiers to control particulate erosion. Erosion control measures for channelized flow would minimize the clean stormwater run-on contact with areas of tailings and co-mingled contaminated soils and control runoff that has entered these areas. Stormwater run-on and runoff swales would be comprised of vegetated or riprap/hardened surfaces or diversion culverts/headwalls.

Alternative RA2

Alternative RA2 focuses on in-place containment for areas of tailings and co-mingled contaminated soils/sediment using covers as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes mobilization of particulate-bound mercury from entering Furnace Creek through re-contouring areas of tailings and co-mingled contaminated soils/sediment, installation of covers, and implementing BMPs during construction and PRSC. These approaches would contain mercury source material in the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.

The existing surface tailings and co-mingled contaminated soils/sediment areas would be graded to the extent practicable for the installation of an in-place containment system using covers. Upland covers would be installed in areas where the existing grades are relatively shallow and stable and is outside the banks of the Furnace Creek. A vegetated simple soil cover is the most representative upland cover type that can be effectively used as an in-place containment system. Creek bank covers would be installed in areas that are in close proximity to the creek bed and are within the floodway or that have adjacent steep slopes. Creek bank covers could consist of hardened (such as riprap) or reinforced vegetated covers using engineered materials, like geogrid or geoweb cellular confinement system filled with uncontaminated soil, gravel, or riprap material. Creek bed covers would be installed to contain the channel bottom or the bed of Furnace Creek to prevent or minimize re-suspension of contaminated channel bottom tailings/co-mingled sediments in the water column.

Alternative RA3

Alternative RA3 focuses on excavation and onsite disposal of tailings and co-mingled contaminated soils/sediment with reclamation of upland and creek bank areas and rehabilitation of the creek bed along with erosion and sediment control BMPs to manage particulate-bound mercury and thus achieve PRAOs. These approaches would remove mercury source material from the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with contaminated sediment within the Furnace Creek bed.

Under this alternative, the primary source of mercury contamination (i.e., surface tailings and co-mingled mercury-impacted soils/sediment within the Furnace Creek removal action boundary) would be mechanically and/or pneumatically excavated. Excavated surface tailings and co-mingled contaminated soils/sediment would be direct loaded, as practical, and transported for onsite disposal. For this EE/CA, it is assumed that the existing tailings repository location would be expanded and used for onsite disposal of excavated surface tailings and co-mingled contaminated soils/sediment. The excavated upland and creek bank areas within the Furnace Creek catchment area would be graded and backfilled to provide positive drainage and support vegetation and not to match the surface conditions or grades that previously existed. The creek corridor of the Furnace Creek would be rehabilitated to stabilize the bank slopes and reduce future erosion of remaining mercury-contaminated soil and sediment.

Detailed Analysis and Comparative Analysis of Removal Action Alternatives

These removal action alternatives are evaluated and compared using the criteria specified in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993). This EE/CA evaluates the three removal action alternatives against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost, as well their sub-criteria.

The results of the detailed analysis for each removal action alternative are presented in Exhibit ES-1 to allow a comparative analysis of the alternatives and identify the key tradeoffs between them as presented in the EE/CA.

Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended removal action alternative for Furnace Creek is Alternative RA3. Alternative RA3 includes removal (excavation) and onsite disposal of tailings and co-mingled contaminated soils/sediment within a repository located outside of the Furnace Creek catchment area. This alternative addresses the mobility and the availability of mercury in tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment area; thus, PRAOs for the Furnace Creek removal action would be better achieved as compared to Alternative RA1 and RA2.

Under Alternative RA3, tailings and co-mingled contaminated soils/sediment would be removed (excavated) and the existing tailings repository location would be expanded for onsite disposal of excavated mercury source material. The new onsite disposal repository would be contained using a suitable cover specifically designed for the repository conditions with erosion control measures installed. This would also considerably enhance the existing tailings repository; thus, potentially reducing the long-term O&M requirement. Also, potential future or additional remedial action may not be required under Alternative RA3, because tailings and co-mingled contaminated soils/sediment would be excavated (removed) from within the Furnace Creek removal action area and disposed at an onsite repository outside the Furnace Creek catchment area. Thus, the overall removal action activities under Alternative RA3 would be compatible with the overall OU1 remedial strategy.

The relative percent difference between costs for all three removal action alternatives is insignificant given the +50% to -30% accuracy range for the cost estimates. Alternative RA2 and RA3 are approximately 39% and 46%, respectively higher in cost than Alternative RA1. For Alternative RA3 the overall effectiveness based on "long-term effectiveness and permanence", "short-term effectiveness", and "implementability" criteria is higher than other alternatives (Exhibit ES-1). Thus, the overall effectiveness of Alternative RA3 was determined to be proportional to its costs and hence cost-effective (i.e., it represents a reasonable value for the money to be spent).

Once the EE/CA is finalized, it will be presented to the public. For non-time critical removal actions, the National Contingency Plan (NCP) requires a 30-day public comment period on the EE/CA and any supporting documentation (including fact sheets or other documents summarizing the alternatives under consideration). After the public comment period is over, a written response to significant comments received during the comment period is prepared. The response to comments should be included in the administrative record file.

The final phase of the EE/CA process is to prepare the Action Memorandum. The Action Memorandum, as a primary decision document, substantiates the need for removal action, identifies the proposed action, and explains the rationale for the removal action alternative selected.

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Exhibit ES-1. Summary of Comparative Analysis for Removal Action Alternatives

		Effectiveness					Implementability					Cost	
Removal Action Alternative	Description	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Technical Feasibility	Administrative Feasibility	Availability of Services and Materials	State (Support Agency) Acceptance	Community Acceptance	Present Value Cost (Dollars)	
RA1	Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures	+	+	❷	⓿	❹	❹	❸	❹	NE	NE	$$$	$1,040,000
RA2	In-Place Containment of Mercury Source Material using Covers	+	+	❸	⓿	❹	❸	❹	❹	NE	NE	$$$	$1,468,000
RA3	Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces	+	+	❺	⓿	❸	❹	❹	❹	NE	NE	$$$$	$1,571,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess removal action alternatives (for instance, individual rankings for an alternative are not additive).

Legend for Qualitative Ratings System:

Effectiveness and Implementability				Cost	
For First Two Criteria		For Rest of the Criteria		Present Value Cost in Dollars	
—	Unacceptable	⓿	None	⓿	None
+	Acceptable	❶	Low	$	Low ($0 through $500K)
+*	Acceptable with ARAR Waiver(s)	❷	Low to Moderate	$$	Low to Moderate ($500K through $1M)
		❸	Moderate	$$$	Moderate ($1M through $1.5M)
		❹	Moderate to High	$$$$	Moderate to High ($1.5M through $2M)
		❺	High	$$$$$	High (Greater than $2M)
		NE	Not Evaluated		

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Section 1
Introduction

This engineering evaluation/cost analysis (EE/CA) report for the Furnace Creek area at Operable Unit (OU) 1 of the Black Butte Mine (BBM) Superfund Site (Site) was prepared for the U.S. Environmental Protection Agency (EPA) Region 10 by EA Engineering, Science, and Technology, Inc. (EA) and CDM Federal Programs Corporation (CDM Smith) under Task Order 0103-RICO-10EK for Architectural and Engineering Services (AES10) Contract Number EP-W-06-004.

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1.1 Purpose

This EE/CA was prepared to support the selection of a removal action alternative for implementation as a non-time-critical removal action (NTCRA) at the Furnace Creek area of OU1. An EE/CA approval memorandum (EPA 2016) was prepared by EPA that summarizes the rationale for initiation of an NTCRA for the Furnace Creek area of OU1 and that the NCP criteria for initiating an NTCRA for the Furnace Creek area of OU1 were met. Section 300.415 (b)(4)(i) of the NCP requires completion of an EE/CA for all NTCRAs.

The purpose of the EE/CA is to document the environmental review and removal action selection process and provide a framework for evaluating and selecting alternative technologies. The EE/CA identifies preliminary removal action objectives (PRAOs) of the NTCRA and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the PRAOs.

The results of the EE/CA, along with EPA's response decision, will be summarized in an Action Memorandum after review and response to public comments on the EE/CA.

1.2 EE/CA Organization

The EE/CA is organized as follows:

1. Summarize site characterization and present the conceptual site model (CSM) for Furnace Creek (presented in Section 2)
2. Identify a removal action boundary for the Furnace Creek removal actions contemplated in this EE/CA and provide rationale (presented in Section 2)
3. Present the removal scope, schedule, and PRAOs for the Furnace Creek removal action (presented in Section 3)

4. Identify removal action alternatives that may be used to satisfy the PRAOs and evaluate the effectiveness, implementability, and cost of each alternative (presented in Section 4)

5. Conduct a comparative analysis of removal action alternatives to each other with respect to effectiveness, implementability, and cost (presented in Section 5)

6. Recommend the removal action alternative that best meets the evaluation criteria (presented in Section 6)

Section 2

Site Characterization

The first part of this section presents an overview of the physical characteristics of the Site and previous removal actions completed within OU1. The second part focuses on the CSM for the Furnace Creek catchment area of OU1. The Furnace Creek CSM is used as the basis for identification of the removal action area boundary for the Furnace Creek removal action, which is evaluated in this EE/CA.

2.1 Site Description and Background

Physical characteristics of the Site are presented in this section, including site location, topography, manmade features, climate, hydrology, geology, hydrogeology, and ecology.

2.1.1 Site Location, Topography, and Access

The Site is located in a rural area approximately 10 miles south of Cottage Grove in Lane County, Oregon. The latitude and longitude are 43° 34' 42" north, 123° 3' 58" west. The Site is located in the northwest ¼ of Section 6, Township 23 south, Range 3 west on the U.S Geological Survey (USGS) Harness Mountain 7.5-Minute Topographic Quadrangle, 2011.

The Site is located in an area of rugged topography at the end of London Road on the east side of Garoutte Creek (Figure 2-1). Elevations in the area range from approximately 1,000 feet North American Vertical Datum of 1988 (NAVD88) adjacent to Garoutte Creek to approximately 2,600 feet NAVD88 at the top of Black Butte. The Site is located within the watersheds of Dennis Creek and Furnace Creek, which are tributaries to Garoutte Creek. Much of the Site and most of the Furnace Creek watershed is covered by thick vegetation, which makes Site access challenging.

The Site is accessible by paved roads and several natural surface roads from Cottage Grove, Oregon. The Site is accessed by traveling approximately 10 miles south to the end of London Road, which leads south from the city of Cottage Grove. The lower Furnace Creek drainage is accessible via an undeveloped foot path from the Weyerhaeuser Road adjacent to the West side of Garoutte Creek or from an overgrown dirt road that runs along the east side of Garoutte Creek. The upper Furnace Creek drainage is accessible through dense vegetation off of the south side of the main dirt road that runs adjacent to Furnace Creek through the tailings impoundment.

2.1.2 Site Features

The Site encompasses the former new and old furnace mine site areas, including mine portals, distributed tailings, and the receiving surface water streams immediately adjacent to the former mining activity (Figure 2-1).

General Site Features

Currently, much of the Site is undeveloped forest. A single-family residence (private residence) is within the Site and present near the Federal Emergency Management Agency (FEMA) flood Zone A of Garoutte Creek at the main point of access to the Site. The residence includes a home, several outbuildings, and a hay field. A water system is present, which conveys surface water from the upper portion of the Furnace Creek catchment through a system of hoses and tanks used by the residence for a potable water source. This residence is occupied year-round.

Underground Mine

Underground mine workings constructed prior to 1934 were documented by the USGS (Wells and Waters 1934). It is reported that the mine continued to operate on an intermittent basis through the late 1960s, and therefore additional underground workings are certainly present at the Site. The underground workings accessed the mercury ore through several adits (i.e., approximately horizontal tunnels leading from the surface into the mine) and through a series of stopes that provided for extraction of the ore. Generally speaking, the stopes followed the trend of the Black Butte fault, which controlled ore deposition. Several other apparent mine workings were identified based on evaluation of light detection and ranging (LiDAR) imagery, which may be workings constructed after 1934. Currently, there are no mine workings directly impacting the Furnace Creek watershed.

Old Furnace Area

A furnace structure, termed the "Old Furnace" was utilized to process mercury ore and produce elemental mercury. This type of furnace operated by placement of a "charge" of ore and fuel into the furnace and burning the fuel to heat the ore. The furnace heated the mercury ore to temperatures above the stability temperature of the mineral cinnabar (HgS), which volatilized the mercury and sulfur (Rytuba 2002). The volatile emissions from the furnace were passed through a condenser system, which collected elemental mercury as it cooled and condensed from mercury vapor into elemental mercury.

Remnants of the Old Furnace are located on the north side of the Furnace Creek catchment as shown in Figure 2-1. The foundation of the furnace and a group of sub-vertical pipes of approximately 12 inches in diameter are present in the area. These vertical pipes are thought to have been a part of the condenser system for the furnace. Miscellaneous steel pipes and other former furnace-related infrastructure are also present in the area of the foundation.

Tailings

After the mercury was recovered from the ore, the tailings were discharged directly downslope from the furnace, which was common operational mine practice in the U.S. prior to approximately 1970. Mercury tailings are also called "calcines" because lime and/or calcium carbonate was added to the ore to assist in desulfurization of the ore (Rytuba 2002). In this report, the more general term "tailings" is used to describe this material. The tailings are relatively coarse in texture and have a characteristic pink to red color, which results from oxidation of iron present in the ore. The texture of the tailings ranges generally from sandy gravel to gravel, which when combined with the color makes the tailings relatively easy to differentiate from natural materials.

Tailings produced by the Old Furnace were discharged directly to the Furnace Creek. These tailings have been remobilized downstream to some extent and have, in places, buried the channel of Furnace Creek. During the removal action, tailings produced from processing of ore through the "New Furnace," located outside of the Furnace Creek Watershed, with relatively lower mercury concentrations were used to cover tailings in the Old Furnace Area, which contained relatively higher mercury concentrations.

2.1.3 Climate

The climate is marine temperate with mild wet winters and dry summers. The highest precipitation falls between November and April. Precipitation at the Site is evaluated by long-term precipitation data collected at the onsite weather station and historical long-term weather data compiled from four National Oceanographic and Atmospheric Administration (NOAA) weather stations in proximity of the Site. These NOAA stations are the Black Butte, Sutherlin, Cottage Grove Dam, and Eugene weather stations. The Black Butte station, located closest to the Site, shows the highest precipitation of the four weather stations. In 2012, the Black Butte station recorded an annual precipitation of approximately 70 inches, which is higher than the 30-year average for annual precipitation between 1960 and 1989, which is 48.5 inches (CDM Smith 2014a).

2.1.4 Surface Water

Surface water hydrology for OU1 is described in this section. Furnace and Dennis Creek are the primary streams that contribute to the fate and transport for the mine wastes to Garoutte Creek and the downstream watershed (OU2).

2.1.4.1 Garoutte Creek Watershed

At 16.6 square miles (10,600 acres) in extent, the Garoutte Creek watershed is the largest watershed in the OU1 investigation, and it encompasses the entirety of the 0.23 square mile OU1 boundary. Furnace and Dennis Creek watersheds are entirely within the Garoutte Creek watershed. Furnace and Dennis Creeks define the south and north drainage boundaries, respectively, for the mined areas and play critical roles in the fate and transport of mine wastes from the Site. These contributing watersheds are discussed separately in the following subsections. Garoutte Creek is a larger stream that consists of cobbles, gravel, and sand. Bank-full width is approximately 40 feet, and average depth is 1 foot. In May 2013, flow in lower Garoutte Creek was approximately 17 cubic feet per second (cfs).

Garoutte Creek extends northward from its origin on the slope of the 3,311-foot NAVD88 Harness Mountain to a point approximately 1.5 miles downstream of Dennis Creek at the confluence with Big River. Beyond this confluence, the name of the combined surface waters of Big River and Garoutte Creek becomes the Upper Coast Fork Willamette River (CFW). The Upper CFW flows northward for approximately 7 miles where it enters Cottage Grove Lake.

Water quality stream discharge in the Garoutte Creek watershed is monitored at two locations within OU1. The two locations include an upstream, background location immediately upstream of the Furnace Creek confluence called Garoutte Creek upstream station (GU1), and a downstream location immediately upstream of the Dennis Creek confluence, designated Garoutte Creek downstream station (GD1) (Figure 2-1).

2.1.4.2 Furnace Creek Watershed

At 0.05 square miles (29.8 acres), the Furnace Creek watershed consists of a single deeply entrenched channel with no smaller stream segment contributions. Furnace Creek is a small, ephemeral creek within the larger Garoutte Creek watershed and is encompassed completely within OU1. Its origin is a spring that emerges along the west facing slopes of Black Butte, and the drainage forms the south boundary of the mined area of the Site. The stream is approximately 0.4 miles in length, and based on the 2012-15 monitoring period, the lower half of the stream channel becomes dry and does not have surface flow for approximately 6 months of the year (mid-May through mid-November). The upper portion of the watershed near the spring source has a continuous, albeit small discharge that reliably supplies water for the private residence year round.

The last 900 linear feet of the creek is partially filled with deposits of historic mine tailings from the Old Furnace. A headwall scarp about 120 feet upstream of the confluence with Garoutte Creek is present and reportedly the result of a high flow event that occurred when active logging in 1998 broke up a small reservoir in the upper portion of the Furnace Creek watershed where the private residence receives its water supply (Private Residence 2012). Evidence of the large volume of water flushing through the channel is present in the deeply entrenched, much wider channel that is now populated with 15-year-old alder trees. The high flow event may have resulted in intermixing of tailings and soil and possible burial of tailings in areas of debris flow deposits within the Furnace Creek catchment.

Stream discharge and water quality at Furnace Creek has been monitored at a staff gauge and stilling well located just upstream of the confluence with Garoutte Creek, designated station F1 (Figure 2-1). Additional water quality samples were collected during the summer of 2013 and spring of 2014 at the private residence's water supply in the upper watershed to evaluate natural background concentrations of mercury and other metals above the areas disturbed by mining activities.

2.1.4.3 Dennis Creek Watershed

At 1.1 square miles (690 acres), the Dennis Creek watershed presents a northern boundary for the mined area of the Site. Dennis Creek is a perennial stream drainage within the larger Garoutte Creek watershed, with a dominate substrate consisting of cobbles and gravel. The stream is approximately 2 miles in length and in its lower half flows within OU1. The creek receives drainage from the north facing slopes of Black Butte and south facing slopes of a forested ridge and high point named Stennett Butte that is predominantly under Bureau of Land Management ownership. The stream is steeply entrenched but is less sloping and wider, with a more defined flood terrace as compared to Furnace Creek. Approximately 0.7 miles upstream of the confluence with Garoutte Creek, a prominent northwest tributary drainage enters Dennis Creek. This unnamed drainage originates along the slopes of the Site and numerous mine adits and rock dumps are present with the catchment of this drainage.

2.1.5 Geology

The geology of the Site is relevant to assessment of the hydrogeological framework and understanding the potential source materials present on and near the site. Therefore, this section focuses on description of the bedrock geology, alluvial and colluvial deposits, hydrothermal alteration, and ore mineralization. Other aspects of the site geology were described by Derkey (1973) and Wells and Waters (1934). The Site geologic map is shown in Figure 2-2.

Geology

The bedrock at the Site is volcanic in origin and consists of primarily pyroclastic rocks such as tuff, tuffaceous sandstone and siltstone, and pebble to boulder conglomerate of the Fisher Formation (Derkey 1973). This formation is referred to by an alternative name, the Calapooya Formation, in older reports such as Wells and Waters (1934). The tuff was deposited by airfall of volcanic particles, and the tuffaceous sandstone, siltstone, and pebble conglomerate deposits are reworked sedimentary deposits composed primarily of volcanic particles of silt, sand, or pebble to boulder size. Local deposits of andesite are also present. Andesite is a crystalline rock formed through cooling of lavas of andesitic composition. In the Site, Wells and Waters (1934) report that rocks on the east side of Garoutte Creek contain relatively more andesite as compared to rocks west of Garoutte Creek. The various rock units are interlayered, and the individual layers are not laterally continuous. A major fault is present at the Site, which crops out near the top of Black Butte and trends towards the west northwest.

The bedrock is the parent material for colluvial and alluvial deposits. Colluvium is unconsolidated material that has been deposited primarily by gravity. These materials are several feet thick and are present on hill sides. Alluvial materials have been deposited primarily by flowing water and are present within tributary and major drainages. The alluvial materials are relatively thicker, with depths of over 10 feet observed within tributary drainages to Garoutte Creek such as the Furnace Creek drainage.

Mineralization

The Black Butte mercury deposit is a hydrothermal mineral deposit formed by circulation of hot mineralized waters through the bedrock rock units. The Black Butte fault was a conduit for these hydrothermal fluids. The hydrothermal fluids caused deposition of cinnabar (mercury sulfide) and other sulfide minerals, quartz and carbonate veining, replacement of primary minerals with silica and carbonate, and alteration of primary rock minerals to clays. Rock containing sufficient mercury to support profitable extraction (i.e., “ore”) was restricted to areas close to the Black Butte Fault. The ore contains cinnabar as well as other iron, copper, and zinc sulfide minerals such as pyrite, arsenopyrite, tetrahedrite, chalcopyrite, and sphalerite (Derkey 1973). Two other forms of mercury, elemental mercury and metacinnabar, have been reported, but are not common (Wells and Waters 1934).

The brown colored ribs of rock that are exposed on Black Butte are within the area of highest mercury enrichment. The ore body cropped out in this area, and rock containing enriched concentrations of mercury eroded naturally over geological time long before mining commenced in the area. Therefore, natural soils, colluvium, and alluvium in the Site were likely enriched in mercury to some extent prior to initiation of mining activities. Erosion of sediments containing mercury from these areas of natural enrichment may also contribute to the stored mercury load present within the Garoutte Creek watershed.

Ore-grade mineralization at the Site was restricted to areas close to the fault, but relative enrichments in mercury concentration as compared to background conditions are possible at distances further from the fault within the hydrothermally altered rocks. The geologic map provided by Wells and Waters (1934) shows a large area of altered rocks in the area of the Black Butte fault, with alteration extending approximately 1 mile in an orientation perpendicular to the fault and approximately 2 miles in an orientation parallel to the fault. Although the strongest hydrothermal alteration and associated ore mineralization is centered on the fault, the large alteration zones show that the bedrock was permeable enough to allow the hydrothermal fluids to circulate through, and affect, a relatively large volume of rock. Wells and Waters (1934) also identify similar alteration zones north of Dennis Creek (called East Fork Garoutte Creek on the Wells and Waters map) and south of Garoutte Creek in an area called Cinnabar Mountain.

Although ore-grade mineralization was only exploited within a relatively local area at the Site, altered rocks that may contain naturally enriched mercury concentrations are present within a larger area encompassing several square miles within the Garoutte Creek watershed. Although the concentration of mercury in these altered rocks is likely lower than the ore, the exposed area of these altered rocks is much larger than the exposures at the Site. Natural erosion of these altered rocks could also contribute to mercury loads in the Garoutte Creek watershed.

2.1.6 Site Hydrogeology

Groundwater occurs in three hydrogeological systems within the Site:

1. Upland groundwater in tailings and weathered bedrock
2. Alluvial groundwater within soils and sediment of Garoutte, Dennis and Furnace Creeks
3. Deep bedrock fracture flow groundwater

Groundwater occurrence within the Furnace Creek catchment is limited to the upland groundwater and alluvial groundwater systems, which are included in the Furnace Creek CSM discussion in Section 2.3. An overview of the upland, alluvial, and deep bedrock fracture flow groundwater systems follows.

The upland groundwater system occurs on the slopes of the Site where surface water infiltration enters Site tailings and/or native soil overburden and collects in soils immediately above the weathered bedrock, which is predominantly comprised of hydrothermally altered siltstone and tuff. Native soil in the upland area is of low permeability, generally comprising clay or silt. In areas where groundwater flows in this shallow zone and the weathered bedrock occurs at the surface, the groundwater is pushed to the surface and occurs as seeps where it runs along the surface before re-infiltrating again. This seepage has been observed at the base of the hillside in the vicinity of monitoring well MW7, where the permeability contrast between native soil and underlying weathered bedrock results in groundwater discharge at ground surface.

Alluvial groundwater systems occur throughout the lowland floodplain of Garoutte Creek and within the Dennis and Furnace Creek catchments. Alluvium ranges from lower permeability overbank deposits to higher permeability channel deposits in historic or active channel locations. The alluvial system is truncated by underlying bedrock or in areas where bedrock crops out at the surface.

The deep bedrock groundwater system consists of fracture flow groundwater within the bedrock underlying the hillside. No bedrock wells were installed during the OU1 RI; however, a water supply well located within the Site's mining area is presumed to be completed within the bedrock groundwater system. Reports on mining at the Site indicate that significant groundwater was encountered along faults during underground mining activities (Wells and Waters 1934).

The upper portion of the Furnace Creek tributary near sampling site Upper Furnace Creek (UFC) 1 is perennial and used to supply domestic water to a Site resident. The lower portion of Furnace Creek near sampling site Furnace Creek (FC) 1 is ephemeral, and flows only after the seasonal soil moisture deficit has been replenished and interception from vegetation has diminished (typically during the winter). The groundwater elevation data collected from wells located in the upper and lower reaches of the creek (MW10 and MW9) show the groundwater table is below the creek bed throughout the year (Figure 2-4). This results in a losing stream condition for Furnace Creek along its entire length. Further evidence for the consistently losing stream condition of Furnace Creek includes a rapid decline in the hydrograph after a storm event near the mouth of the creek, indicating a lack of sustained groundwater baseflow contribution.

2.1.7 Ecology

Terrestrial and aquatic habitats were characterized during OU1 RI field surveys using the Ecological Risk Checklist that was adapted from EPA for use on hazardous waste sites (CDM Smith 2014a). Habitats and communities present within the Site are described below.

Terrestrial Habitat Assessment

Terrestrial habitats in and around the Site consist of mixed forest dominated by Douglas-fir (*Pseudotsuga menziesii*), Western red cedar (*Thuja plicata*), Western hemlock (*Tsuga heterophylla*), and bigleaf maple (*Acer macrophyllum*). Understory vegetation within forested areas consists of vine maple (*Acer circinatum*), Oregon grape (*Mahonia aquifolium*), and thimbleberry (*Rubus parviflorus*), with Himalayan blackberry (*Rubus armeniacus*) dominating forest edges and open, disturbed areas. There are also large upland areas disturbed by mining and reclamation activities that are dominated by stands of invasive Scotch broom (*Cytisus scoparius*).

Aquatic Habitat Assessment

Aquatic habitats are associated with Furnace, Dennis, and Garoutte Creeks. The following presents a description of these habitats based on the preliminary field surveys completed during the OU1 RI.

Downstream portions of Furnace Creek, where Old Furnace tailings are deposited, only experience discharge seasonally during the wet season from late November through mid-May. The substrate in Furnace Creek consists primarily of fine-grained sediment and tailings in the mid to lower reach segments downstream to the mouth. Due to its steep slope and ephemeral nature, Furnace Creek does not support habitat for fish but may support larval amphibians in upstream reaches where flow is perennial. Both Dennis Creek and Garoutte Creek support habitat for fish and other aquatic species.

Riparian vegetation occurs adjacent to the creeks and is dominated by deciduous trees and shrubs, including bigleaf maple, red alder (*Alnus rubra*), and vine maple. Sword fern (*Polystichum munitum*) and thimbleberry are common understory riparian species, with Himalayan blackberry dominant along much of the riparian habitat. Reed canarygrass (*Phalarius arundinacea*) is present along some of the wider reaches of Garoutte Creek.

2.2 Previous Removal Actions at the Black Butte Mine

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 TCRA, the following activities were completed:

- Tailings were removed from the slope above the creek as part of the slope stabilization to limit erosion of materials into Dennis Creek.
- Mercury-impacted tailings and soil at the Old Furnace and New Furnace were capped with soil and tailings removed from the Dennis Creek drainage that were determined to have low mercury concentrations.
- Tailings removed during the TCRA activities that had high concentrations of mercury were placed in a repository located at the Main Tailings Pile and capped with soil having low mercury concentrations.

In 2009, EPA Region 10 completed a Hazard Ranking System (HRS) evaluation for BBM (Ecology and Environment 2009). Based on the results of the overland discharge/flood component of the evaluation, the Site was added to the National Priorities List (NPL) on March 5, 2010.

In 2012, EPA completed a Site optimization review (EPA 2012), which evaluated conditions and identified optimal approaches for conducting the remedial investigation (RI) at the Site. In the optimization review (EPA 2012), a preliminary site-wide CSM was developed that identified several key areas contributing to transport of mercury from the Site to Cottage Grove Lake, including:

- Black Butte Mine
- CFW River and Garoutte Creek
- Cottage Grove Lake Wetland Exposed Low Pool
- Cottage Grove Lake

Based on these defined areas, three operable units were established as follows:

- Operable unit 1 (OU1): The Black Butte Mine area and vicinity
- Operable unit 2 (OU2): The CFW from Big River confluence to Cottage Grove Lake
- Operable unit 3 (OU3): Cottage Grove Lake

The optimization review (EPA 2012) identified that Furnace Creek may be the largest source of mercury to the downstream watershed. Results of the ongoing OU1 RI, completed between November 2012 and June 2015, document that Furnace Creek is an ongoing and dominant source of mercury from OU1 to the downstream watershed of Garoutte Creek and the CFW (OU2) and Cottage Grove Lake (OU3). Mercury within sediment of Cottage Grove Lake and the associated dissolved fraction is an ongoing source of mercury available for methylation, which results in elevated mercury in fish tissue. These finding prompted EPA to proceed with an NTCRA to address mercury source material at the Furnace Creek area of OU1.

2.3 Source, Nature, and Extent of Contamination

The source, nature, and extent of contamination is evaluated through the development of a CSM. The CSM is a tool that is used to organize and communicate information about a site. It provides a summary of where sources of contamination are located, how contaminants will migrate, and to where they will migrate.

The preliminary CSM for the Site from EPA's optimization review (EPA 2012) is a sitewide CSM addressing mercury transport from the Site along the CFW to Cottage Grove Lake. Mercury loading to Garoutte Creek and the CFW is believed to have caused elevated mercury concentrations in the sediment and tissue of fish at Cottage Grove Lake and the CFW. A schematic representation of the sitewide CSM from the optimization review (EPA 2012) is presented in Figure 2-3. In Figure 2-3, only the dominant sources of mercury to the downstream watershed are indicated. For example, although the transport of mercury from the Main Tailing Pile as suspended sediment in Dennis Creek does occur, it is not considered a dominant source of mercury to the downstream watershed and is not indicated as such in Figure 2-3. The sitewide CSM includes two key components: (1) the release and transport of mercury from the Site and (2) the mercury methylation process in Cottage Grove Lake. The OU1 RI was conducted to evaluate the first component, and EPA is currently evaluating the second component. Surface water and sediment data collected during the ongoing OU1 RI activities identified that Furnace Creek is the most significant source of mercury contamination to Garoutte Creek. The following sections present the current CSM for Furnace Creek that is used as the basis for developing removal action alternatives in this EE/CA.

2.3.1 Furnace Creek Conceptual Site Model

The purpose of the Furnace Creek CSM is to describe mercury source materials within the Furnace Creek catchment area and identify the primary contaminant transport pathways from Furnace Creek source materials to Garoutte Creek.

Mercury is present in surface water at Furnace Creek and Garoutte Creek primarily as particulate-bound mercury in the suspended load, and significant transport of mercury occurs along Furnace Creek during periods of higher stream flow during and following rainfall events. Primary sources of mercury within the Furnace Creek catchment area include mine tailings and mercury furnace wastes at the Furnace Creek Tailings Area and the Old Furnace Area. Dispersion of mercury from the primary source materials results in secondary sources of mercury, including contaminated soil and sediment. Erosion and depositional processes result in mobilization of particulate-bound mercury from the primary and secondary sources into Furnace Creek. During active periods of flow at Furnace Creek, particulate-bound mercury is transported in the suspended load, ultimately discharging to Garoutte Creek. Transport of mercury in the dissolved phase also occurs but to a lesser extent than transport of particulate mercury. The dissolved fraction of mercury in surface water results from leaching of mercury from primary and secondary sources to the creek during rain events and from desorption and dissolution of mercury from sediment in Furnace Creek. Particulate and dissolved mercury concentrations increase during storm events when the greater amounts of sediment are suspended in the water column.

As described above, Furnace Creek is a losing stream. Although dissolved mercury is present in groundwater within the Furnace Creek catchment area, the water level elevation data and ephemeral character (rapid discharge and dry condition of the creek for 6 months of the year) provide clear evidence for the lack of upland groundwater discharge (baseflow contribution) to Furnace Creek, resulting in an incomplete pathway of dissolved mercury entering Furnace Creek discharge from contaminated perched upland groundwater. A graphical depiction of the Furnace Creek CSM is presented in Figure 2-4.

Other contaminant transport and exposure pathways associated with the Furnace Creek catchment area, but not considered significant or relevant to the downstream transport of mercury, include direct contact (human and ecological) with primary and secondary source materials and surface water, wind dispersion of particulate-bound mercury, and volatilization of elemental mercury from furnace waste at the Old Furnace area. Further discussion of these less significant transport and exposure pathways is excluded from the Furnace Creek CSM and will be addressed later in the OU1 RI/feasibility study.

2.3.2 Contaminant Sources

Primary Sources

Primary sources of mercury within the Furnace Creek catchment area consist of furnace wastes associated with the Old Furnace and tailings at the Furnace Creek Tailings Area. Both of these primary source materials are located on slopes, which are subject to erosion into the channel of Furnace Creek.

Potential sources of mercury associated with the Old Furnace include residual mercury in, around, or beneath the remnant ore processing equipment. Residual mercury may be in the form of cinnabar from ore processed at the Site, elemental mercury released during the processing of mercury vapors, or more soluble forms, such as mercury oxides and organic-bound mercury. Sequential mercury extraction analysis performed on tailings/soil samples collected from the Old Furnace area indicates that the major amount of mercury is in the relatively insoluble form of cinnabar and elemental mercury but some of the mercury is present in readily methylated forms (EPA 2007). The extent of furnace wastes is expected to be limited to the location of the Old Furnace remnants and immediate downslope area. During the 2007 TCRA, much of the area of the Old Furnace and remnant structures was capped with soil and tailings removed during the regrading of the slope above Dennis Creek. The tailings used to cap the Old Furnace area contained less than 23 milligrams per kilogram (mg/kg) mercury, as verified by field screening during the removal action (EPA 2008). The extent of the Old Furnace Area capped during the 2007 TCRA is shown in Figure 2-5. Screening level field X-ray fluorescence (XRF) and Lumex mercury data collected at Furnace Creek during the 2007 removal action are presented in **Appendix A**. These data include both mercury concentrations in surface soil prior to capping and mercury concentrations in surface soil after the soil cap was placed. Although the remnants of the Old Furnace remain in place and may contain high concentrations of mercury, the capping soil placed during the 2007 TCRA is expected to limit erosion of high mercury concentration furnace wastes and affected soil at the Old Furnace area into Furnace Creek. Although the capping soils do contain mercury up to 23 mg/kg, which could result in elevated concentrations in surface water if mobilized to Furnace Creek, the capped area represents less than 5 percent of the total area of the Furnace Creek catchment and is therefore not a significant source of mercury to surface water. Leaching of mercury from the Old Furnace wastes, capped during previous CERCLA removal actions, and the transport of leachable forms of mercury to groundwater is not expected to be a significant source of mercury as further discussed in Section 2.3.3.2.

As described in Section 2.1.2, spent tailings that had been processed through the Old Furnace were discharged into the Furnace Creek catchment. These tailings have been remobilized downstream to some extent and have, in places, covered the channel of Furnace Creek. The approximate extent of tailings at the Furnace Creek Tailings Area is indicated by the hatched area shown in Figure 2-5, as depicted in EPA's optimization review (EPA 2012). Information on the thickness of tailings is limited to:

1. Boring for monitoring well MW10 advanced in the upper portion of the Furnace Creek Tailings Area (Figure 2-1)

2. Borings MP05, MP06, and MP07, which were advanced during the 2005 Removal Assessment investigation (Appendix A).

3. Four test pits or trenches excavated in the Furnace Creek Tailings Area during the 2007 TCRA, including three test pits to depths exceeding 9 feet and one trench of 20-foot length (Appendix A). The exact 2007 TCRA test pit locations are not known.

Test pit observations indicated that the thickness of tailings ranged from less than 1 foot (MP04 and MP06) to greater than 9 feet in at least one of the 2007 TCRA test pit locations. The thickness of tailings outside of the boring and test pit locations is not known.

Tailings sampled at the location of the Old Furnace by the Oregon Department of Environmental Quality (DEQ) in 2003 had mercury concentrations up to 2,090 mg/kg; however, the Old Furnace area was capped during the 2007 TCRA to address this area of high mercury concentrations (Curtis 2004; EPA 2008). Samples collected from other areas of the Furnace Creek Tailings Area, collected during the OU1 RI in 2013-2014, indicated that the remaining surface soil in the Furnace Creek Tailings Area had mercury concentrations up to 543 mg/kg (CDM Smith 2014b). Field XRF data collected from the Furnace Creek Tailings Area during the TCRA indicate that tailings, soil, and sediment in this area may have even higher mercury concentrations. The range of mercury concentrations in Furnace Creek Tailings Area is shown in Figure 2-5.

Secondary Sources

Mercury-impacted soils within the Furnace Creek catchment are a secondary source of mercury to surface water and groundwater via erosion of soil particles into surface water and leaching of mercury to groundwater. Surficial soils adjacent to tailings areas are impacted by mercury when erosion and depositional process results in dispersion of the tailings into soil. Analysis of incremental surface soil sample tailings and mine materials (TMM) that was collected over the Furnace Creek Tailings Area and consisted of soil mixed with tailings indicated an average mercury concentration of 176 mg/kg (CDM Smith 2014b).

Soil underlying the tailings is impacted by mercury when precipitation leaches mercury from tailings and transports it downward into the underlying soil. Based on discrete-depth soil samples collected at the nearby location MW11 (Figure 2-1) at the Main Tailings Pile, mercury concentrations in soil attenuate rapidly (generally within 10 feet below the tailings/soil contact) in the clay soil that underlies the tailings. Given that clay is present at boring MW11 to depth of greater than 70 feet below ground surface (bgs) and at MW10 to a depth of greater than 15 feet bgs (total depth explored), migration of mercury leached from tailings into the underlying soil is not a significant transport pathway.

As shown in Figure 2-4, alluvium comprising the bed of Furnace Creek is another secondary source of mercury to surface water. This is due to the deposition of and intermixing of tailings/contaminated sediments with the active stream bed. Analysis of the one incremental sediment sample collected from the stream bed at the downstream end of the Furnace Creek Tailings Area (sediment sample station FC1) indicated an average mercury concentration in bulk sediment of 136 mg/kg (CDM Smith 2014a). DEQ collected grab sediment samples from Furnace Creek immediately downstream of the Old Furnace area in 2008, and mercury was detected at concentrations of 70.2 and 173 mg/kg in the primary and duplicate sediment samples collected at this location (DEQ 2008).

2.3.3 Contaminant Transport

Mercury derived from primary and secondary sources is transported via surface water in Furnace Creek to Garoutte Creek in particulate and dissolved forms and to a lesser extend via groundwater. The following subsections describe the contaminant transport in the Furnace Creek catchment.

2.3.3.1 Erosion and Particulate Mercury

The primary transport mechanism of mercury from the Furnace Creek catchment to Garoutte Creek is particulate mercury in surface water. Transport of particulate mercury in surface water occurs via two mechanisms:

3. Erosion of tailings and mercury-impacted soil into the Furnace Creek
4. Re-suspension of mercury-impacted channel bottom sediments into the water column

The relative contribution of each of these mechanisms to the suspended particulate mercury load in Furnace Creek is not well understood. Re-suspension of mercury impacted channel bottom sediment occurs in response to increased flow at Furnace Creek, generally whenever there is a precipitation event. Erosion of tailings or soil into Furnace Creek may occur less frequently, at isolated areas within the catchment area and in response to larger storm events. Due to the steep topography within the Furnace Creek catchment area, there is potential for erosion of tailings and soil into the Furnace Creek channel throughout the catchment area. This subsection provides a description of the transport of particulate mercury via surface water.

Based on the 2012-2013 monitoring period, the lower half of the Furnace Creek channel was dry and did not have surface flow for approximately 6 months of the year. During the 2013-2015 monitoring period, annual rainfall was abnormally low, and flow at the lower half of Furnace

Creek only occurred for a few months of the year. Periods when lower Furnace Creek was flowing include:

- November 2012 through May 2013
- February 2014 through May 2014
- December 2014 through April 2015

Uncertainties in the total annual flow at lower Furnace Creek during dry years should be considered when evaluating the total annual mercury load from Furnace Creek.

Mercury transport via surface water at Furnace Creek was characterized by collecting stream flow and water quality data at surface water monitoring station F1 for calculation of the annual mercury load. Continuous stream flow data were collected at F1 using a pressure transducer installed in a stilling pipe that was calibrated to manual stream flow measurements. Surface water quality data were collected through collection of multiple surface water samples at F1 during three storm events in 2013 and 2014. Annual mercury loading to Furnace Creek was calculated using stream flow measurements, mercury concentration data, and the discharge frequency calculation method, as described in *Final Black Butte OU1 Data Summary Report* (CDM Smith 2014a).

Furnace Creek stream flow ranges from no flow during the dry season to up to approximately 3 cfs during large precipitation events. This estimate is based on continuous stream discharge monitoring data collected during the OU1 RI from December 2012 through October 2014. Much higher flow events are expected to occur during 100-year storm events or catastrophic events like the reported failure of the upstream reservoir in 1998.

Water quality monitoring data collected during the OU1 RI indicate that total suspended solids (TSS) and total mercury concentrations increase as the stream flow rate increases during precipitation events. At Furnace Creek, total mercury concentrations ranged from a low of 595 nanograms per liter (ng/L) during the baseline measurement of the March 2013 storm event to a high of 93,800 ng/L during the peak of the larger February 2014 storm event. The flow was approximately 1 CFS during the February 2014 storm event. Based on precipitation statistics at the Cottage Grove 1 NNE weather station for the period of 1914 through 2014, the February 2014 storm event has a 2-year reoccurrence interval (2-year storm event). Higher mercury concentrations in Furnace Creek are expected during larger storm events such as the December 2012 storm when measured flows were 3 cfs. The total and dissolved mercury concentrations in surface water at Furnace Creek monitoring station F1 during Storm Event #1 (March 2013) and Storm Event #3 (February 2014) are presented in Figure 2-6. The chart in Figure 2-6 indicates that higher mercury concentrations occur during the rising limb and peak of the stream flow hydrograph. An important finding of the monitoring at F1 was that that total mercury concentrations increase significantly with increased stream flow. This is an important element of the Furnace Creek CSM because high total mercury concentrations and relatively high stream flow rates during storm events result in the largest contribution of mercury to the annual mercury load at Furnace Creek.

2.3.3.2 Dissolved Mercury

Mercury in dissolved form is primarily transported via surface water and shallow alluvial groundwater in the Furnace Creek catchment to Garoutte Creek although at much lower concentrations than particulate mercury. The following subsections describe the transport of dissolved mercury in the Furnace Creek catchment.

Dissolved Mercury in Surface Water

Dissolved mercury in surface water at Furnace Creek occurs via two mechanisms:

1. Precipitation infiltrating and leaching mercury from surficial tailings and bank soils to Furnace Creek during storm events.
2. Dissolution of mercury from sediment suspended in the water column during storm events. This occurs during storm events when the amount of suspended sediment increases and particle surface area is at a maximum.

As described in Section 2.3.2, soil and tailings in the Furnace Creek Tailings area have relatively high concentrations of mercury. During the OU1 RI, modified Synthetic Precipitation Leaching Procedure (SPLP) tests were conducted on tailings and soil samples collected from the Furnace Creek Tailings and Main Tailings Pile areas to assess the potential for leaching. The results indicated the potential for mercury to leach from soils at concentrations exceeding human health and ecological regulatory screening levels (CDM Smith 2014a). Based on the data, leaching of mercury from surficial tailings and soil in the Furnace Creek catchment may be occurring during precipitation events as precipitation infiltrates the bank soils, resulting in transient flow into Furnace Creek.

During storm events, dissolved mercury concentrations in surface water of Furnace Creek follow the same trend as total mercury concentrations, as shown in Figure 2-6. Dissolved mercury concentrations rise quickly to a peak concentration at the peak stream flow and then drop back to baseline concentrations as stream flows drop off. This relationship suggests that desorption and dissolution of mercury as sediment particles are suspended in the water column during storm events may be the primary mechanism for the occurrence of dissolved mercury in Furnace Creek.

Transport of dissolved mercury from upland groundwater underlying the Furnace Creek Tailings Area to Furnace Creek does not occur because Furnace Creek is a losing creek along its entire length and therefore not recharged by upland groundwater. This is evident during the summer months by the observed diminishing flow of surface water in Furnace Creek from the headwaters near the private residence’s water supply, where creek flow occurs year round, to the downstream reach, where surface flows diminish and eventually cease, below the Old Furnace. Another line of evidence that Furnace Creek is a losing creek is the separation of water levels in Furnace Creek from the groundwater levels at the nearest adjacent upland groundwater monitoring well, MW10. Based on groundwater level monitoring data for MW10, the seasonal high groundwater level is approximately 5 feet lower than the elevation of the bottom of Furnace Creek adjacent to this well (EA Team 2015).

Dissolved mercury concentrations in surface water are low compared to total mercury concentrations in surface water of Furnace Creek. As shown in Figure 2-6, dissolved mercury during storm events ranges from less than 10 to a maximum of 34 percent of the total mercury concentration in surface water of Furnace Creek. Based on loading estimates for the 2-year period from 2012 through 2014, dissolved mercury contributes approximately 15 percent of the total annual mercury load in surface water of Furnace Creek. Due to the relatively low contribution of dissolved mercury to the total annual mercury load of Furnace Creek, no specific components to address dissolved mercury in Furnace Creek will be included in the Furnace Creek removal action.

Dissolved Mercury in Groundwater at Furnace Creek

As described in Section 2.1.6, groundwater occurs within the Site as upland groundwater, alluvial groundwater, and deep a bedrock fracture flow system. Groundwater occurrence identified within the Furnace Creek catchment is shown in the graphic presentation of the CSM in Figure 2-4, and includes:

1. Upland groundwater – groundwater occurring within the clay-rich soil underlying the Furnace Creek Tailings Area
2. Alluvial groundwater – groundwater occurring within the shallow alluvium directly below the Furnace Creek channel

Monitoring well MW10 is completed in the upland groundwater system near the Old Furnace area. Monitoring well MW9 is completed within the alluvial groundwater underlying Furnace Creek near the mouth. Furnace Creek surface water is in communication with alluvial groundwater. Well locations are shown in Figure 2-7. As shown in Figure 2-4, alluvial groundwater is sub-flow of Furnace Creek and is a perched system as evident by surface water elevations in Furnace Creek and alluvial groundwater higher than the water table of the underlying upland groundwater system. Due to the limited number of the monitoring wells (MW9 and MW10) in the Furnace Creek catchment, there is uncertainty in mercury concentrations in the upland groundwater system and alluvial groundwater system in Furnace Creek. While MW9 and MW10 were placed at representative locations along the upland and alluvial groundwater pathways, there may be other locations where higher concentration source materials and higher concentrations of mercury are present in groundwater.

Upland Groundwater System

Upland groundwater occurs in a clay-rich soil (clay and gravelly clay) that is hydrothermally altered volcanic tuff of the Fisher Formation (CDM Smith 2014a). Due to the low permeability of the clay soils, recharge rates and groundwater velocity within the upland unit are very low. This is evident by the low recharge rates observed at monitoring well MW10 during well development and sampling. Recharge to upland groundwater occurs as precipitation infiltrates the surficial tailings and underlying soil. As water moves through the tailings or affected soil, leaching of mercury occurs; however, the high clay fraction of the soil has a high capacity to adsorb cations and anions due to greater surface area for attraction and other factors, which limits the mobility of mercury. The relatively high soil to water partitioning coefficients that were calculated by comparing soil and groundwater concentrations at monitoring wells completed within the upland groundwater system support the high capacity for soil to adsorb mercury and other metals leached from tailings and affected soil (CDM Smith 2014a). For example, at monitoring well

MW10, the average mercury concentration in soil within the well screen interval was 13.1 mg/kg and in May 2014 the dissolved mercury concentration in groundwater was 1,070 ng/L, which gives a partition coefficient of 1.0x10^6 L/kg, indicating high absorption capacity of the soil. The May 2014 results are the only results available for MW10. Prior to May 2014, previous attempts to collect a sample at MW10 in August 2013 and November 2013 were unsuccessful due to insufficient groundwater in the well for sampling. Groundwater levels in the upland groundwater system are generally lowest in the late summer and fall.

Groundwater level monitoring at MW10 shows that the seasonal high groundwater level (April 2014) is approximately 5 feet lower than the elevation of the bottom of Furnace Creek adjacent to this well, which indicates that upland groundwater does not discharge into Furnace Creek (EA Team 2015). Based on the low permeability soils and the lack of a hydraulic connection between the upland groundwater and Furnace Creek, dissolved mercury from the upland groundwater system is not expected to contribute to mercury loading to Furnace Creek. No components to address mercury transport in the upland groundwater system will be included in the Furnace Creek removal action.

Alluvial Groundwater System

Alluvial groundwater occurs in the channel deposits of Furnace Creek. Due to the coarser grained alluvium, groundwater movement in the alluvial system is expected to be higher than for upland groundwater. The thickness and lateral extent of the alluvial groundwater system is expected to be fairly limited based on the narrow confines of the Furnace Creek drainage and the shallow bedrock evident by outcrops present near the mouth of Furnace Creek. Monitoring points used to characterize the alluvial groundwater system are shown in Figure 2-7 and include monitoring well MW9 and the buried culvert located near station F1. The buried culvert receives water from the sub-flow of Furnace Creek, which is believed to be representative of groundwater with the alluvial groundwater system.

Dissolved mercury concentration in the alluvial groundwater system ranged from 9.21 to 139 ng/L, based on samples collected at MW9 and the buried culvert in November 2013 and May 2014. The highest dissolved mercury concentrations were observed in May 2014 when groundwater flow in the alluvial groundwater system is expected to be highest at the end of the wet season.

Based on dissolved mercury concentrations in alluvial groundwater being low relative to particulate mercury concentrations in Furnace Creek surface water and the limited thickness and lateral extent, the alluvial groundwater system is not considered a significant source of mercury to the downstream watershed relative to the particulate mercury concentration in Furance Creek surface water; therefore, no components to address mercury transport in the alluvial groundwater will be included in the Furnace Creek removal action.

2.3.4 Analytical Data and Affected Media

This section provides an overview of the media impacted by mercury within the Furnace Creek catchment and concentrations relative to reference locations, based on the most recent data collected during the OU1 RI. A comprehensive data presentation and evaluation of all data collected from the Furnace Creek catchment during the OU1 RI is presented in the *Final Black*

Butte OU1 Data Summary Report and *Draft Black Butte OU1 Data Summary Report – Addendum 1* (CDM Smith 2014a and CDM Smith 2014b), respectively.

2.3.4.1 Soil

Soil sample locations and the range of mercury concentrations detected in surface soil at OU1 are shown in Figure 2-5. A background study has not been conducted at OU1; however, as part of the February 2014 Demonstration of Methods Applicability (DMA) study, a 30-point incremental soil sample (GSS) was collected from the floodplain of Garoutte Creek in the area south of the private residence, as indicated in Figure 2-8. The purpose of this sample was to determine total mercury concentrations in soil at areas outside of the tailing areas. The average mercury concentration in the incremental sample was 11.6 mg/kg. Also during the DMA study, an incremental sample was collected from the Furnace Creek Tailings Area (sample TMM), and average mercury concentration in the sample was 176 mg/kg, approximately 15 times greater than mercury concentrations detected in the sample collected from the floodplain (FEMA flood Zone A) of Garoutte Creek. Discrete surface soil sample locations sampled during the DMA study show detections of mercury up to 543 mg/kg, indicating hot spot locations in the Furnace Creek catchment having mercury concentrations at approximately 50 times greater than mercury concentrations detected in the sample collected from the floodplain of Garoutte Creek. The location of the incremental samples GSS and TMM are shown in Figure 2-8.

2.3.4.2 Sediment

The range of mercury concentration in sediment at Furnace Creek at locations upstream and downstream of areas disturbed by mining activities are shown in Figure 2-9**.** The upstream sample is designated UFC1, and the downstream sample is designated FC1. Location UFC1 serves as a reference location, due to its location upstream of areas disturbed by mining, and as background. The range in mercury concentrations for the bulk, <2 millimeter and <62-64 micron sediment size fractions, is shown. Based on Figure 2-9, mercury concentrations in sediment at downstream Furnace Creek sample FC1 exceed concentrations at the reference location by 15 to 20 times.

2.3.4.3 Surface Water

The highest concentrations of total and dissolved mercury on record were detected in surface water at Furnace Creek station F1 during the February 2014 storm event at concentrations of 93,800 and 10,300 ng/L, respectively (Figure 2-6). Upstream Garoutte Creek stream monitoring station GU1 (Figure 2-1) serves as the reference location for OU1 because it is located upstream of the confluence with Furnace Creek and areas disturbed by mining activities. The maximum total and dissolved mercury concentrations detected at GU1 during the Storm Event #3 (February 2014) were 192 and 8.78 ng/L, respectively. Based on this, total mercury concentrations in surface water at F1 exceeded concentrations at the reference location by approximately 500 times, and dissolved mercury concentrations exceeded concentrations at the reference location by approximately 1,200 times during Storm Event #3.

2.3.4.4 Groundwater

Dissolved mercury concentrations in groundwater at upland groundwater monitoring well MW10, the Furnace Creek alluvial groundwater monitoring well MW9, and the seepage from the buried culvert near F1 are shown in Figure 2-7. Dissolved mercury concentrations detected in the background monitoring well MW13 are also shown in Figure 2-7. MW13 was selected as the background location for OU1 groundwater due to its location approximately 1 mile upstream along Garoutte Creek. Dissolved mercury concentrations in upland groundwater monitoring well MW10 exceed concentrations at the reference location by 1,300 times. Dissolved mercury concentrations in Furnace Creek alluvial groundwater monitoring locations MW9 exceed concentrations at the reference location by up to 200 times.

2.3.5 Dominant Source of Mercury to the Downstream Watershed

Furnace Creek is ephemeral, flowing for 4 to 6 months of the year (based on the 2012-2015 monitoring period), and contributes approximately 0.2 percent of the total stream flow in Garoutte Creek, downstream of the Site. However, based on loading calculations for each of the streams monitored during the OU1 RI, Furnace Creek contributes 48 percent of the total annual mercury load to the downstream watershed, representing the largest single contribution of mercury. The 48 percent of the total annual load is a conservative (low) estimate because the loading calculations are based on maximum mercury concentrations measured during the February 2014 storm event, which was a moderate intensity storm event that had a 2-year reoccurrence interval (2-year storm event). Percent contributions to the total annual mercury load for Furnace Creek, Dennis Creek, and Garoutte Creek are shown in Figure 2-10. The high concentrations of particulate mercury in surface water within Furnace Creek are the primary factor for Furnace Creek to contribute such a high percentage of the mercury load at such low annual flow rates. Mercury concentrations in tailings and co-mingled contaminated soils/sediment within downstream Furnace Creek are 15 to 20 times higher than concentrations measured at the upstream Furnace Creek reference location, indicating a significant increase of mercury concentrations in tailings and co-mingled contaminated soils/sediment along Furnace Creek within the Furnace Creek Tailings Area. Table 1 of OU1 Data Summary Report, Addendum 1, Appendix B (CDM Smith 2014b) shows that tailings samples co-mingled contaminated soils/sediment have much higher mercury concentrations than the soils. An NTCRA will be conducted at Furnace Creek to address the high concentrations of particulate mercury in surface water and high mercury concentrations in sediment that are discharging from Furnace Creek to the watershed.

No components to directly address dissolved mercury in surface water and shallow alluvial groundwater underlying Furnace Creek will be included in the NTCRA because the contribution of dissolved mercury from these sources to the total annual load is low. However, NTCRA components to address particulate mercury in Furnace Creek are also expected to reduce dissolved mercury concentrations in Furnace Creek.

2.4 Basis for the Non-Time-Critical Removal Action

It is well established that mercury from the BBM is a dominant source of mercury in the CGR (Curtis et al 2013; OHA 2013; ODEQ 2006; Curtis 2003). Mercury transport from the BBM to the downstream watershed occurred throughout the life of the mine and continues today. Recent surface water and sediment sampling at the CFWR and CGR indicate CGR continues to receive elevated inorganic mercury from upstream sources and that methylmercury concentrations are highest in the top 2 centimeters of sediment of the reservoir (Eckley et al 2015). As discussed in preceding sections and shown in Figure 2-10, storm event surface water monitoring at BBM conducted from 2013 -2014 indicates that Furnace Creek contributes the most significant mercury loading from the BBM to the downstream watershed. Erosion and transport of particulate mercury during storm events is the dominant transport mechanism. The proposed NTCRA is to abate or minimize the threat of release of mercury contaminated tailings and soil into Furnace Creek and downstream watershed, including the CGR.

Streams flowing through or adjacent to mercury sources at the BBM (furnace wastes, mine tailings, and impacted soil) transport mercury laden sediment from BBM into the CFWR which are ultimately deposited into CGR. Inorganic mercury in CGR sediment is converted to methylmercury which bioaccumulates in fish tissue and subsequently may pose a health hazard for people that take and consume fish. The highest methylmercury concentrations are in the top 2 cm of sediment in the reservoir indicating that mercury in recently deposited sediment may be more susceptible to the methylation process than the older buried sediment (Eckley et al 2015). The 2013 Public Health Assessment performed by the Oregon Health Authority (OHA) determined that levels of methylmercury in the fish in CGR (excluding rainbow trout) ranged from 0.3 to 1.6 mg/kg in fish tissue sampled between 1974 and 2003, exceeding the national ambient water quality criterion of 0.3 mg/kg and the Oregon standard of 0.03 mg/kg methylmercury. These concentrations are high enough to warrant a fish advisory to help people limit consumption to levels that are not expected to harm the health of developing babies, young children, and adults. Fish tissue mercury concentrations in fish collected from nearby Dorena Reservoir were substantially lower than fish tissue collected from CGR, suggesting a substantial source of Hg in the watershed of the CFWR that feeds this reservoir (Curtis and Park 1997). Dorena Reservoir is fed by the Row River which joins the Coast Fork downstream of both water bodies. In addition, fish tissue from both reservoirs represented resident fish, rather than stocked rainbow trout. Since stocked trout are taken quickly from the reservoirs and do not have time to accumulate substantial mercury, available data are consistent with a source of mercury in the reservoir rather than in food provided for hatchery fish (Curtis and Park 1997). OHA considers methyl mercury levels in CGR fish a public health hazard and recommends that EPA take action to address mercury releases to the watershed at the BBM (OHA 2013). An independent review conducted by EPA Region 10 human health risk assessors, using a CGR fish tissue data set from 1993 through 2003, provided supporting conclusions regarding the unacceptable risk due to CGR fish consumption. Hazard quotients ranging from 11 to 18 were calculated for black crappie, bluegill, bullhead, largemouth bass, and cutthroat trout, assuming a fish consumption rate of 175 grams per day.

Soil and tailings within the Furnace Creek removal area have high mercury concentrations, approaching 3,000 mg/kg (Figure 2-5). No RAO for the reduction of health risks due to direct contact with soil and sediment in Furnace Creek is included in the EE/CA because the NTCRA will be focused on addressing migration of mercury to the downstream watershed, which will reduce mercury availability to fish in the CFWR and CGR. However, given that areas of high concentration proposed for action in the NTCRA, up to 2,900 mg/kg, some ancillary reduction in direct contact risk could result from the NTCRA.

Although the BBM RI identified that Furnace Creek contributes significant mercury loading to downstream Garoutte Creek, there is uncertainty in how controlling the mercury discharges at Furnace Creek will ultimately affect mercury levels in sediment, surface water, and fish tissue in the CGR. This uncertainty is related to Furnace Creek discharging to the CFWR and not directly to the CGR and the relative contribution of mercury loading from sediment within the CFWR. From recent surface water and sediment investigation by the USGS and EPA in the CFWR and CGR: 1) it is clear that the contemporary loading of mercury in the CFWR just upstream of CGR reflect an influence from mining sources and 2) recent and contemporary mercury deposition to CGR sediments from the CFWR may be more available for methylation and mercury contribution to CGR than historically deposited mercury that is buried deeper within the sediment matrix. The demonstrated uncontrolled discharge at Furnace Creek and observed ongoing loading of mercury to the CGR is sufficient to warrant a removal action.

2.5 Furnace Creek Removal Action Boundary

The Furnace Creek removal action boundary is shown in Figure 2-11. The boundary was selected to include all areas of the Furnace Creek Tailings that are inside the Furnace Creek catchment as defined by the LiDAR dataset, excluding the portion of the Old Furnace area that was capped during the 2007 TCRA.

All of the Furnace Creek Tailings that lie within the Furnace Creek catchment are included in the removal action boundary because the tailings have high total mercury concentrations and are located on steep slopes subject to erosion into the channel of Furnace Creek. Once in channel, the tailings are transported in the suspended load of Furnace Creek to the downstream watershed. The entire length of the Furnace Creek Tailings Area is included in the removal action boundary because XRF and Lumex screening data collected from the channel and banks of Furnace Creek during the 2007 TCRA indicate consistently high mercury concentrations in sediment and bank soil extending all the way to the confluence with Garoutte Creek (Appendix A). For removal action alternatives involving excavation or containment, the presence of tailings based on visual identification supplemented by field XRF (for tailings identification) will be used to define the horizontal and vertical extent of removal action boundary.

Tailings or affected soil located outside of the Furnace Creek catchment were excluded from the removal area boundary because these tailings are outside the drainage pathway to Furnace Creek and do not contribute to mercury loading of Furnace Creek.

The portion of the Old Furnace that was capped during the 2007 TCRA was also excluded based on the assumption that the capping soil has limited migration of mercury from residual furnace wastes to Furnace Creek.

Section 3

Identification of Removal Action Objectives

3.1 Statutory Limits on Removal Actions

Section 104(c)(1) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that Superfund–financed removal actions not continue after $2 million has been obligated for the response action or 12 months has elapsed from the date of the initial response to a release or threatened release of hazardous substances. A removal action may qualify for exemption from the $2 million/12-month statutory limits; the conditions for an exemption include one or more of the following:

- Continued response actions are immediately required to prevent, limit, or mitigate an emergency; there is an immediate risk to public health or welfare or the environment; and such assistance will not otherwise be provided on a timely basis
- Appropriate remedial actions have been determined in consultation with the state(s), and the state(s) in which the source of the release is located have entered into cooperative agreements or contracts with the federal government concerning the actions
- Continued response action is otherwise appropriate and consistent with the remedial action to be taken

3.2 Determination of Removal Action Scope

The scope of the removal action 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. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek are the dominant source of mercury to Garoutte Creek as discussed in Section 2.3.5. 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.

No components to directly address dissolved mercury in surface water and shallow alluvial groundwater underlying Furnace Creek will be included in the removal action because the contribution of dissolved mercury from these sources to the total annual load is low. However, removal action components to address particulate mercury in Furnace Creek are also expected to reduce dissolved mercury concentrations in Furnace Creek.

The following PRAOs have been developed for the Furnace Creek removal action:

1. 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

2. Reduce the migration of Furnace Creek mercury to Garoutte Creek

Tailings co-mingled with soils and sediments would be primarily targeted for removal action to meet the above-mentioned PRAOs. The performance of the removal action will be measured by:

- Visual confirmation:
  - No visual evidence of tailings are found after they have been removed or capped for removal action alternatives involving excavation or containment
  - Tailings have relatively coarse texture (sandy gravel to gravel) and a characteristic pink to red color as compared to the underlying native material. Native material will have no evidence of tailings co-mingled with soils and sediments.
- Analytical confirmation:
  - Analytical confirmation can be determined by using field XRF or other reliable tool
  - During removal design, reliable indicators to identify tailings would be developed such as identification of inorganic constituents (e.g., arsenic) within soils/sediments
- Comparison of pre- and post-removal action annual mercury loading in surface water of Furnace Creek at the confluence with Garoutte Creek

3.3 Determination of Tentative Removal Action Schedule

The scope of the removal action, given the limited size of the Furnace Creek catchment area, should allow completion of removal action construction within 5 months. Implementation of the removal action must be completed during the summer months when lower Furnace Creek is not flowing. The following is a tentative schedule of major removal action milestones:

Activity	Tentative Date
▪ EE/CA	July 2016
▪ Public comment period	August 2016 through September 2016
▪ Response to significant public comments	October 2016
▪ Action Memorandum	October 2016
▪ Removal action design/planning	November 2016 through May 2017
▪ Removal action construction start	June 2017
▪ Removal action construction completion	October 2017

3.4 Planned Remedial Activities

There are additional remedial activities currently being planned for the Site. An optimization review for the Site was performed by EPA (EPA 2012). The recommendation from the review for the OU1 portion of the RI included routine stormwater sampling, additional groundwater and sediment sampling, and a demonstration of method applicability for field-based metals analyses. EPA is currently assessing these recommendations as well as reviewing other potential data needs to determine future RI activities at the Site, including within OU1. Some of these activities may be conducted within or in close proximity to the Furnace Creek removal action area identified within this EE/CA.

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Section 4

Identification and Analysis of Removal Action Alternatives

4.1 Overview

This section describes and analyzes each removal action alternative identified and developed to address the mercury source material within the Furnace Creek catchment area, which consists of furnace wastes associated with the Old Furnace (i.e., tailings) and mercury-impacted soil and sediment within the bed of Furnace Creek that is co-mingled with tailings. Mercury source material is subject to erosion into the channel of Furnace Creek, which can then migrate to Garoutte Creek.

The following removal action alternatives were identified for evaluation in this EE/CA:

- Alternative RA1: Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures
- Alternative RA2: In-Place Containment of Mercury Source Material using Covers
- Alternative RA3: Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

These removal action alternatives are evaluated and compared using the criteria specified in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993). Evaluation criteria are used to compare removal action alternatives in the areas of effectiveness, implementability, and cost. The evaluation criteria and subcriteria are:

Effectiveness

- <u>Overall Protection of Human Health and the Environment</u> – This subcriterion evaluates how each alternative achieves adequate protection and describe how the alternative will reduce, control, or eliminate risks at the Site through the use of treatment, engineering, or institutional controls. This evaluation should identify any unacceptable short-term impacts.
- <u>Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and Other Criteria, Advisories, and Guidance</u> – This subcriterion evaluates how each alternative addresses/complies with applicable or relevant and appropriate requirements of federal and state statutes as well as other criteria, advisories, and guidance that are typically identified as "to be considered" (TBC) information.
- <u>Long-Term Effectiveness and Permanence</u> – This subcriterion evaluates the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes at the Site. Magnitude of risk as well as adequacy and reliability of controls are specific factors evaluated.

- Reduction in Toxicity, Mobility, or Volume of Waste – This subcriterion evaluates EPA's policy of preference for treatment (i.e., for technologies that will permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element).

- Short-Term Effectiveness – This subcriterion evaluates the effects of the alternative during implementation before the removal objectives have been met. Alternatives should also be evaluated with respect to their effects on human health and the environment following implementation. Protection of the community, protection of the workers, environmental impacts, and time until response objectives are achieved are specific factors evaluated.

Implementability

- Technical Feasibility – This subcriterion evaluates the ability of the technology to implement the remedy. The reliability of the technology is also of concern, as technical problems associated with implementation may delay the schedule.

- Administrative Feasibility – This subcriterion evaluates those activities needed to coordinate with other offices and agencies. The administrative feasibility of each alternative should be evaluated, including the need for offsite permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies. Statutory limits as well as permits and waivers are specific factors evaluated.

- Availability of Services and Materials – This subcriterion determines if offsite treatment, storage and disposal capacity, equipment, personnel, services and materials, and other resources necessary to implement an alternative will be available in time to maintain the removal schedule. Availability of funds to meet post-removal site controls (PRSC) requirements is also a factor.

- State (Support Agency) Acceptance – This subcriterion evaluates the State of Oregon’s (through DEQ) anticipated response to and acceptance of a removal action alternative.

- Community Acceptance – This subcriterion evaluates the public’s anticipated response to and acceptance of a removal action alternative.

Cost

- Direct Capital Costs, Indirect Capital Costs, and Annual PRSC Costs – This subcriterion evaluates the capital for materials, equipment and related items, and the annual PRSC cost. Cost estimates for each removal action alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000). As stated in this guidance, it is also pertinent to development of cost estimates for an EE/CA.

An analysis has been performed for all the removal action alternatives as it relates to ARARs and is included in Appendix B. The last two subcriteria of implementability (State Acceptance and Community Acceptance) are not directly evaluated in this EE/CA. The agency acceptance and the community acceptance criteria are evaluated when the final decision on the proposed plan is selected in conjunction with the preparation of the EE/CA Action Memorandum. These two subcriteria are extremely significant; careful planning and consideration is required to gain adequate acceptance.

The descriptions and evaluation using the qualitative ratings system of each removal action alternative (Alternatives RA1, RA2, and RA3) are presented in Sections 4.2, 4.3, and 4.4, respectively. The qualitative rating categories are defined in Exhibit 5-1 in Section 5. The detailed rationale for the ratings is provided in Appendix C.

4.2 Alternative RA1: Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

Alternative RA1 uses retention of sediments within the Furnace Creek using stormwater detention basins and erosion control measures for sheet flow and channelized flow on the side slopes and banks within the Furnace Creek catchment area along with implementing best management practices (BMPs) during construction and PRSC as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes both the contact of stormwater run-on with tailings and contaminated soils/sediments and mobilization and control of particulate-bound mercury entering Furnace Creek by retaining mercury source material within the Furnace Creek catchment area. This alternative also minimizes mobilization of particulate-bound mercury entering Furnace Creek from migrating to Garoutte Creek. However, these approaches would minimally reduce the potential for leaching of mercury into groundwater and surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.

The concepts of this alternative are illustrated on Figure 4-1, 4-2, and 4-3. It should be noted that concepts provided are for evaluation purposes and do not reflect design requirements or designs for a specific location. The concepts would require additional development that can be initiated during the removal design phase.

Stormwater Detention Basins

The retention of sediments within Furnace Creek removes particulate-bound mercury in Furnace Creek stormwater prior to entry in Garoutte Creek. This will require installation of multiple in-line stormwater detention basins with particulate/sediment filtration mechanism within the Furnace Creek. These multiple smaller stormwater detention basins will help reduce the stormwater flow velocity and achieve increased hydraulic residence time, thus, increasing the sediment deposition and retention. Figure 4-1 illustrates the conceptual model of these multiple in-line detention basins within Furnace Creek.

The in-line detention basins will have adequate storage capacity to provide attenuation to flood peaks and can achieve enough retention time for particulate to settle out of the captured stormwater before it overflows downstream into Garoutte Creek. It is anticipated that these detention basins would be constructed within the Furnace Creek at regular intervals to achieve the desired velocity reduction and sediment deposition. During a storm event, the stormwater would flow through an overflow weir from upgradient detention basin into the downgradient detention basins, thus, capturing sediments in the process. The detention basins would be designed to self-drain through a sediment filtration system after a storm event to reduce the potential of stormwater ponding within the basins and causing anoxic conditions to occur. These conditions will promote methylation of mercury.

Depending on factors, such as stormwater flow velocity or selected design storm (e.g., 25-year, 24-hour storm event), the detention basin could be lined with articulating concrete blocks (ACB), be vegetated, or left unvegetated. Use of ACB or leaving the detention basin unvegetated would provide ease of performing PRSC maintenance such as removal of sediment and debris. ACB was selected as the most representative technology/method that would provide erosion control as well as ease of performing PRSC maintenance. The overflow weir would be armored using riprap.

Timely PRSC would be required to maintain the self-draining mechanism including the sediment filtration system to reduce the potential of stormwater ponding and formation of methyl mercury as well as removal of retained sediment containing particulate mercury. Sediment would be removed during periods of low flow within Furnace Creek down to the surface of the ACB and transported to upland locations within the Furnace Creek catchment area. The sediments would be contoured and stabilized using the erosion control measures indicated for sheet flow.

Erosion Control Measures for Sheet Flow

Erosion control measures for sheet flow would be implemented within upland areas of tailings and co-mingled contaminated soils areas, which have the potential of erosion. These measures will minimize mobility and migration of particulate-bound mercury from tailings and contaminated soils to Furnace Creek. This would require minimal re-contouring and revegetation as well as limited surficial treatment of highly contaminated soils using chemical agents such as magnesium chloride to control dust or soil tackifiers to control particulate erosion. Figure 4-2 illustrates the conceptual model of sheet flow erosion control measures within the Furnace Creek catchment area.

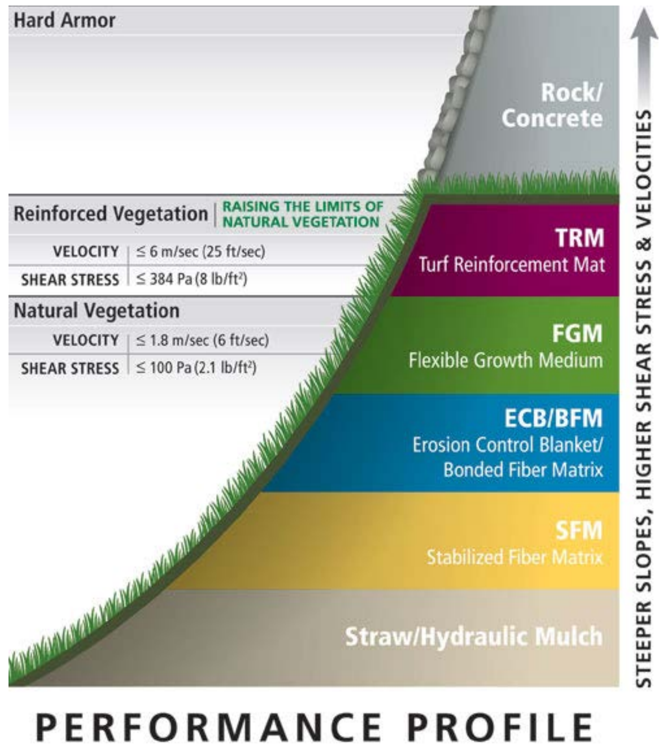
Other BMPs erosion and sediment control measures would be required during and after construction to prevent the mobility and migration of particulate-bound mercury to Furnace Creek, as discussed later in this subsection.

Erosion Control Measures for Channelized Flow

Erosion control measures for channelized flow would minimize the clean stormwater run-on contact with areas of tailings and co-mingled contaminated soils and control runoff that has entered these areas. These measures include the installation of stormwater run-on swales upgradient of tailings and contaminated soils/sediment areas.

Stormwater run-on and runoff swales would be comprised of vegetated or riprap/hardened surfaces or diversion culverts/headwalls. Vegetated or hardened (riprap) swales would be installed on the upland areas and on the creek banks within the Furnace Creek removal action area to minimize erosion of tailings and contaminated soils. Typically, vegetated swales are considered for channelized runoff with velocities less than 6 feet per second (fps) and riprap/hardened swales are considered for channelized runoff with velocities at or greater than 6 fps. Also, swales would be installed at regular intervals (e.g., every 30 vertical feet) of side-slope to control runoff to minimize particulate mobilization. This spacing intercepts the stormwater before its velocity is high enough to scour the tailings and co-mingled contaminated soils and cause erosion and thus particulate mobilization. Typical types of erosion control measures that will provide the necessary protection based on the velocity are shown in Exhibit 4-1.

Exhibit 4-1. Performance Profile



In order to implement stormwater control measures under this alternative, trees and other debris (other types of vegetation or boulders) will need to be removed in order for the proper construction equipment to have access to the removal action area. Re-contouring of slopes will also be required for installation of swales. Swales would be designed to handle the flow projected from a given storm event (e.g., 25-year, 24-hour storm event), which also dictates whether the swale would get vegetated or riprap. Figure 4-2 illustrates the conceptual model of swales within the Furnace Creek catchment area.

Uncontaminated soil or riprap required to construct swales and detention basins would be transported from borrow areas outside of OU1 that are tested for mercury contamination as well as other types of contaminants that may exist within borrow sources but are not currently present at OU1.

Best Management Practices During Construction and Post-Removal Site Controls

BMPs would be used during construction of the removal action and during implementation of post-removal site controls as discussed in the following paragraphs.

Dust suppression would be maintained to eliminate migration of particulate-bound mercury during implementation of this alternative. Water-based dust suppression is assumed to be conducted in most situations in order to minimize exposure risk to the onsite workers, but chemical-based dust suppression, such as magnesium chloride, could be considered during construction for some specific applications like haul road maintenance.

During implementation of the removal action, dewatering may be required. The water from the dewatering process would be pumped through a sediment filter (such as a Geotube®) prior to discharge downstream. The collected sediment will be placed within the upland areas and stabilized using erosion control measures.

Other BMPs erosion and sediment control measures would be required during and after construction to prevent the mobility and migration of particulate-bound mercury to Furnace Creek. This may include hydroseeding or placement of erosion control devices such as silt fences, straw bales, rip-rap and erosion control blankets, or turf reinforcement mats.

Access controls (specifically posted warnings) would be implemented to discourage access and warn people of the removal action. These access controls would include appropriate warning and informational signs. PRSC would be required to maintain the integrity of the access controls if damaged by weather or vandalism.

Monitoring would be performed during the construction of removal action components and would consist of dust monitoring/control, borrow source testing, and monitoring and maintenance of erosion and sediment control measures.

Health and safety precautions, including establishment of exclusion and contaminant reduction zones, use of personnel protective equipment (PPE), and monitoring, would be used during implementation of this removal action alternative to reduce risks to workers.

Community awareness activities include informational and educational programs to inform the public about Site risks and activities being performed to reduce these risks. Dissemination of this information could use electronic communication (e-mails and web site updates), printed communication (flyers, facts sheets, newspaper articles, or signs), and/or personal communication (public meetings or personal visits). Community awareness activities would be put in place during the implementation of removal action and would be part of PRSC.

Annual PRSC would consist of monitoring (inspection) and maintenance as necessary to ensure the continuing effectiveness of the completed removal action and that stormwater detention basins and erosion control measures continue to prevent the mobilization of particulate-bound mercury from the Furnace Creek catchment area. Monitoring would be performed routinely as part of the annual PRSC. Contaminated soils/sediments removed during routine PRSC maintenance activity from stormwater detention basins would be placed within the upland areas and stabilized using erosion control measures. For this EE/CA, it is assumed that PRSC would continue for 10 years after the completion of removal action.

Removal Action Component Quantity Summary

Exhibit 4-2 provides a summary of the major removal action components for Alternative RA1 requiring construction and the estimated quantities for these components.

Exhibit 4-2. Summary of Quantities for Major Removal Action Components – Alternative RA1

Removal Action Component	Unit	Estimated Quantity Furnace Creek Area of the Site
Estimated horizontal extent of contaminated soil (Furnace Creek removal action boundary)	ACR	2.1
Estimated number of detention basins required	EA	4
Estimated volume of fill and riprap material to be used in the detention basins	LCY	3,150
Estimated length of vegetated or riprap/hardened swales to be installed	LF	2,250

Notes: ACR = acres; EA = each; LCY = loose cubic yards; LF = linear feet

4.2.1 Effectiveness

4.2.1.1 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative RA1 is provided in Table C-1 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "acceptable." **+**

4.2.1.2 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative RA1 is provided in Table C-1 (Appendix C) using the evaluation criteria considerations. ARARs evaluated for this alternative are included in Appendix B. The overall rating on this criterion for Alternative RA1 is "acceptable." **+**

4.2.1.3 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative RA1 is provided in Table C-1 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "low to moderate." ❷

4.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative RA1 is provided in Table C-1 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "none." ⓿

4.2.1.5 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative RA1 is provided in Table C-1 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "moderate to high."❹

4.2.2 Implementability

4.2.2.1 Technical Feasibility

Evaluation of technical feasibility for Alternative RA1 is provided in Table C-2 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "moderate to high." ❹

4.2.2.2 Administrative Feasibility

Evaluation of administrative feasibility for Alternative RA1 is provided in Table C-2 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "moderate." ❸

4.2.2.3 Availability of Services and Materials

Evaluation of availability of services and materials for Alternative RA1 is provided in Table C-2 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA1 is "moderate to high." ❹

4.2.3 Cost

Evaluation of cost for Alternative RA1 is provided in Table C-3 (Appendix C) using the evaluation criteria considerations. Detailed cost estimates for this alternative are included in Appendix D. The overall rating on this criterion for Alternative RA1 is “moderate.” $$$

4.3 Alternative RA2: In-Place Containment of Mercury Source Material using Covers

Alternative RA2 focuses on in-place containment for areas of tailings and co-mingled contaminated soils/sediment using covers as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes mobilization of particulate-bound mercury from entering Furnace Creek through re-contouring areas of tailings and co-mingled contaminated soils/sediment, installation of covers, and implementing BMPs during construction and PRSC. These approaches would contain mercury source material in the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.

The concepts for this alternative are illustrated on Figures 4-4 and 4-5. It should be noted that concepts provided are for evaluation purposes and do not reflect design requirements or designs for a specific location. The concepts would require additional development that can be initiated during the removal design phase.

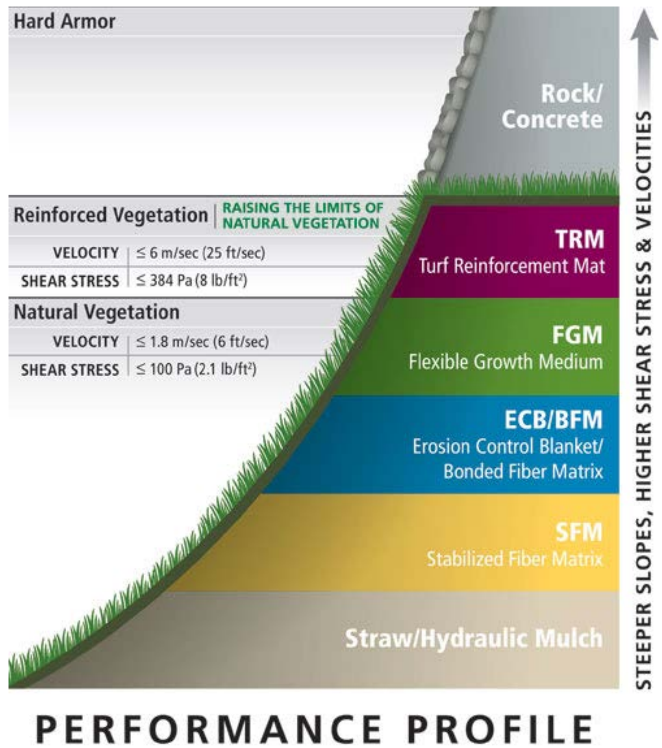
In addition, there may be specific locations within the Furnace Creek catchment area that are not amenable to an in-place containment approach as described for this alternative. In those specific locations, an erosion control measure approach, as described for Alternative RA1, or an excavation/onsite disposal approach, as described for Alternative RA3, could be considered during the removal design phase if indicated in the Action Memorandum. However for purposes of this evaluation, a fundamental assumption is that Alternative RA2 could be implemented as described across the removal action area as shown on Figure 4-4.

In-Place Containment

The existing surface tailings and co-mingled contaminated soils/sediment areas would be graded to the extent practicable for the installation of an in-place containment system using covers. The extent of the Furnace Creek removal action area boundary is conceptually divided into three zones: upland areas, creek bank, and creek bed. These zones are based on factors such as steepness of existing surface, proximity to stream, and the creek channel or the creek bed. These factors dictate the type of cover and erosion control measures used for in-place containment within each zone. Covers will be designed during the removal design phase of the project. In order to install the in-place containment systems, trees and vegetated debris would need to be removed in order for the proper construction equipment to have access to the removal action area. Removed vegetation would be chipped and placed in upland areas.

Erosion control measures for covers would be carefully considered to provide permanence and minimize maintenance. Main factors affecting erosion control measures for covers include hydraulic shear stress, velocity, and steep slopes. Shear stress is a measure of the erosive forces acting on the surface and is a function of velocity and depth. The shear stress and velocity values aid in determining areas that are likely to erode. Typical types of erosion control measures that will provide the necessary protection based on the velocity are shown in Exhibit 4-3.

Exhibit 4-3. Performance Profile



Upland covers would be installed in areas where the existing grades are relatively shallow and stable and is outside the banks of the Furnace Creek. A vegetated simple soil cover is the most representative upland cover type that can be effectively used as an in-place containment system. A typical vegetated simple soil cover would consist of a subsoil layer, a growth media (i.e., organic) layer, and a vegetative layer. The subsoil layer material serves as a buffer between the growth media and the rooting zone above the contaminated soils. This layer helps control the flow of water, provides water storage for vegetation, and provides an expanded root zone. The thickness of the subsoil layer is assumed to be 18 inches. The growth media portion of the vegetated soil cover has relatively high organic content, which would allow for increased moisture retention to help the vegetation through drought periods. The growth media would be compatible with local soils to be capable of supporting native vegetation. Growth media would be "manufactured" by amending subsoil material as previously described with organics, lime, and fertilizer. Erosion control would be provided as necessary. The thickness of the growth media layer is assumed to be 6 inches. The vegetative layer is one of the most important elements for stability of the vegetated simple soil cover. The vegetative layer would minimize erosion of the underlying soils as well as retain precipitation and promote evapo-transpiration. Before establishment of the vegetative layer on the covers, erosion control measures would limit erosion and subsequent transport of uncontaminated cover soil during storm events. Lateral stormwater swales would be constructed, as needed, on the vegetated soil covers to intercept flows from the upgradient slopes and convey them into the channel of Furnace Creek. Swales would be installed as described in Alternative RA1.

Creek bank covers would be installed in areas that are in close proximity to the creek bed and are within the floodway or that have adjacent steep slopes. Surface tailings and co-mingled contaminated soils/sediment within the creek banks have higher potential to erode into the Furnace Creek. Typically, the most permanent in-place containment system for creek bank covers would be hardened (such as riprap), and they can be placed on steeper slopes (generally no steeper than 2H:1V) than vegetated covers (generally no steeper than 3H:1V). However, vegetated covers could also be used, depending on location-specific factors such as hydraulic shear stress, velocity, and steep slopes. Creek banks would be graded to a stable slope to the extent practicable, so as to facilitate installation of hardened covers. Excess material generated during grading the creek banks would be placed within the upland areas and contained using upland covers. In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk of an uncontrolled slope failure that discharges tailings/co-mingled soil directly to Furnace Creek.

A typical hardened cover would consist of geotextile, bedding layer, and a hardened protection layer. The bedding layer can be constructed using a layer of gravel material (e.g., 1 1/2-inch minus stone), which would provide a stable foundation for the hardened protection layer, assumed to be 6-inches thick. The hardened protection layer could then be constructed using a graded riprap, assumed to be Class 1. A layer of geotextile is placed to separate the bedding layer and the hardened protection layer to prevent the migration of particulate-bound mercury from underlying soils through riprap to the creek. Covers on steep slopes not amenable to typical covers previously described could also be installed using engineered materials, like geogrid or geoweb cellular confinement system filled with uncontaminated soil, gravel, or riprap material. These infill materials are typically used to provide a degree of erosion control needed:

- Soil and vegetation on upper portion of side slopes or creek banks
- Sand and pit-run gravel only for low flows
- Gravel or crushed stone (assumed to be a maximum 3-inch size) for low to moderate velocities
- Gravel or crushed stone with riprap material for moderate to high velocities
- Concrete or soil cement for moderate to high velocities

Creek bed covers would be installed to contain the channel bottom or the bed of Furnace Creek to prevent or minimize re-suspension of contaminated channel bottom tailings/co-mingled sediments in the water column, thus, reducing the migration of particulate-bound mercury to Garoutte Creek. The creek bed covers would include a filter mechanism that would prevent leaching or re-suspension of tailings/co-mingled contaminated sediments through protective layers of the cover. Filter mechanisms could be achieved through placement of a geotextile separation layer between the creek bed and the hardened surfacing material. Filter mechanisms could also be achieved through riprap and stone gradation to design the cover that meets the tailings/sediment leaching or re-suspension protection requirements for Furnace Creek. In most cases, a hardened cover layer of riprap or rounded stone (river rock) would be required for protection, but in specific locations, a vegetated layer within the hardened layer could be considered where amenable based on the hydrodynamic factors previously described.

Uncontaminated soil or rock/riprap used for the construction of covers would be brought from a borrow source outside of OU1. The borrow source selected would be tested to determine that mercury contamination is not present as well as other types of contaminants that may exist within borrow sources but are not currently present at OU1.

Best Management Practices During Construction and Post-Removal Site Controls

BMPs would be used during construction of the removal action as well as during implementation of PRSCs; they generally would be similar to those described for Alternative RA1. The primary difference would be that the PRSCs would be specific to monitoring and maintenance of the covers as well as the erosion control measures.

Removal Action Component Quantity Summary

Exhibit 4-4 provides a summary of the major removal action components for Alternative RA2 requiring construction and the estimated quantities for these components.

Exhibit 4-4. Summary of Quantities for Major Removal Action Components – Alternative RA2

Removal Action Component	Unit	Estimated Quantity
		Furnace Creek Area of the Site
Estimated horizontal extent of contaminated soil (Furnace Creek removal action boundary)	ACR	2.1
Estimated horizontal extent for creek bed cover	SF	8,400
Estimated horizontal extent for creek bank cover	SF	16,200
Estimated horizontal extent for upland cover	SF	66,900
Estimated volume of volume of riprap cover material	LCY	1,090
Estimated volume of stone/gravel cover material	LCY	860
Estimated volume of subsoil cover material required	LCY	5,000
Estimated volume of growth media cover material required	LCY	1,690
Estimated area of covers to be revegetated	SF	74,820

Notes: ACR = acres; LCY = loose cubic yards; SF = square feet

4.3.1 Effectiveness

4.3.1.1 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative RA2 is provided in Table C-4 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “acceptable.” **+**

4.3.1.2 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative RA2 is provided in Table C-4 (Appendix C) using the evaluation criteria considerations. ARARs evaluated for this alternative are included in Appendix B. The overall rating on this criterion for Alternative RA2 is “acceptable.” **+**

4.3.1.3 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative RA2 is provided in Table C-4 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “moderate.”❸

4.3.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative RA2 is provided in Table C-4 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “none.” ⓿

4.3.1.5 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative RA2 is provided in Table C-4 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “moderate to high.” ❹

4.3.2 Implementability

4.3.2.1 Technical Feasibility

Evaluation of technical feasibility for Alternative RA2 is provided in Table C-5 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “moderate.”❸

4.3.2.2 Administrative Feasibility

Evaluation of administrative feasibility for Alternative RA2 is provided in Table C-5 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “moderate to high.”❹

4.3.2.3 Availability of Services and Materials

Evaluation of availability of services and materials for Alternative RA2 is provided in Table C-5 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA2 is “moderate to high.” ❹

4.3.3 Cost

Evaluation of cost for Alternative RA2 is provided in Table C-6 (Appendix C) using the evaluation criteria considerations. Detailed cost estimates for this alternative are included in Appendix D. The overall rating on this criterion for Alternative RA2 is “moderate.” $$$

4.4 Alternative RA3: Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

Alternative RA3 focuses on excavation and onsite disposal of tailings and co-mingled contaminated soils/sediment with reclamation of upland and creek bank areas and rehabilitation of the creek bed along with erosion and sediment control BMPs to manage particulate-bound mercury and thus achieve PRAOs. These approaches would remove mercury source material from the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with contaminated sediment within the Furnace Creek bed.

The concepts for this alternative are illustrated on Figures 4-6, 4-7, 4-8, and 4-9. It should be noted that concepts provided are for evaluation purposes and do not reflect design requirements or designs for a specific location. The concepts would require additional development that can be initiated during the removal design phase.

In addition, there may be specific locations within the Furnace Creek catchment area that are not amenable to excavation approach as described for this alternative; e.g., excavation of buried tailings and contaminated sediments in areas of debris flow deposits during the high flow event within the Furnace Creek catchment. In those specific locations, an erosion control measure approach as described for Alternative RA1 or an in-place containment approach as described for Alternative RA2 could be considered during the removal design phase if indicated in the Action Memorandum. However, for purposes of this evaluation, a fundamental assumption is that Alternative RA3 could be implemented as described across the removal action area as shown on Figures 4-6 and 4-7.

Excavation of Mercury Source Material

Under this alternative, the primary source of mercury contamination (i.e., surface tailings and co-mingled mercury-impacted soils/sediment within the Furnace Creek removal action boundary) would be mechanically and/or pneumatically excavated. In order to perform excavation and onsite disposal, trees and vegetated debris would need to be removed for the proper construction equipment to have access to the removal action area. Removed vegetation would be chipped and placed in upland areas.

The purpose of excavation to underlying native material is to remove tailings (and co-mingled contaminated soil/sediment) that is the predominant source of particulate mercury loading to Furnace Creek and thus Garoutte Creek. Horizontal and vertical delineation of tailings and co-mingled contaminated soils/sediment would be required during excavation to meet PRAOs and to calculate the excavation volume for disposal and for designing an onsite repository; however, there would not be a specific numerical concentration of mercury targeted for excavation. The criteria proposed to identify tailings are discussed in Section 3.2.

Once tailings delineation is completed, excavation to underlying native material would be conducted within the removal action area boundary until tailings are removed. Determination that tailings are removed would be made through monitoring (consisting of intrusive visual inspections and sample collection/analysis) as described in Section 3.2.

If the actual slope of the excavation is steeper than the maximum allowable slope for equipment to safely work, then proper mitigation measures, like using long-reach equipment, cutting back the slope, or sloping and benching system, would be performed. In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk of an uncontrolled slope failure that discharges tailings/co-mingled soil directly to Furnace Creek. Pneumatic excavation (i.e., vacuum extraction) could be used in areas where accessibility to surface tailings and co-mingled mercury-impacted soils using standard equipment would be difficult.

Onsite Disposal

Excavated surface tailings and co-mingled contaminated soils/sediment would be direct loaded, as practical, and transported for onsite disposal (assumed to be performed with trucks). There may be some locations where direct loading of trucks is not possible; in those locations, limited stockpiling could be performed on areas not yet excavated using BMPs and other erosion control measures.

During the removal design phase, detailed topographical maps from the LiDAR data set would be used to design and locate a suitable location for an onsite disposal repository. Based on the existing topographical maps, areas with 12 percent grade or less are located north of the existing tailings repository and upstream of the confluence of Dennis Creek and Garoutte Creek (outside of FEMA flood Zone A). For this EE/CA, it is assumed that the existing tailings repository location would be expanded and used for onsite disposal of excavated surface tailings and co-mingled contaminated soils/sediment. It is anticipated that the existing tailings repository location would meet the requirements that would be considered suitable for onsite disposal. But, during removal design if the existing tailings repository location were not available or practicable another location could be found using existing LiDAR data set.

Expansion of the existing repository rather than a new location would reduce future PRSC requirements. The onsite disposal repository would be contained using a cover specifically designed for the repository conditions. For purposes of the EE/CA, the expanded repository surface is assumed to be suitable for a vegetated simple soil cover and swales as described for Alternative RA2 in Section 4.3. The actual type and configuration of cover will be evaluated during the removal design phase.

Uncontaminated soil or rock/riprap used for the removal action (onsite disposal repository cover and reclamation /rehabilitation) would be brought from a borrow source outside of OU1. The borrow source selected would be tested to determine that mercury contamination is not present as well as other types of contaminants that may exist within borrow sources but are not currently present at OU1.

Reclamation of Upland Areas and Creek Banks

The excavated upland and creek bank areas within the Furnace Creek catchment area would be graded and backfilled to provide positive drainage and support vegetation and not to match the surface conditions or grades that previously existed. Growth media as described for Alternative RA2 in Section 4.3 (6-inch thickness) is assumed to be placed to support the vegetation for reclamation along with erosion control devices such as erosion control blankets or turf reinforcement mats, silt fences, and straw bales. Reclamation may include hydroseeding of upland areas; a variety of bioengineering techniques may be required for creek bank stabilization. Bioengineering techniques may include installation of bank revetments, fascines (bush wattles), vegetated gabions, or crib wall at scour susceptible zones of the banks.

Rehabilitation of Creek Corridor

The creek corridor of the Furnace Creek would be rehabilitated to stabilize the bank slopes and reduce future erosion of remaining mercury-contaminated soil and sediment. As described in Section 4.3, main factors controlling the channel erosion include hydraulic shear stress, velocity, and steep slopes. The creek bed rehabilitation design would depend on the calculated velocity of flow within Furnace Creek, as at a velocity of 5 to 6 feet per second flow becomes erosive to soil and vegetation. Thus, hardened erosion control measures (e.g., river rock) or reinforced vegetation (e.g., vegetated turf reinforcement mats) would be placed where flow velocities are higher. Where flow velocities are lower, natural vegetation along with vegetation revetments could be installed.

Uncontaminated soil or rock/riprap used for the removal action (onsite disposal repository cover and reclamation /rehabilitation) would be brought from a borrow source outside of OU1. The borrow source selected would be tested to determine that mercury contamination is not present as well as other types of contaminants that may exist within borrow sources but are not currently present at OU1.

Best Management Practices During Construction and Post-Removal Site Controls

BMPs would be used during construction of the removal action as well as during implementation of PRSCs; they generally would be similar to those described for Alternative RA1. The primary difference would be that the PRSCs would be specific to monitoring and maintenance of the onsite disposal repository.

Removal Action Component Quantity Summary

Exhibit 4-5 provides a summary of the major removal action components for Alternative RA3 requiring construction and the estimated quantities for these components.

Exhibit 4-5. Summary of Quantities for Major Removal Action Components – Alternative RA3

Removal Action Component	Unit	Estimated Quantity Furnace Creek Area of the Site
Estimated horizontal extent of contaminated soil (Furnace Creek removal action boundary)	ACR	2.1
Estimated volume of mercury source material to be excavated	BCY	5,800
Estimated dimensions of the onsite disposal repository	FT	Length = 160 Width = 130 Height = 12
Estimated volume of subsoil and growth media required for installing a vegetated simple soil cover at onsite disposal repository	LCY	2,190
Estimated area of the Furnace Creek (bed) to be rehabilitated	SF	16,800
Estimated volume of stone/river-rock material	LCY	720
Estimated area of excavated area to be reclaimed	SF	74,700
Estimated volume of growth media required	LCY	1,840

Notes: ACR = acres; BCY = bank cubic yard; FT = feet; LCY = loose cubic yards; SF = square feet

4.4.1 Effectiveness

4.4.1.1 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative RA3 is provided in Table C-7 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "acceptable." **+**

4.4.1.2 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative RA3 is provided in Table C-7 (Appendix C) using the evaluation criteria considerations. ARARs evaluated for this alternative are included in Appendix B. The overall rating on this criterion for Alternative RA3 is "acceptable." **+**

4.4.1.3 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative RA3 is provided in Table C-7 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "high."❺

4.4.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative RA3 is provided in Table C-7 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "none." ⓿

4.4.1.5 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative RA3 is provided in Table C-7 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "moderate."❸

4.4.2 Implementability

4.4.2.1 Technical Feasibility

Evaluation of technical feasibility for Alternative RA3 is provided in Table C-8 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "moderate to high."❹

4.4.2.2 Administrative Feasibility

Evaluation of administrative feasibility for Alternative RA3 is provided in Table C-8 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "moderate to high."❹

4.4.2.3 Availability of Services and Materials

Evaluation of availability of services and materials for Alternative RA3 is provided in Table C-8 (Appendix C) using the evaluation criteria considerations. The overall rating on this criterion for Alternative RA3 is "moderate to high."❹

4.4.3 Cost

Evaluation of cost for Alternative RA3 is provided in Table C-9 (Appendix C) using the evaluation criteria considerations. Detailed cost estimates for this alternative are included in Appendix D. The overall rating on this criterion for Alternative RA3 is "moderate to high." $$$$

4.5 State (Support Agency) Acceptance

The State of Oregon (through DEQ) may have technical and administrative concerns. Assessment of the state acceptance will not be completed until comments on the Action Memorandum are submitted to EPA by DEQ. DEQ may review the alternatives, and their concerns will be considered in determining the recommended alternative in the final EE/CA and in the final selection of the removal action in the Action Memorandum. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in the EE/CA.

4.6 Community Acceptance

Assessment of community acceptance will include responses to questions any interested person in the community may have regarding any component of the removal action alternatives presented in the final EE/CA. This assessment will be completed after EPA receives public comments on the final EE/CA during the public commenting period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the EE/CA.

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Section 5

Comparative Analysis of Removal Action Alternatives

This EE/CA evaluates the three removal action alternatives discussed in Section 4 against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost, as well their sub-criteria. The results of the detailed analysis for each removal action alternative are presented in Exhibit 5-1 to allow a comparative analysis of the alternatives and identify the key tradeoffs between them as presented in the EE/CA. Comparative analysis for the removal action alternatives using the evaluation criteria has been put into narrative form in the following subsections. Only significant comparative differences between alternative are presented; the full set of rationale for the qualitative ratings is provided in Appendix C.

5.1 Overall Protection of Human Health and the Environment

All removal action alternatives evaluated in this EE/CA would address the PRAOs for the Furnace Creek removal action and would provide the protection for human health and the environment. Achievement of PRAOs would potentially reduce the risk to human health from ingestion of mercury within fish from Garoutte Creek and/or Cottage Grove Lake.

Alternative RA1 addresses PRAOs through retention of tailings and co-mingled contaminated soils/sediment within the Furnace Creek using stormwater detention basins and erosion control measures. Reduction in mobility and availability of mercury source material within the Furnace Creek catchment area to migrate in particulate form to surface water in Furnace Creek would be addressed primarily though erosion control measures such as installation of run-on/runoff swales. Reduction in migration of Furnace Creek mercury to Garoutte Creek would be addressed through in-line stormwater detention basins within the Furnace Creek. However, mercury source material is left exposed within the Furnace Creek removal action area; thus, it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. Also, there is a potential of stormwater ponding within the basins causing anoxic conditions to occur. These conditions could promote methylation of mercury; thus, posing additional risk to human health and environment due to decrease in water quality standards in the future.

Alternative RA2 addresses the PRAOs primarily through in-place containment using covers. Mobility and availability of mercury source material within the Furnace Creek catchment area to migrate in particulate form to surface water in Furnace Creek would be eliminated by installing in-place containment system using covers for upland and creek bank areas. Also, re-suspension of contaminated channel bottom sediments into the water column would be eliminated by installing in-place containment system using covers within the Furnace Creek bed. However, mercury source material is left within the Furnace Creek removal action area (although covered); thus, if covers are not maintained it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury.

Alternative RA3 includes excavation and onsite disposal of mercury source material within a repository located outside of the Furnace Creek catchment area; thus, PRAOs for the Furnace Creek removal action would be achieved with additional permanence over time for the Furnace Creek removal area as compared to Alternative RA1 and RA2. This alternative effectively eliminates availability of mercury source material within the Furnace Creek catchment area to migrate in particulate form to surface water in Furnace Creek catchment area. The onsite disposal repository would be contained using a cover specifically designed for the repository conditions. With proper construction and maintenance, the cover at the onsite disposal repository would eliminate exposure of mercury source material to humans and ecological receptors in the future as part of overall OU1 exposures to mercury. The excavated areas would be reclaimed using placement of growth media and installation of vegetation. The Furnace Creek banks and bed would be rehabilitated using installation/placement of river rock and/or reinforced vegetation. These measures would stabilize remaining soils and sediment containing lower concentrations of mercury.

Thus, Alternative RA1, RA2, and RA3 were given a rating of acceptable.

5.2 Compliance with ARARs

Alternatives RA1, RA2, and RA3 were given acceptable ratings under the assumption that removal action components identified in the alternatives would sufficiently control mobility and migration of mercury source material within surface water to be in compliance with chemical-specific ARARs such as Oregon water quality standards. Location- and action-specific ARARs would be addressed, to the extent practicable, during the removal action implementation. Additional information concerning compliance with potential ARARs is provided in Appendix B.

5.3 Long-term Effectiveness and Permanence

Alternative RA1 addresses reduction of mobility and availability of mercury source material through retention of sediments within the Furnace Creek using stormwater detention basins and erosion control measures. Long-term effectiveness and permanence is not entirely ensured since mercury source material is left within the Furnace Creek removal action area. Protection to human health and the environment is dependent on retention of particulate-bound mercury within stormwater detention basins and erosion control measures. This would require continuous removal and management of mercury source material from within the detention basins that would pose exposure risks to humans as well as ecological receptors in the future as part of overall OU1 exposures to mercury. Adequacy and reliability of these measures may decrease over time especially during significant storm events within the Furnace Creek catchment area; thus, robust long-term monitoring and maintenance would be required to maintain the long-term effectiveness and permanence of the remedy. Also, if the sediment filtration system within the stormwater detention basins are not maintained, there is a potential of stormwater ponding within the basins causing anoxic conditions to occur. These conditions could promote methylation of mercury. Thus, this alternative was given a rating of “low to moderate”.

Alternative RA2 addresses reduction of mobility and availability of mercury source material to migrate in particulate form to surface water through in-place containment using covers. But, long-term effectiveness and permanence is not entirely ensured since tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area (although covered). Protection to human health and the environment is partially dependent on long-term monitoring and maintenance of the covers. With proper construction and maintenance, the covers would break the exposure pathway; thus, reducing the exposure risk to humans and ecological receptors in the future as part of overall OU1 exposures to mercury. Erosion of tailings and co-mingled contaminated soils into the Furnace Creek would be eliminated by installing in-place containment systems using upland and creek bank covers. Re-suspension of channel bottom contaminated sediments into the water column would be eliminated by installing in-place containment system using creek bed covers. Long-term permanence of cover on steeper slopes and within the floodway of the Furnace Creek may reduce over time requiring maintenance. Adequacy and reliability of these measures may decrease over time if woody vegetation became established and penetrated the covers or erosional damage occurred; thus, long-term monitoring and maintenance of multiple cover systems would be required to maintain the long-term effectiveness and permanence of the remedy. Thus, this alternative was given a rating of "moderate".

Alternative RA3 addresses reduction of mobility and the availability of mercury source material to migrate in particulate form to surface water through removal (excavation) of mercury source material from within the Furnace Creek removal action boundary and onsite disposal outside the Furnace Creek catchment area; thus, long-term effectiveness and permanence is ensured within the removal action area. The onsite disposal repository would be contained using a suitable cover specifically designed for the repository conditions; thus, reducing the exposure risk to humans and ecological receptors in the future as part of overall OU1 exposures to mercury. Long-term permanence of cover may reduce in not maintained. Adequacy and reliability of these measures may decrease over time if woody vegetation became established and penetrated the covers or erosional damage occurred; thus, long-term monitoring and maintenance would be required to maintain the long-term effectiveness and permanence of the remedy. PRAOs for the Furnace Creek removal action would be better addressed, as compared to Alternative RA1 and RA2 by providing a permanent remedy through excavation; thus, this alternative was given a rating of "high".

5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

All removal action alternatives fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Thus, all of the retained alternatives were given a rating of "none".

5.5 Short-Term Effectiveness

Alternative RA1 would have short-term risks to workers, the community, and the environment primarily through construction of stormwater detention basins and installation of erosion control measures. There would be minor impacts to the community, as truck traffic would only be required to transport uncontaminated materials for the installation of stormwater detention basins and erosion control measures. The alternative requires minimal excavation as compared to Alternative RA3 for constructing stormwater detention basins and grading for installation of erosion control measures. However, installation of berms for stormwater detention basins within the Furnace Creek may result in increased short-term risk to workers as compared to Alternative RA2. Erosion control measures, BMPs, safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the environment during remedy implementation. Construction of detention basin dams would have adverse environmental impacts on the hydrology of the Furnace Creek as well as Garoutte Creek. While construction would result in emissions from equipment, use of fuel efficient vehicles would reduce those impacts. Overall, Alternative RA1 was given a rating of “moderate to high”.

Alternative RA2 requires installation of in-place containment system across the Furnace Creek removal action area and a longer duration of construction period than Alternative RA1, which poses slightly increased short-term risks to workers, the community, and the environment. There would be minor impacts to the community under this alternative, as truck traffic would only be required to transport uncontaminated materials for the installation of covers. No tailings and co-mingled contaminated soils/sediment will be transported offsite or outside of OU1. The alternative requires minimal excavation for grading purposes. Mercury source material would be graded and contained in-place using covers. Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation. In steep locations, temporary retaining structures could be installed to reduce the risk to workers and the environment due to uncontrolled slope failure that could discharge mercury source material directly to Furnace Creek. Short-term risks to workers, the community, and the environment could be mitigated through measures such as water-based dust suppression, erosion control BMPs to minimize the impact to the Furnace Creek and the Garoutte Creek. While construction would result in emissions from equipment, use of fuel efficient vehicles would reduce those impacts. Overall, Alternative RA2 was given a rating of “moderate to high”.

Alternative RA3 would have extensive disturbance of mercury source material across the Furnace Creek removal action area compared to Alternative RA1 and RA2, which poses increased short-term risks to workers, the community, and the environment. It is anticipated that the duration of construction would be same as for Alternative RA2. Excavated mercury source material will be not be transported offsite or outside of OU1; thus, the short-term risks to the community would be from trucks used to haul uncontaminated materials for covers for the onsite disposal repository and for reclamation/rehabilitation of excavated areas. The alternative requires extensive excavation of mercury source material for onsite disposal. Therefore, there would be an increased short-term risk to workers as compared to Alternative RA1 and RA2, but safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation. In steep locations, temporary retaining structures could be installed to reduce the risk to workers and the environment due to uncontrolled slope failure that could discharge mercury source material directly to Furnace Creek. Water-based dust suppression, erosion control BMPs to minimize the impact to the Furnace Creek and the Garoutte Creek While construction would result in emissions from equipment, use of fuel efficient vehicles would reduce those impacts. Overall, Alternative RA3 was given a rating of “moderate”.

5.6 Implementability

Alternative RA1 includes construction of stormwater detention basins with limited excavation or grading of mercury source material. Alternative RA2 and RA3 includes installation of in-place containment system using covers and removal (excavation) with onsite disposal of mercury source material, respectively, which is a common construction practice, but results in longer construction period and uses more construction equipment to complete than Alternative RA1.

Implementing removal action under Alternative RA1 would be relatively straightforward as compared to Alternative RA2 and RA3, but could be challenging within the Furnace Creek due to steep and narrow topography. It is anticipated that installation of in-place containment system using covers would be more challenging as compared to removal (excavation) activities within the Furnace Creek banks and creek bed due to steep and narrow topography.

Potential future or additional remedial action may be required under Alternatives RA1 and RA2, because tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area which could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. Potential future or additional remedial action may not be required under Alternative RA3, because tailings and co-mingled contaminated soils/sediment would be excavated (removed) from within the Furnace Creek removal action area and disposed at an onsite repository outside the Furnace Creek catchment area. Thus, the overall removal action activities under Alternative RA3 could be more compatible with the overall OU1 remedial strategy.

All removal action alternatives are fund-financed; thus the statutory limit of 2 million dollars and 12-month duration limit applies. It is anticipated that all removal action alternatives would comply with this statutory limit.

Labor, equipment, materials, and technical specialists required for implementing the removal action under all alternatives should be available. Use of worker safety measures such as PPE and establishment of work zones required to protect human receptors, implementation of dust suppression mechanism, installation of erosion control measures, and slope stability measures are standard practice and can be implemented using available equipment and labor resources. Borrow material would be required from locations outside of OU1; offsite permits to develop borrow resources may be required depending on whether they are located within the Site boundary.

State (support agency) and community acceptance are not directly evaluated in this EE/CA. For detail explanation refer Section 4.5 and 4.6.

Ratings for all sub-criteria under implementability are presented in Exhibit 5-1.

5.7 Cost

Present value costs for all removal action alternatives were analyzed over a 10-year period after construction (Years 1 through 10), after the construction of the removal action which was assumed to occur in Year 0.

The present value cost for Alternative RA1 was given a rating of “moderate.” The present value cost for this alternative is approximately $1,040,000.

The present value cost for Alternative RA2 was given a rating of "moderate." The present value cost for this alternative is approximately $1,468,000.

The present value cost for Alternative RA3 was given a rating of "moderate to high." The present value cost for this alternative is approximately $1,571,000.

Exhibit 5-1. Summary of Comparative Analysis for Removal Action Alternatives

Removal Action Alternative	Description	Effectiveness					Implementability					Cost	
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Technical Feasibility	Administrative Feasibility	Availability of Services and Materials	State (Support Agency) Acceptance	Community Acceptance	Present Value Cost (Dollars)	
RA1	Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures	+	+	❷	⓿	❹	❹	❸	❹	NE	NE	$$$	$1,040,000
RA2	In-Place Containment of Mercury Source Material using Covers	+	+	❸	⓿	❹	❸	❹	❹	NE	NE	$$$	$1,468,000
RA3	Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces	+	+	❺	⓿	❸	❹	❹	❹	NE	NE	$$$$	$1,571,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess removal action alternatives (for instance, individual rankings for an alternative are not additive).
2. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix D.

Legend for Qualitative Ratings System:

Effectiveness and Implementability

For First Two Criteria

—	Unacceptable
+	Acceptable
+*	Acceptable with ARAR Waiver(s)

For Rest of the Criteria

⓿	None
❶	Low
❷	Low to Moderate
❸	Moderate
❹	Moderate to High
❺	High
NE	Not Evaluated

Cost

Present Value Cost in Dollars

⓿	None
$	Low ($0 through $500K)
$$	Low to Moderate ($500K through $1M)
$$$	Moderate ($1M through $1.5M)
$$$$	Moderate to High ($1.5M through $2M)
$$$$$	High (Greater than $2M)

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Section 6

Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended removal action alternative for the Furnace Creek is Alternative RA3. Alternative RA3 includes removal (excavation) and onsite disposal of tailings and co-mingled contaminated soils/sediment within a repository located outside of the Furnace Creek catchment area. This alternative addresses the mobility and the availability of mercury in tailings and co-mingled contaminated soils/sediment within the Furnace Creek catchment area; thus, PRAOs for the Furnace Creek removal action would be better achieved, as compared to Alternative RA1 and RA2.

Alternative RA1 addresses the reduction in mobility and availability of mercury source material through retention of sediments within the Furnace Creek using stormwater detention basins and erosion control measures, but tailings and co-mingled contaminated soils/sediment are left exposed to erosion within the Furnace Creek removal action area; thus, it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. Alternative RA2 addresses reduction in mobility and availability of mercury source material to migrate in particulate form to surface water through in-place containment. For Alternative RA2, tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area under cover; thus, the availability of mercury source material is contingent upon long-term effectiveness and permanence of the in-place containment system. Also, if the covers are not maintained it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. Under Alternative RA3, tailings and co-mingled contaminated soils/sediment would be removed (excavated) and the existing tailings repository location would be expanded for onsite disposal of excavated mercury source material. The new onsite disposal repository would be contained using a suitable cover specifically designed for the repository conditions with erosion control measures installed. This would also considerably enhance the existing tailings repository; thus, potentially reducing the long-term O&M requirement under OU1. Also, potential future or additional remedial action may not be required under Alternative RA3, because tailings and co-mingled contaminated soils/sediment would be excavated (removed) from within the Furnace Creek removal action area and disposed at an onsite repository outside the Furnace Creek catchment area. Thus, the overall removal action activities under Alternative RA3 would be compatible with the overall OU1 remedial strategy.

The relative percent difference between costs for all three removal action alternatives is insignificant given the +50% to -30% accuracy range for the cost estimates. Alternative RA2 and RA3 are approximately 41% and 51%, respectively higher in cost than Alternative RA1. For Alternative RA3 the overall effectiveness based on “long-term effectiveness and permanence”, “short-term effectiveness”, and “implementability” criteria is higher than other alternatives (Exhibit 5-1). Thus, the overall effectiveness of Alternative RA3 was determined to be proportional to its costs and hence cost-effective i.e., it represents a reasonable value for the money to be spent.

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Section 7

References

CDM Smith. 2014a. Final Black Butte OU1 Data Summary Report. July 24, 2014.

CDM Smith. 2014b. Draft Black Butte OU1 Data Summary Report – Addendum 1. September 5, 2014.

Curtis, L.R. 2004. Final Report Reconnaissance Soil Sampling at the Black Butte Mine. Department of Environmental and Molecular Toxicology. Oregon State University. Prepared for the Oregon Department of Environmental Quality. August 9, 2004.

Curtis, L.R., 2003. Final Report Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir. Prepared for the U.S. Army Corps of Engineers, May 20, 2003.

Curtis, L.R., Morgans, D.L., Thoms, B., Villenueve, D. 2013. Extreme Precipitation Appears a Key Driver of Mercury Transport from the Watershed to Cottage Grove Reservoir, Oregon. Environmental Pollution. 176. 178 -184.

Curtis, L.R. & Park, J.G. 1997. Mercury Distribution in Sediments and Bioaccumulation by Fish in Two Oregon Reservoirs: Point-Source and Nonpoint-Source Impacted Streams. Arch. Environ. Contam. Toxicol. 33. 423-429.

Derkey, R.E. 1973. Geology of the Black Butte Mercury Mine. Lane County, Oregon, unpublished Master's Thesis. University of Montana.

EA and CDM Smith (EA Team). 2015. Final Planning Memorandum for the Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon. October 9, 2015.

Eckley, C.S., Luxton, T.P., McKernan, J.L., Goetz, J., Goulet, J. 2015. Influence of Reservoir Water Level Fluctuations on Sediment Methylmercury Concentrations Downstream of the Historical Black Butte Mercury Mine, OR. Applied Geochemistry. 61. 284 -293.Ecology and Environment. 2009. Hazard Ranking System Document, Black Butte Mine. Prepared for EPA Region 10. September 2009.

EPA. 2016. Engineering Evaluation/Cost Analysis Approval Memorandum for Furnace Creek Removal Action.

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

EPA. 2008. Final Removal Action Report for Black Butte Mine, Cottage Grove, Oregon. July 20, 2008.

EPA. 2000. A Guide to Developing and Documenting Cost Estimates during the Feasibility Study. EPA 540-R-00-002. July

EPA. 1993. Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA. EPA 540-R-057. August.

Oregon Department of Environmental Quality (DEQ). 2008. Black Butte Mine Mercury Loading Assessment Results. August 21, 2008.

DEQ. 2006. Willamette Basin Total Maximum Daily Load (TMDL) Report. September 29, 2006.Oregon Health Authority (OHA). 2013. Public Health Assessment Final Release Black Butte Mine, Cottage Grove, Oregon EPA Facility ID: OR0000515759. March 13, 2013.

Private Residence. 2012. CDM Smith communication with the Private Residence during the November 2012 Surface Monitoring Station Installation Field Event.

Rytuba. 2002. Mercury Geoenvironmental Models. US Geological Survey Open File Report OF02-195J.

Wells, F.G. and A.C. Waters. 1934. Quicksilver Deposits of Southwestern Oregon. US Geological Survey Bulletin 850.

Figures

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Figure 2-1

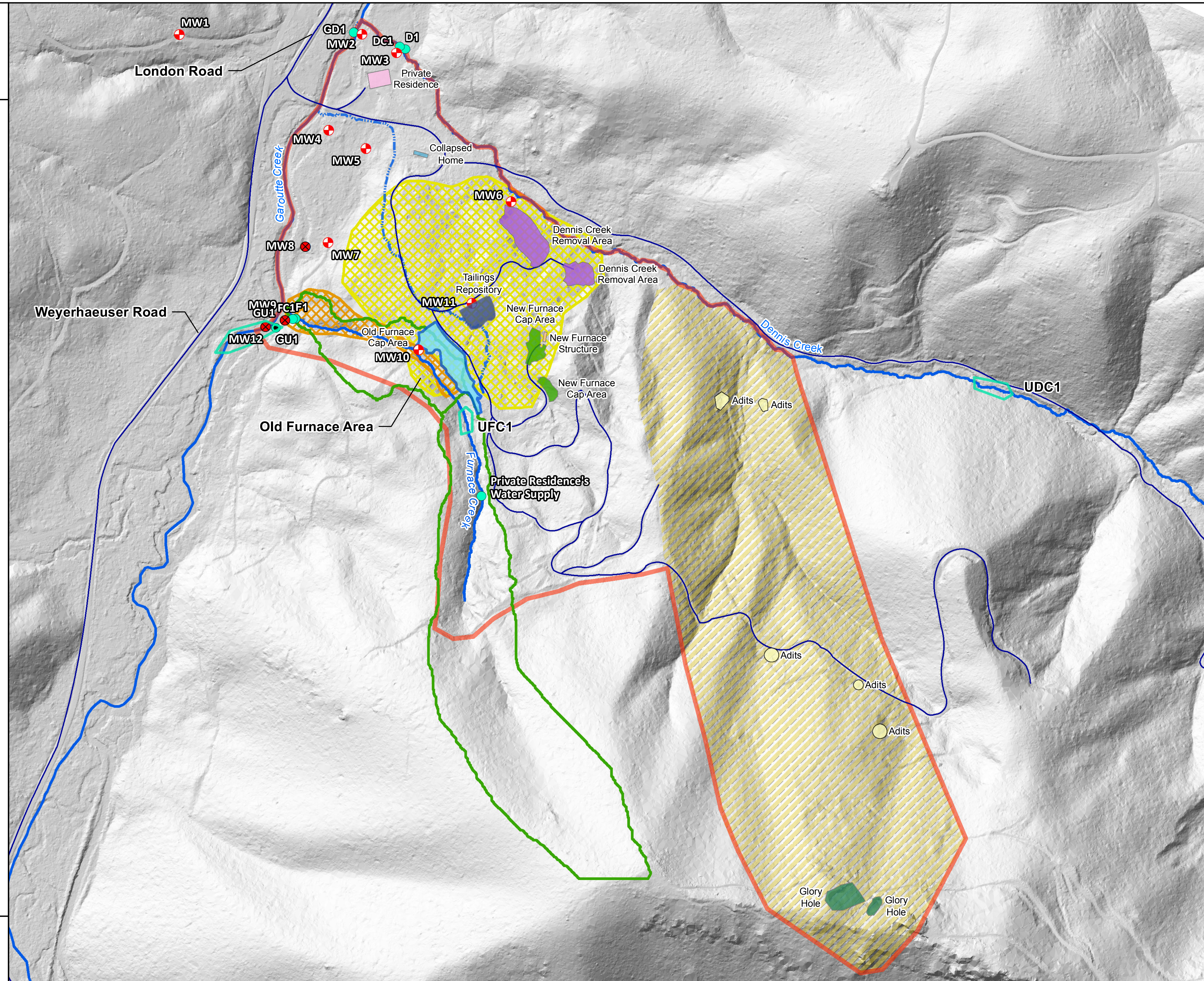
Black Butte Mine Superfund Site
Operable Unit 1
Site Location Map

Legend

- Groundwater Monitoring Well (Sonic)
- Groundwater Monitoring Well (Hand Driven)
- Surface Water Monitoring & Sediment Sampling Location
- Surface Water Monitoring Station
- Road
- Creek/Stream/Drainage
- Intermittent Creek/ Stream/Drainage
- OU1 Boundary
- Furnace Creek Catchment Boundary
- Approximate Extent of Old Furnace Area Capped During the 2007 Removal Action
- Main Tailings Pile
- Furnace Creek Tailings Area
- Cinnabar Ore Zone
- New Furnace Cap Area
- Adits
- Collapsed Home
- Glory Hole
- New Furnace Structure
- Private Residence
- Dennis Creek Removal Area
- Tailings Repository

N

0 250 500 1,000
Feet



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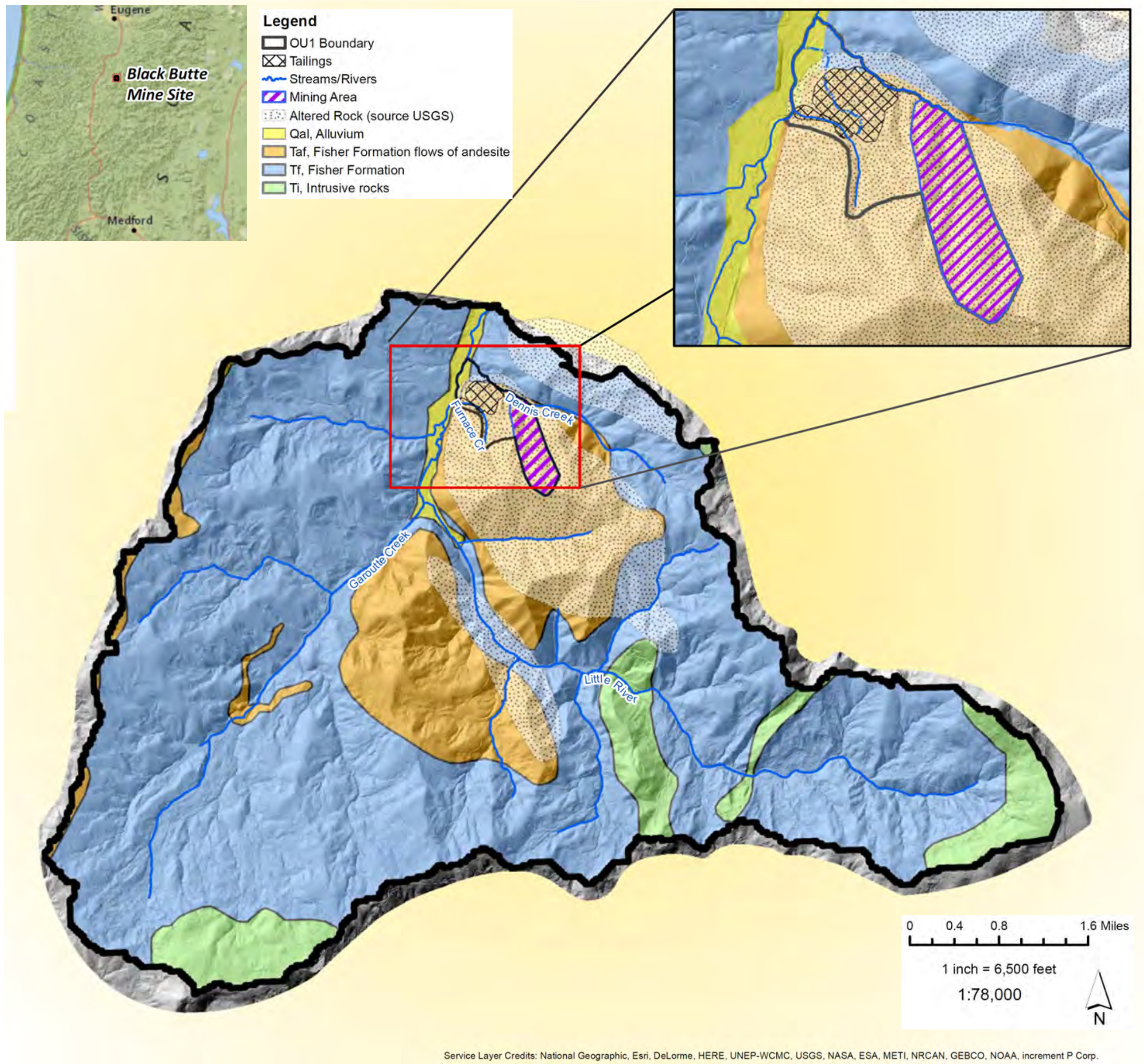

Black Butte Mine Superfund Site

Figure 2-2
Site Geologic Map

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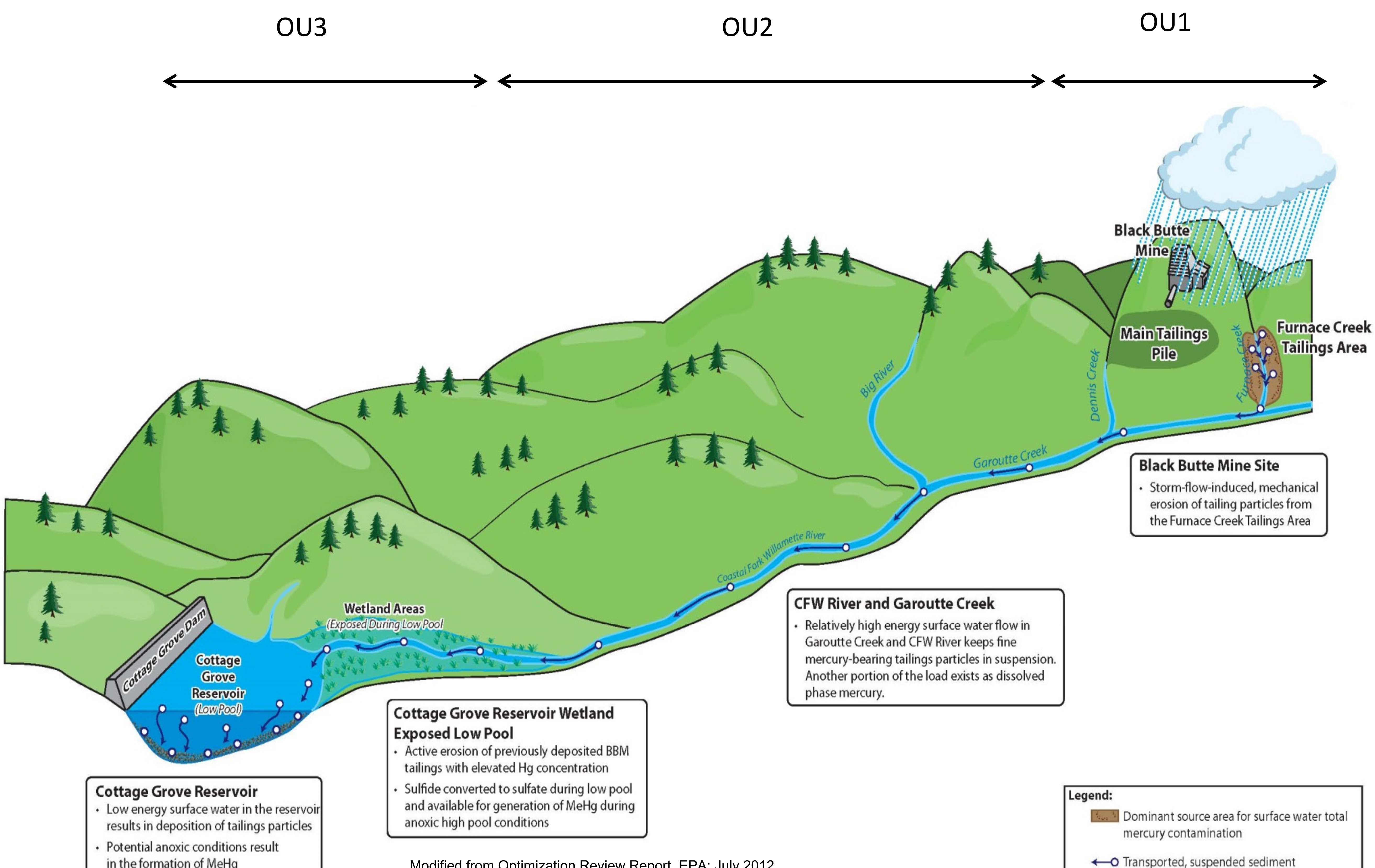

Modified from Optimization Review Report, EPA; July 2012

Black Butte Mine Superfund Site

Figure 2-3
Schematic of Sitewide Conceptual Site Model

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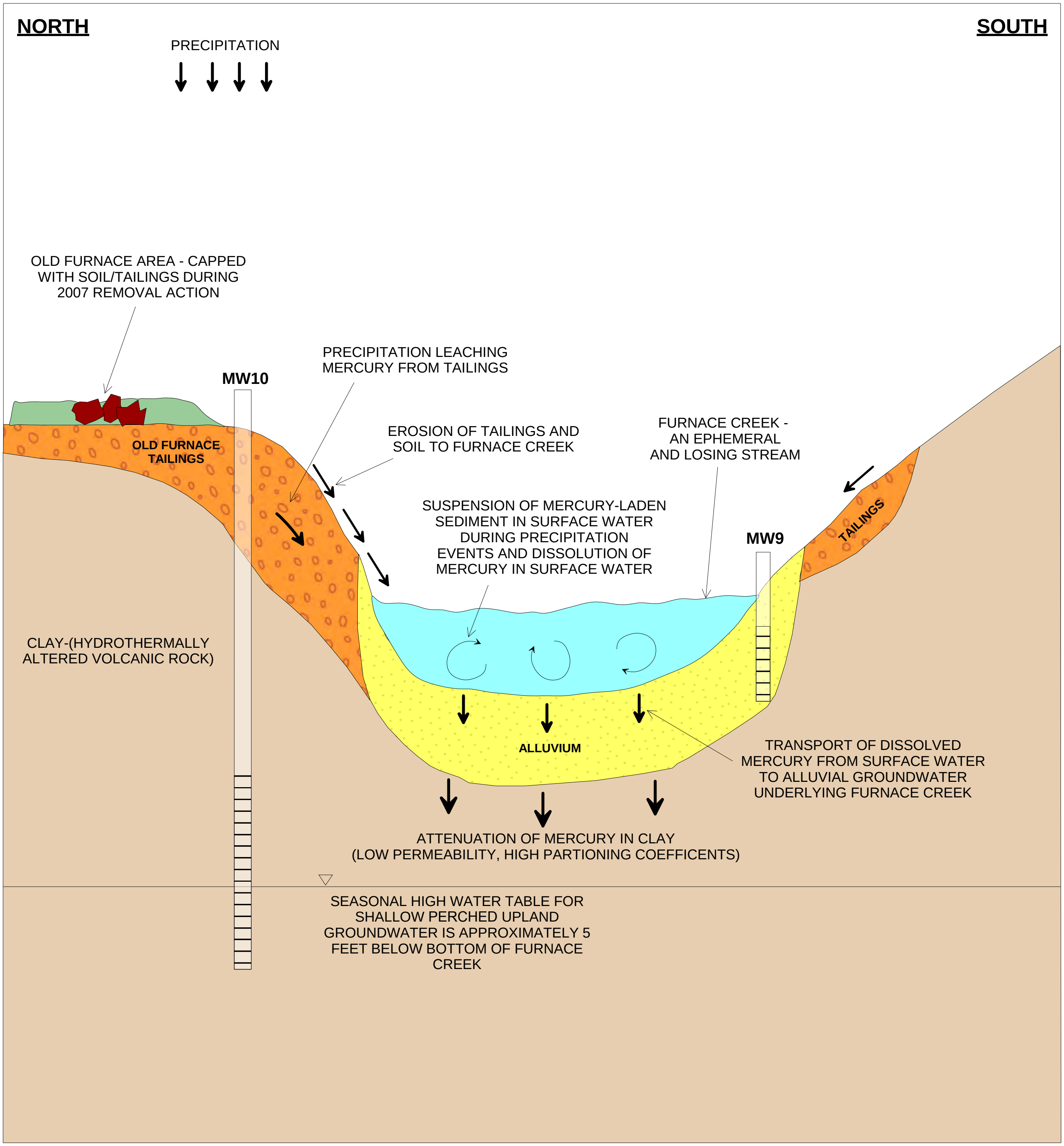

Note: Alluvium comprising the bed of Furnace Creek is co-mingled with tailings/contaminated sediments

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EA CDM Smith	Black Butte Mine Superfund Site	Figure 2-4 Furnace Creek Conceptual Site Model

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Figure 2-5

Black Butte Mine
Operable Unit 1
Soils Sampling Location Map
Mercury Concentrations

Legend

- EPA Monitoring Well Soil Sample Locations (2013/2014 Data)
- EPA Soil Sample Locations (Feb 2014 Event)
- DEQ Soil Sample Locations (2003)

Soil Concentrations for All Samples

Mercury (mg/kg)

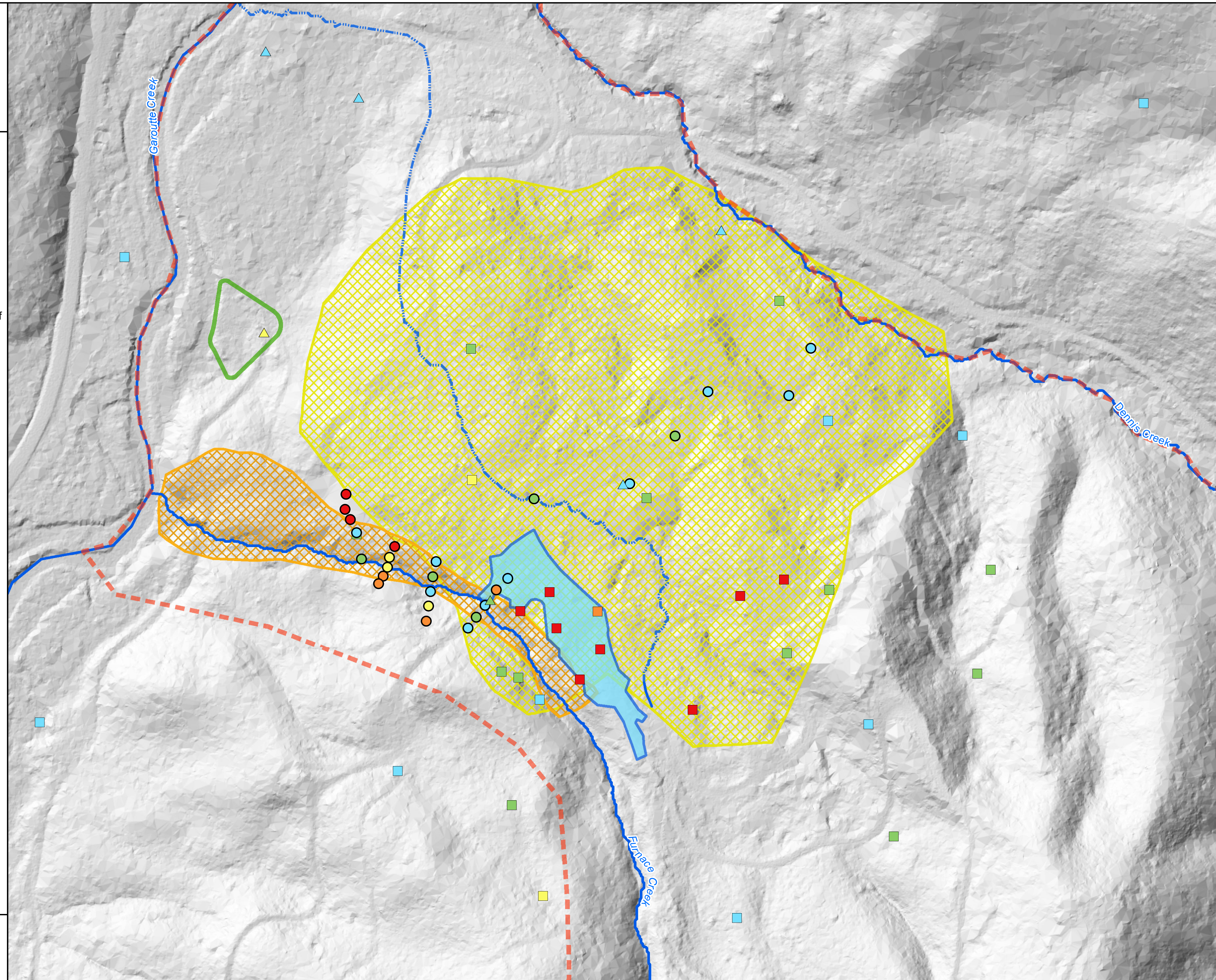
- ≤ 10
- >10 - 50
- >50 - 100
- >100 - 200
- >200

- Creek/Stream/ Drainage
- Intermittent Creek/ Stream/Drainage
- OU1 Boundary
- Main Tailings Pile
- Furnace Creek Tailings Area
- Approximate Extent of Old Furnace Area Capped During the 2007 Removal Action
- Historic Ore Processing Wastewater Handling Area

Note: 2003 DEQ soil sample locations within the footprint of the 2007 removal action capping are no longer exposed at the surface.

N

0 100 200 400
Feet



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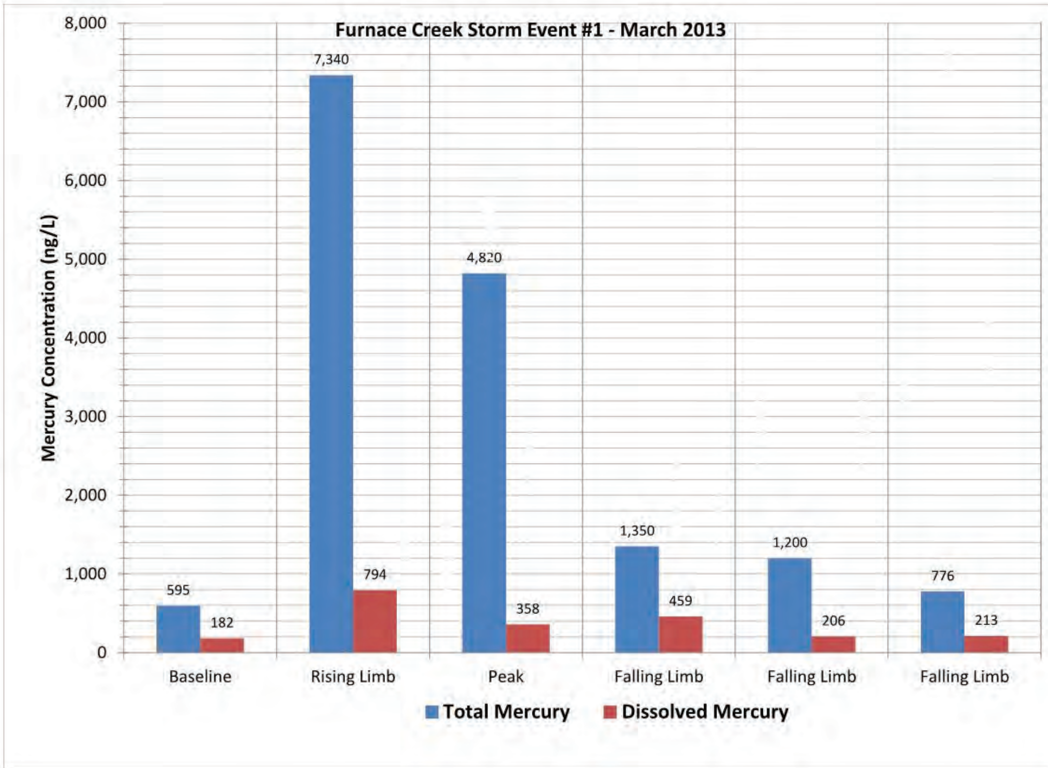

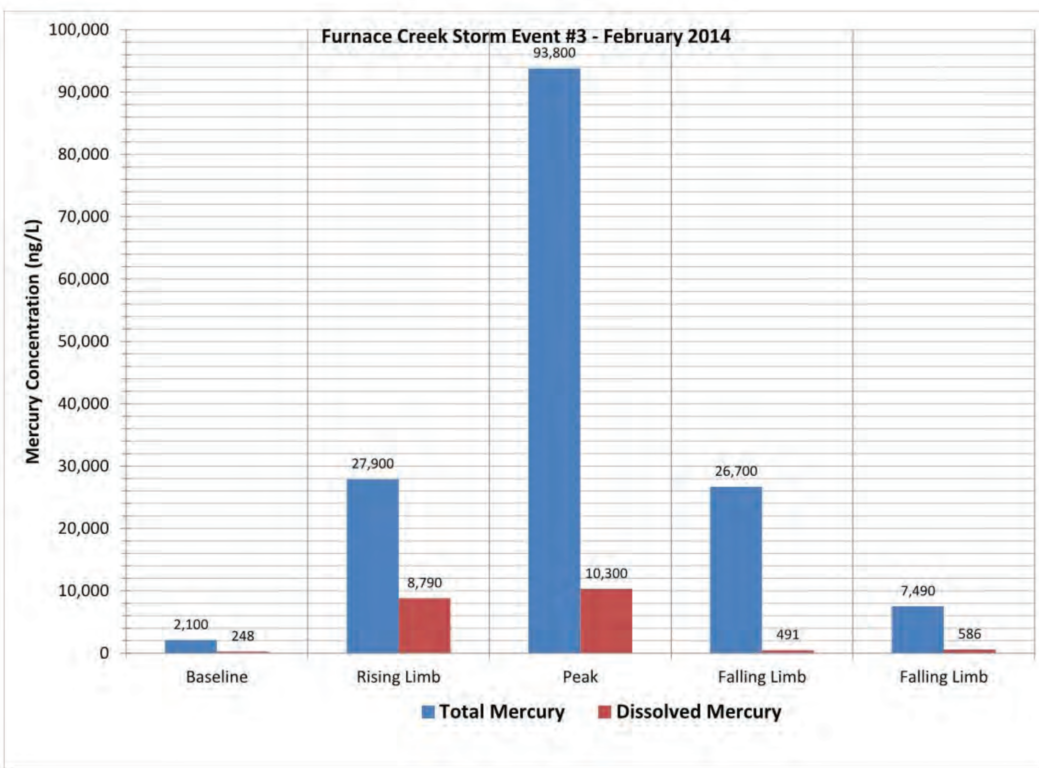

Notes:
ng/L – nanograms per liter
Samples collected at Furnace Creek station F1

EA CDM Smith	Black Butte Mine Superfund Site	**Figure 2-6** Total Versus Dissolved Mercury in Surface Water at Furnace Creek

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Figure 2-7

Groundwater Monitoring Well Locations and Dissolved Mercury Concentrations

Legend

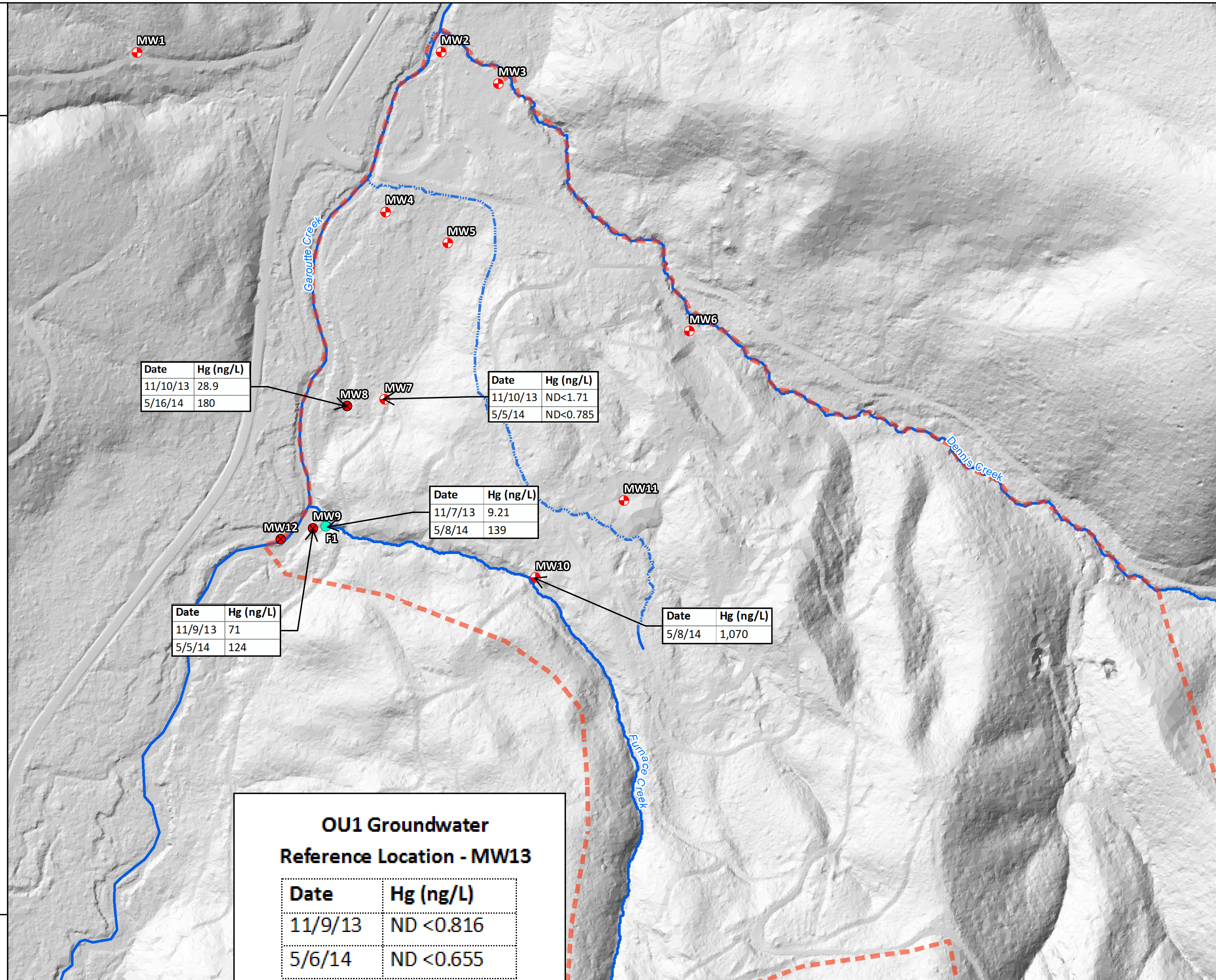
- Groundwater Monitoring Well (Sonic)
- Groundwater Monitoring Well (Hand Driven)
- Seepage Sample Point at the Buried Culvert
- Creek/Stream/Drainage
- Intermittent Creek/ Stream/Drainage
- OU1 Boundary

Notes:
ng/L = nanograms per liter
ND = not detected

1. Eight wells (MW1, through MW9, MW12, and MW13) are installed and screened within the alluvial aquifer system.
2. Two wells (MW10 and MW11) are installed and screened within the perched upland aquifer system.

N

0 500
Feet



OU1 Groundwater Reference Location - MW13

Date	Hg (ng/L)
11/9/13	ND <0.816
5/6/14	ND <0.655

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Figure 2-8

Incremental Soil Samples at OU1 and Average Mercury Concentrations in Soil

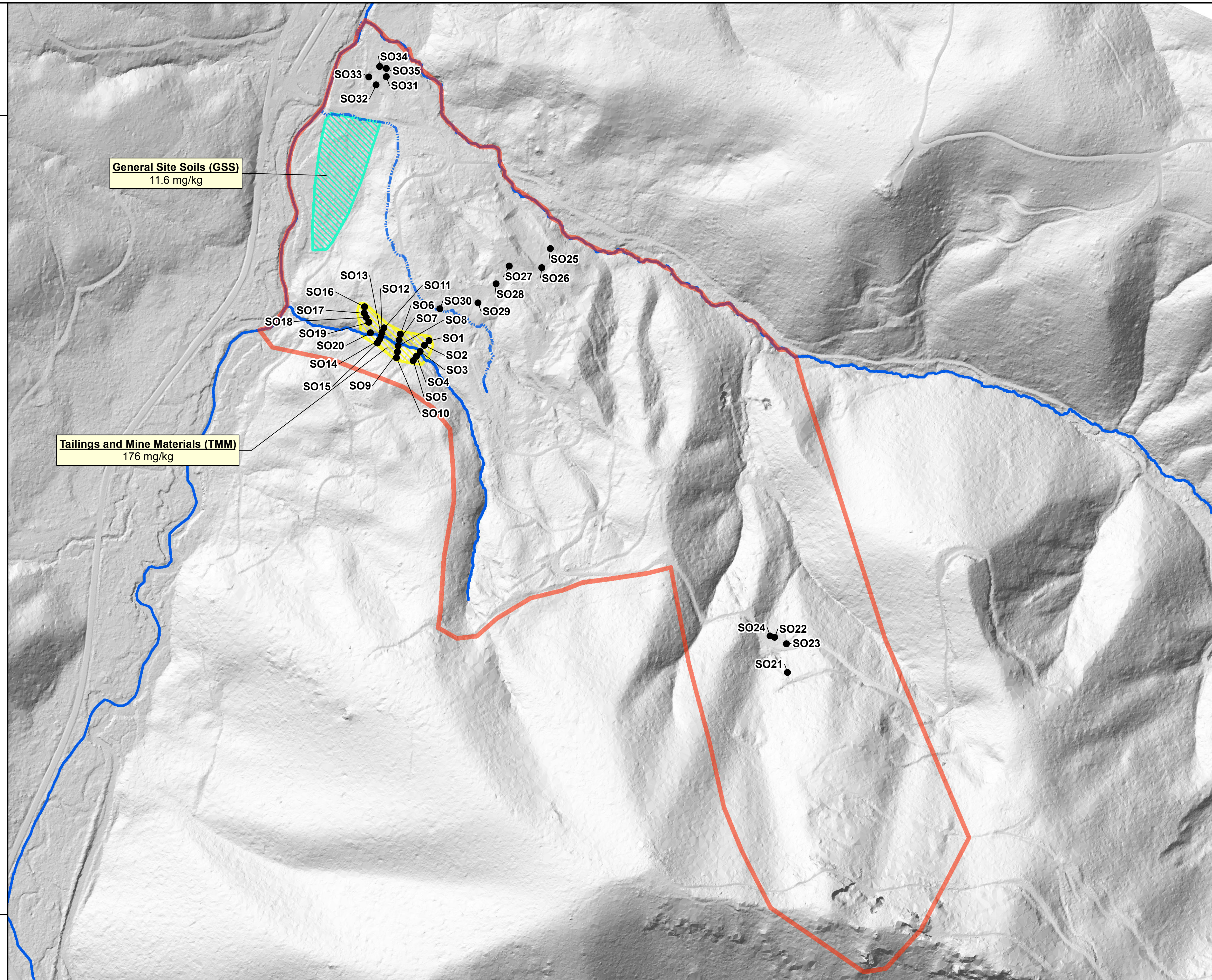
Legend

- Location of Discrete Point Samples
- Creek/Stream/Drainage
- Intermittent Creek/ Stream/Drainage
- General Site Soils Incremental Sampling Decision Unit
- Tailings and Mineralized Materials Incremental Sampling Decision Unit
- OU1 Boundary

Notes: mg/kg = milligrams per kilogram

N

0 500 1,000
Feet



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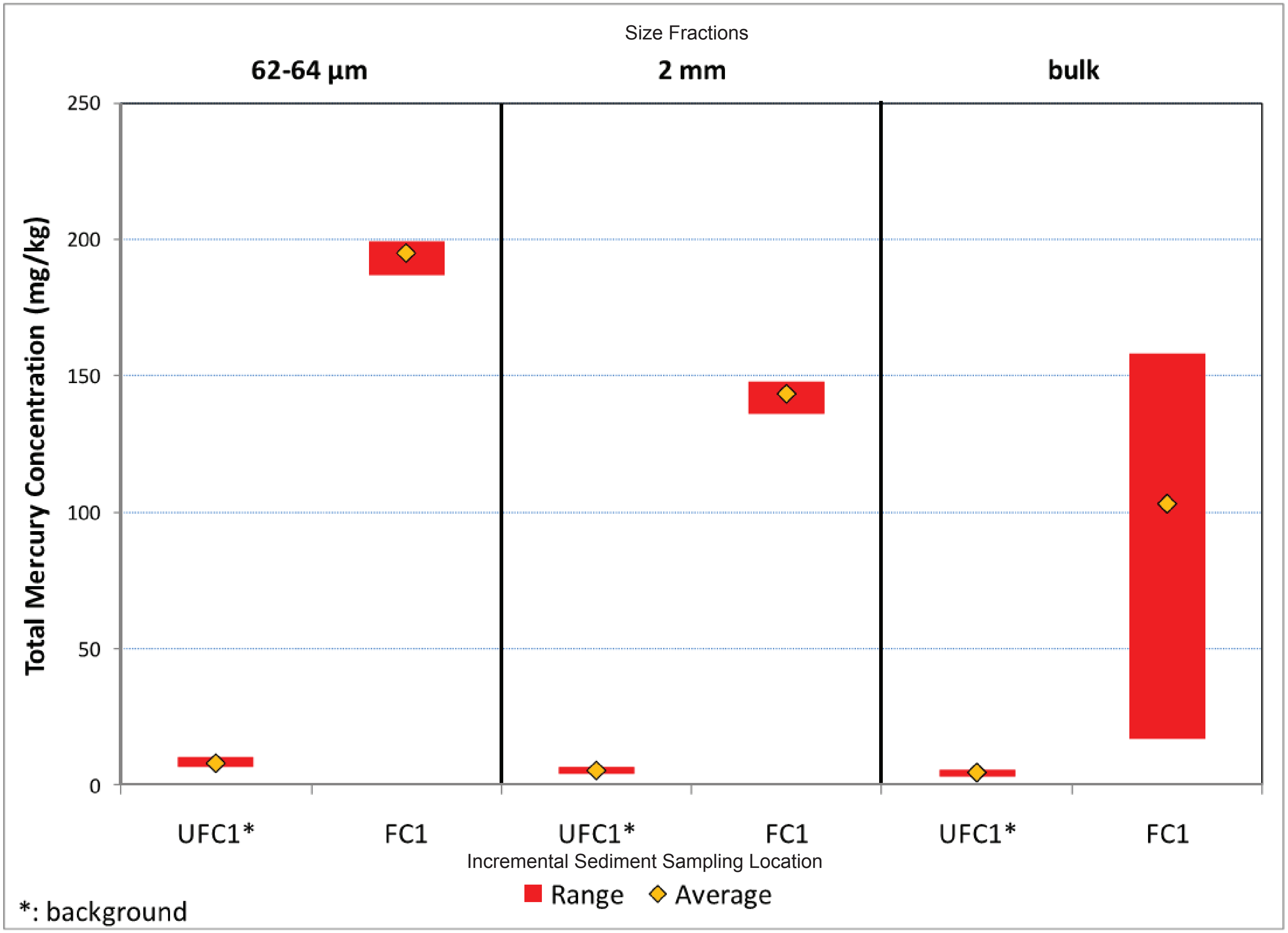

Notes:
mg/kg – milligrams per kilogram
µm – micron
mm - millimeter
UFC1 – Incremental sediment sample collected from upstream Furnace Creek, upstream of the areas disturbed by the mining activities
FC1 – Incremental sediment sample collected from downstream Furnace Creek, just upstream of the Garoutte Creek confluence

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Black Butte Mine Superfund Site

Figure 2-9
Mercury Concentrations in Sediment at Upstream and Downstream Furnace Creek

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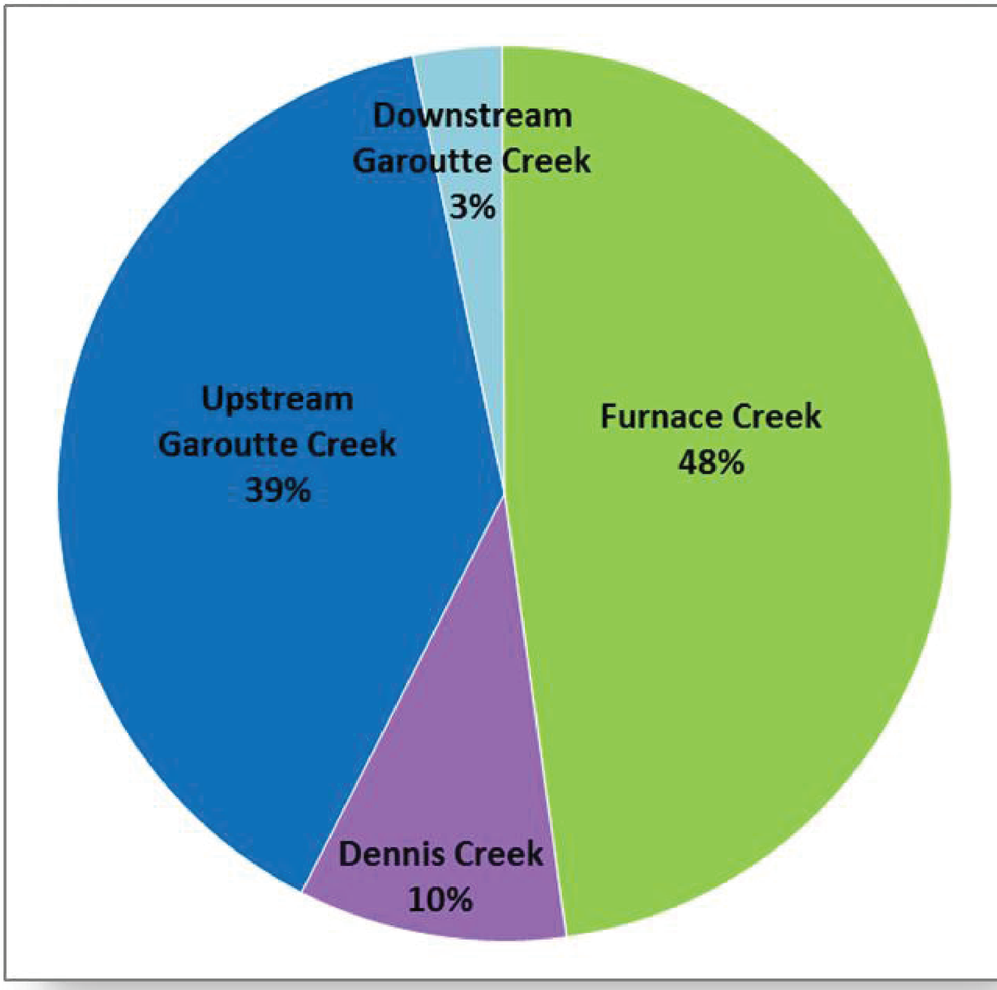

Note:
1. Percentage calculated for the downstream watershed at a point on Garoutte Creek immediately downstream of the confluence with Dennis Creek (Downstream of OU1).

2. Upstream Garoutte Creek is based on loading estimate at station GU1. Dennis Creek is based on loading estimate at station D1. Furnace Creek is based on loading estimate at station F1. Downstream Garoutte Creek based on loading estimate at station GD1 minus the estimated loads at station GU1 and F1.

3. Percentages are based on mercury loads calculated as mercury mass times volume per based on stream discharge and mercury concentration data collected from November 2012 through February 2014.

EA CDM Smith	Black Butte Mine Superfund Site	**Figure 2-10** Percent Contribution to Annual Mercury Loads in Downstream Watershed

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Figure 2-11

Furnace Creek Removal Action Boundary

Legend

- EPA Monitoring Well Soil Sample Locations (2013/2014 Data)
- EPA Soil Sample Locations (Feb 2014 Event)
- DEQ Soil Sample Locations (2003)

Soil Concentrations for All Samples

Mercury (mg/kg)

- ≤ 10
- >10 - 50
- >50 - 100
- >100 - 200
- >200

- Creek/Stream/ Drainage
- Intermittent Creek/ Stream/Drainage
- Location of Old Furnace Area Capped During the 2007 Removal Action
- Proposed Furnace Creek Removal Action Boundary
- OU1 Boundary
- Main Tailings Pile
- Furnace Creek Tailings Area
- Furnace Creek Catchment Boundary

Note: 2003 DEQ soil sample locations within the footprint of the 2007 removal action capping are no longer exposed at the surface. Furnace Creek removal action and Furnace Creek catchment has overlapping boundaries.

N

0 100 200 400

Feet

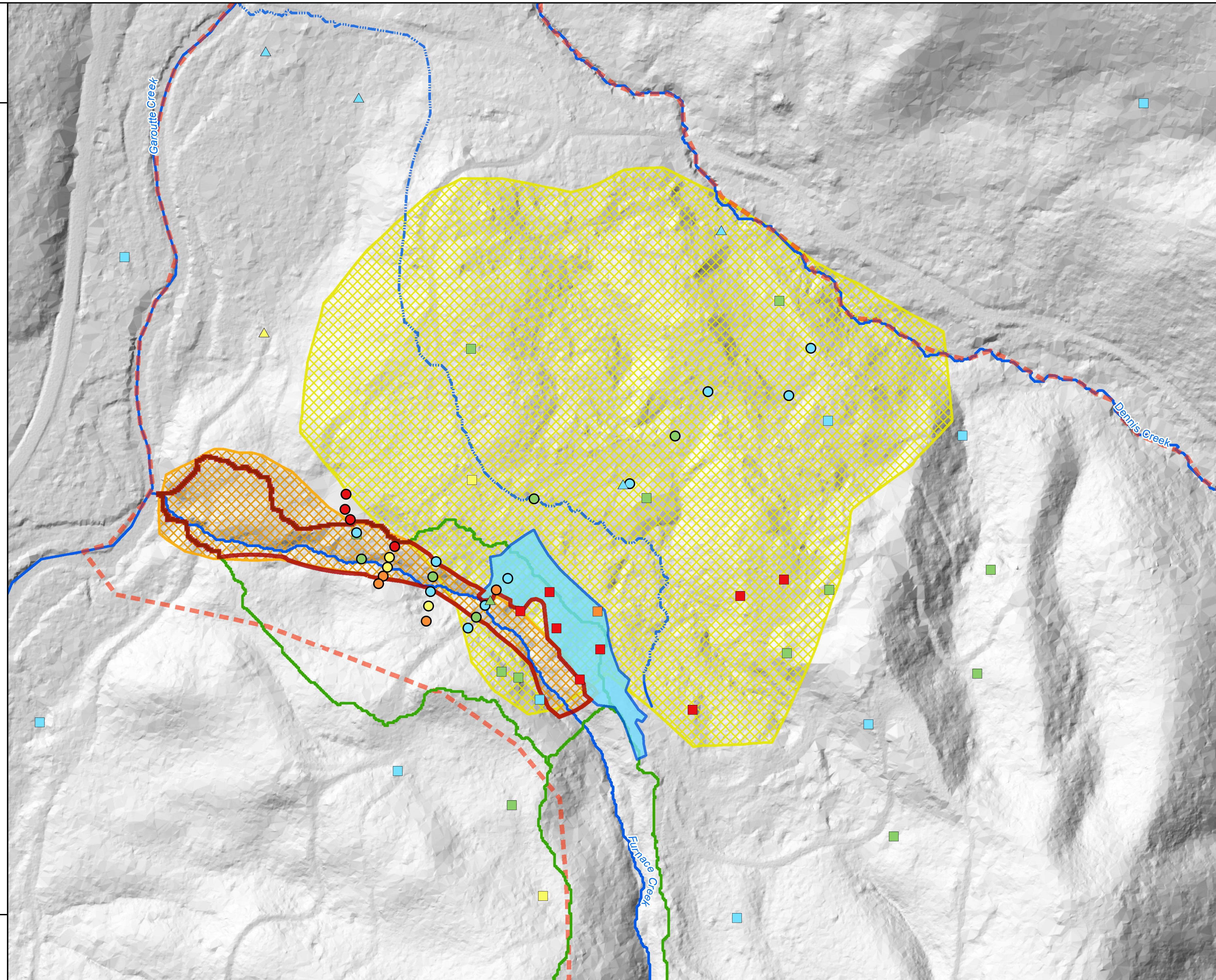

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Figure 4-1
Alternative RA1:
Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

Legend

- Creek/Stream/ Drainage
- Proposed Furnace Creek Removal Action Boundary
- OU1 Boundary
- Furnace Creek Catchment Boundary
- Stormwater Run-On Swale
- Stormwater Run-Off Swale
- Stormwater Detention Basin

N

0 50 100 200
Feet

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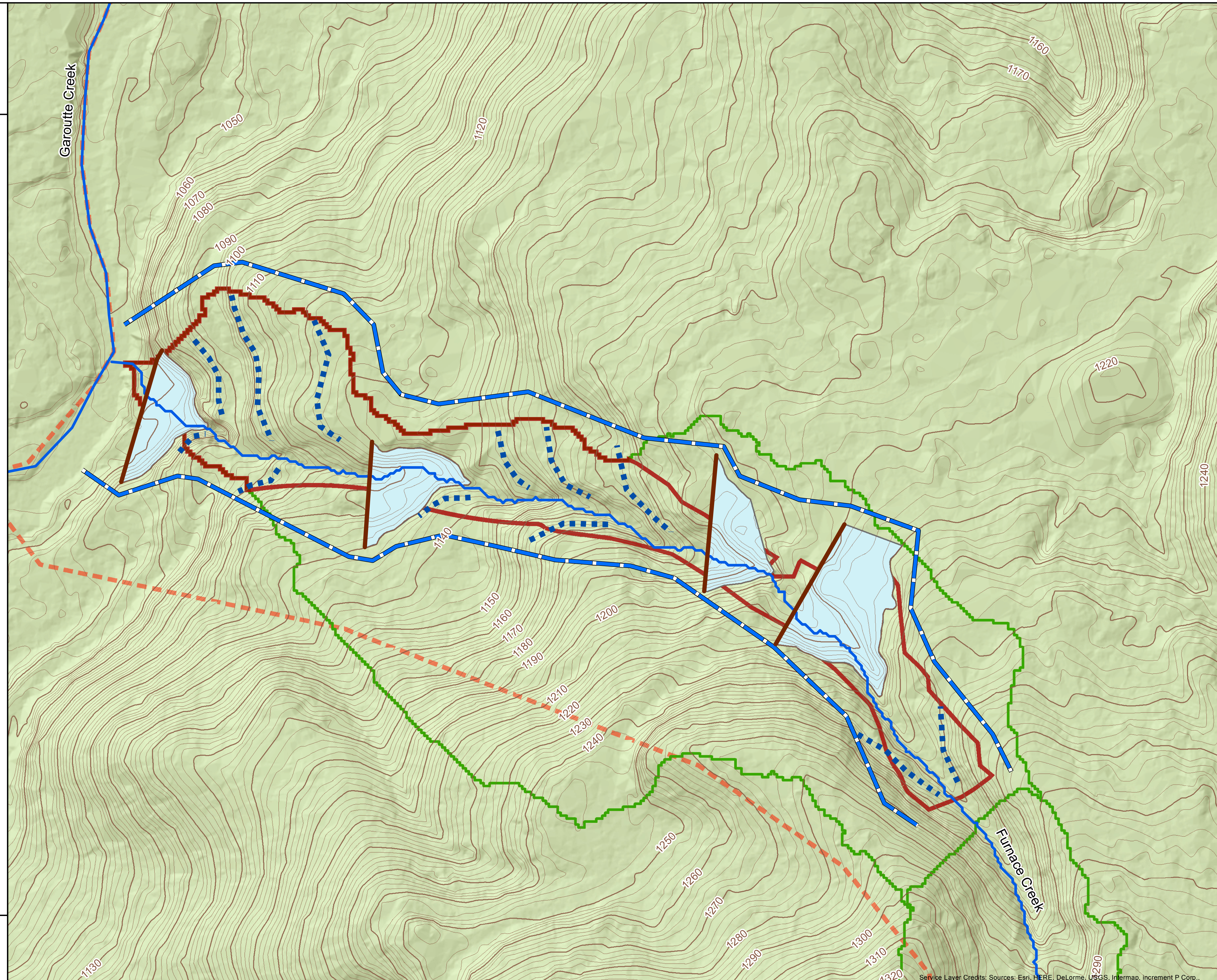

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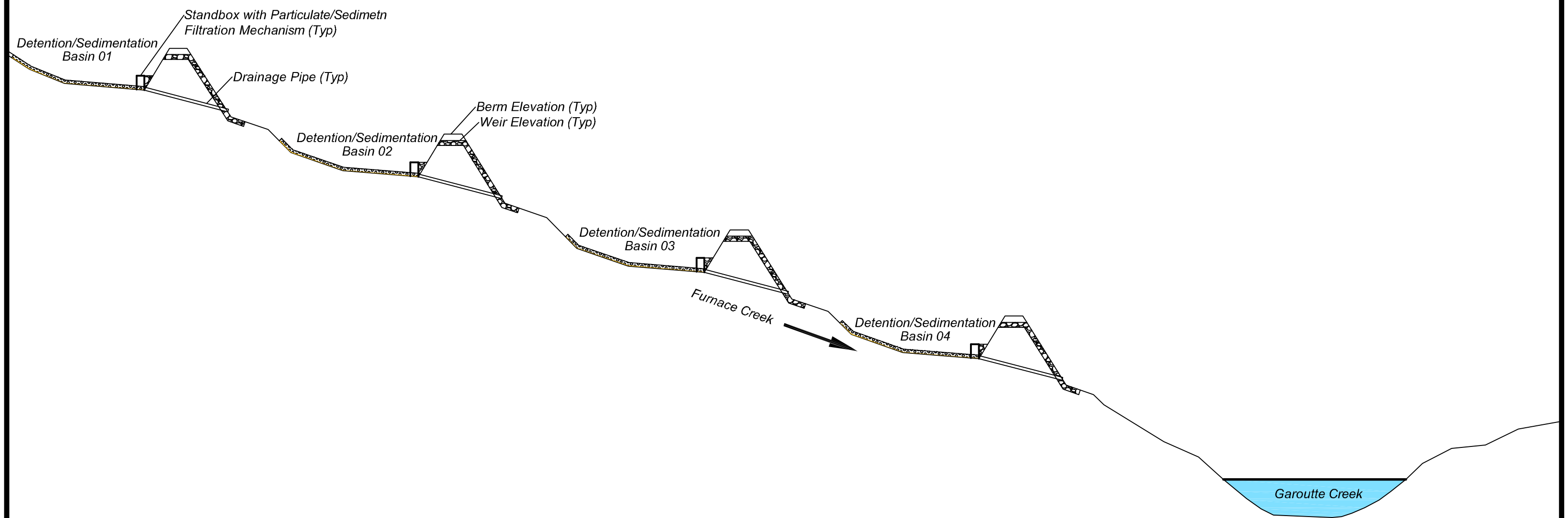
Figure 4-2
Stormwater Detention Basin Concept for Alternative RA1

Legend

- Articulated Concrete Blocks
- Riprap
- Geotextile



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Note: The concept provided in this figure is for illustrative purposes only and does not reflect an earthwork design for a specific location or design requirements. The concept requires additional development that can be initiated during the removal design phase of the project.

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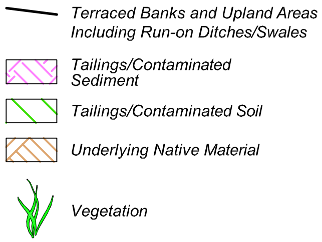
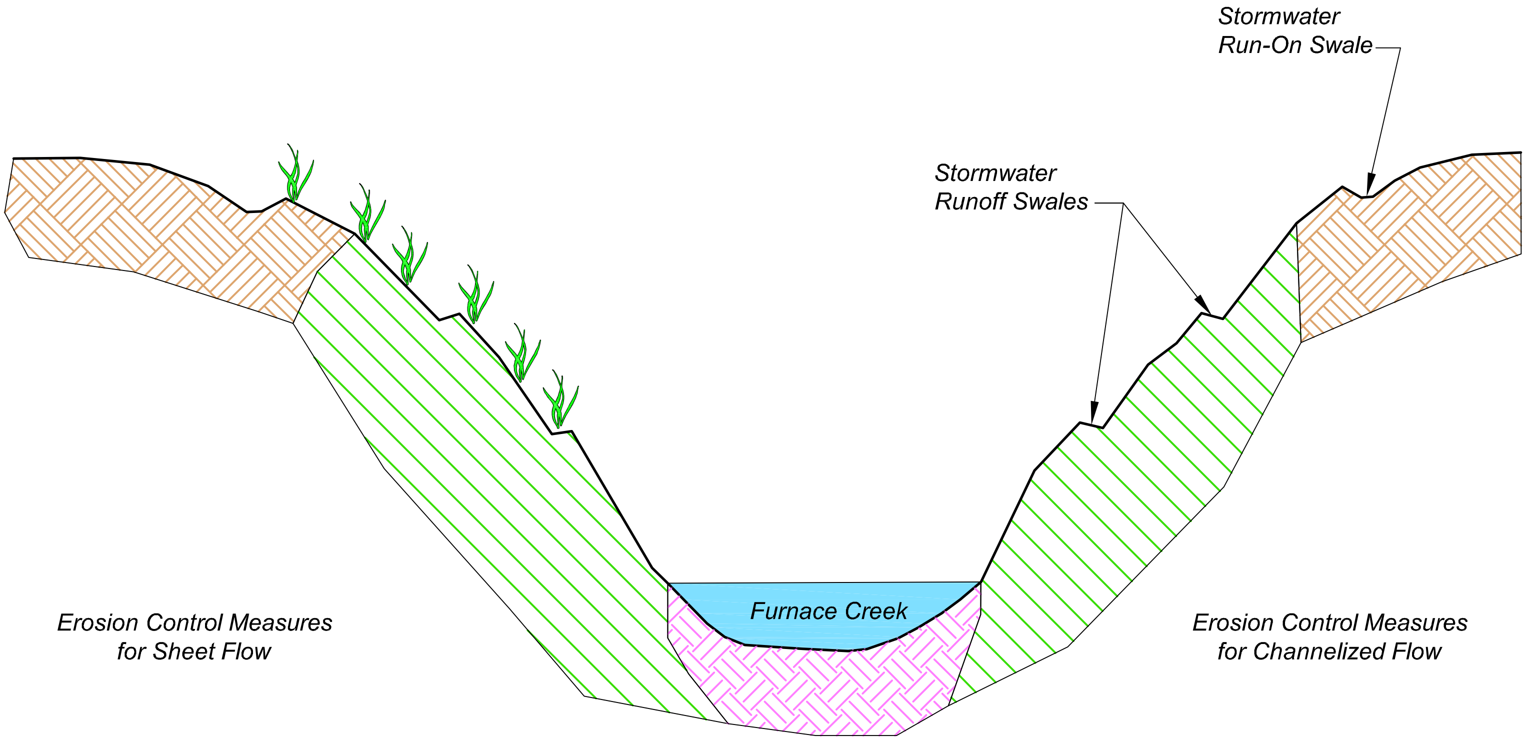
Figure 4-3
Erosion Control Measures
Concept for Alternative RA1

Legend





Note: The concept provided in this figure is for illustrative purposes only and does not reflect an stormwater control design for a specific location or design requirements. The concept requires additional development that can be initiated during the removal design phase of the project.

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Figure 4-4

Alternative RA2:
In-Place Containment of Mercury Source Material using Covers

Legend

- Creek/Stream/ Drainage
- Proposed Furnace Creek Removal Action Boundary
- OU1 Boundary
- Furnace Creek Catchment Boundary
- Creek Bed and Creek Bank Cover System
- Upland Cover System

N

0 50 100 200
Feet

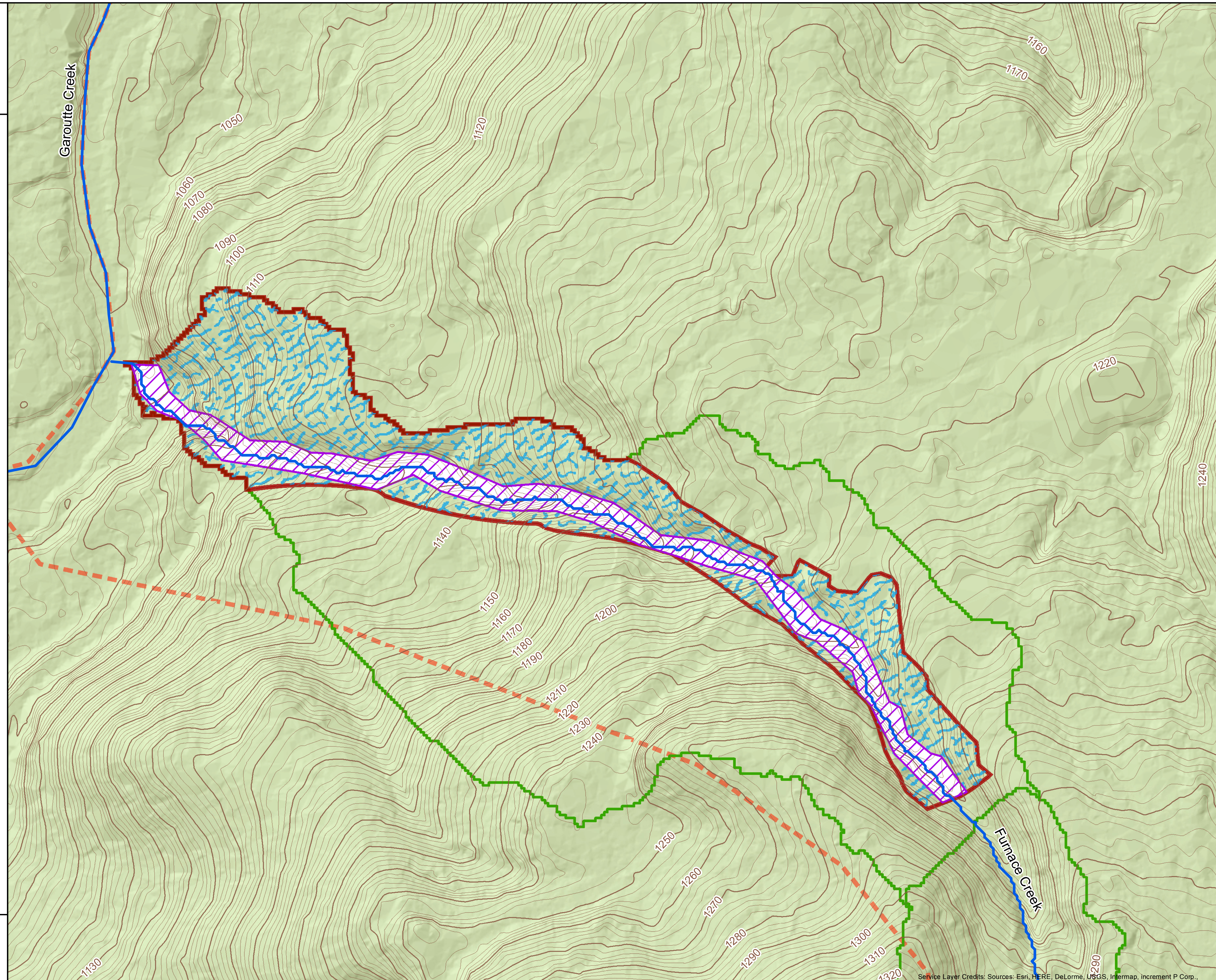

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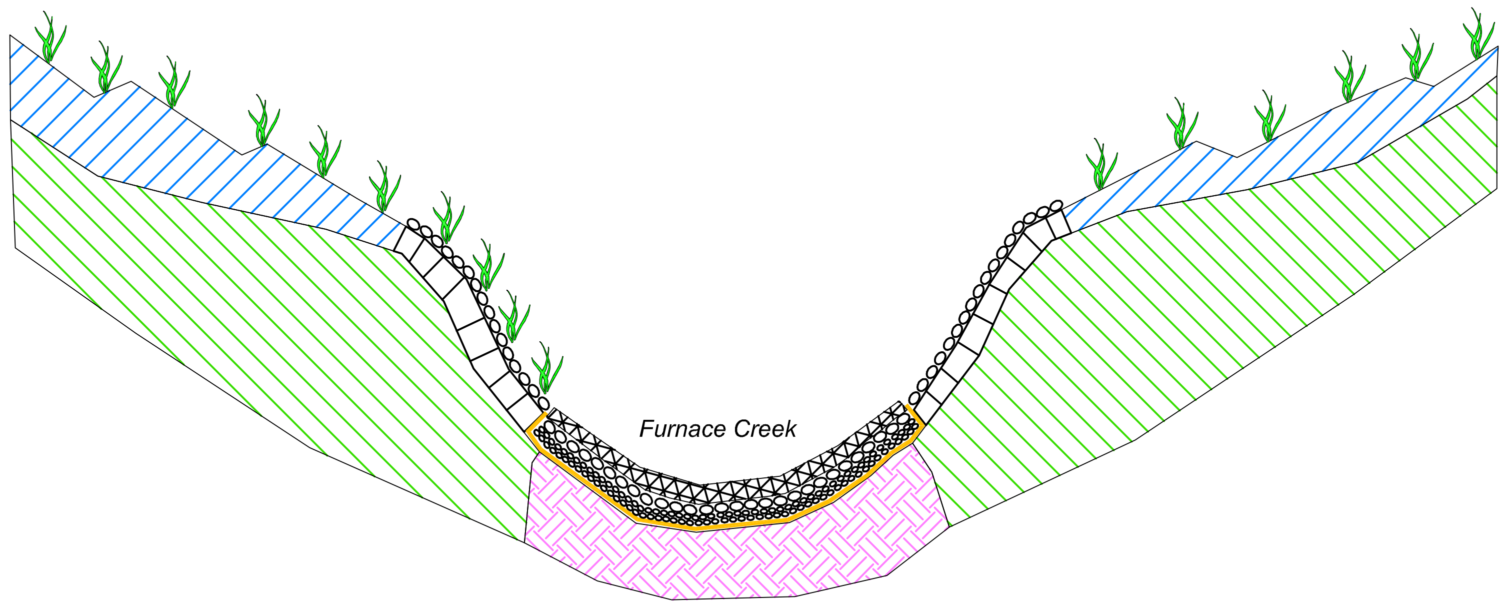
Figure 4-5
In-Place Containment Concept for Alternative RA2

Legend

- *Tailings/Contaminated Sediment*
- *Tailings/Contaminated Soil*
- *Upland Cover*
- *Vegetation*
- *Creek Bank Cover*
- *Creek Bed Cover*



Note: The concept provided in this figure is for illustrative purposes only and does not reflect an in-place containment design for a specific location or design requirements. The concept requires additional development that can be initiated during the removal design phase of the project.

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Figure 4-6
Alternative RA3:
Excavation and Onsite Disposal of Mercury Source Material with Reclamation/ Rehabilitation of Excavated Surfaces

Legend

- Creek/Stream/ Drainage
- Proposed Furnace Creek Removal Action Boundary
- OU1 Boundary
- Furnace Creek Catchment Boundary
- Existing Tailings Repository
- Extent of Removal
- Extent of Onsite Disposal Repository

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Feet

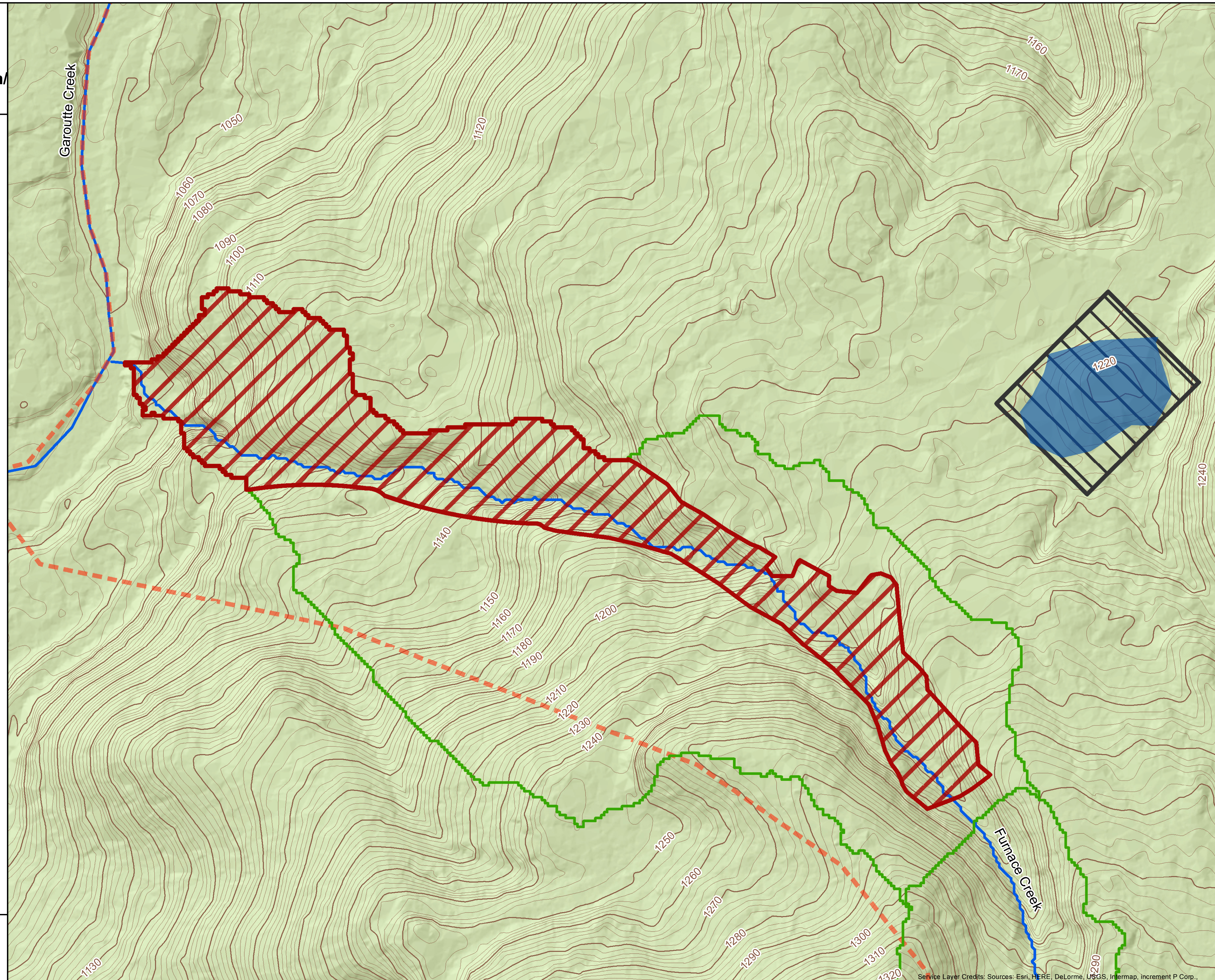

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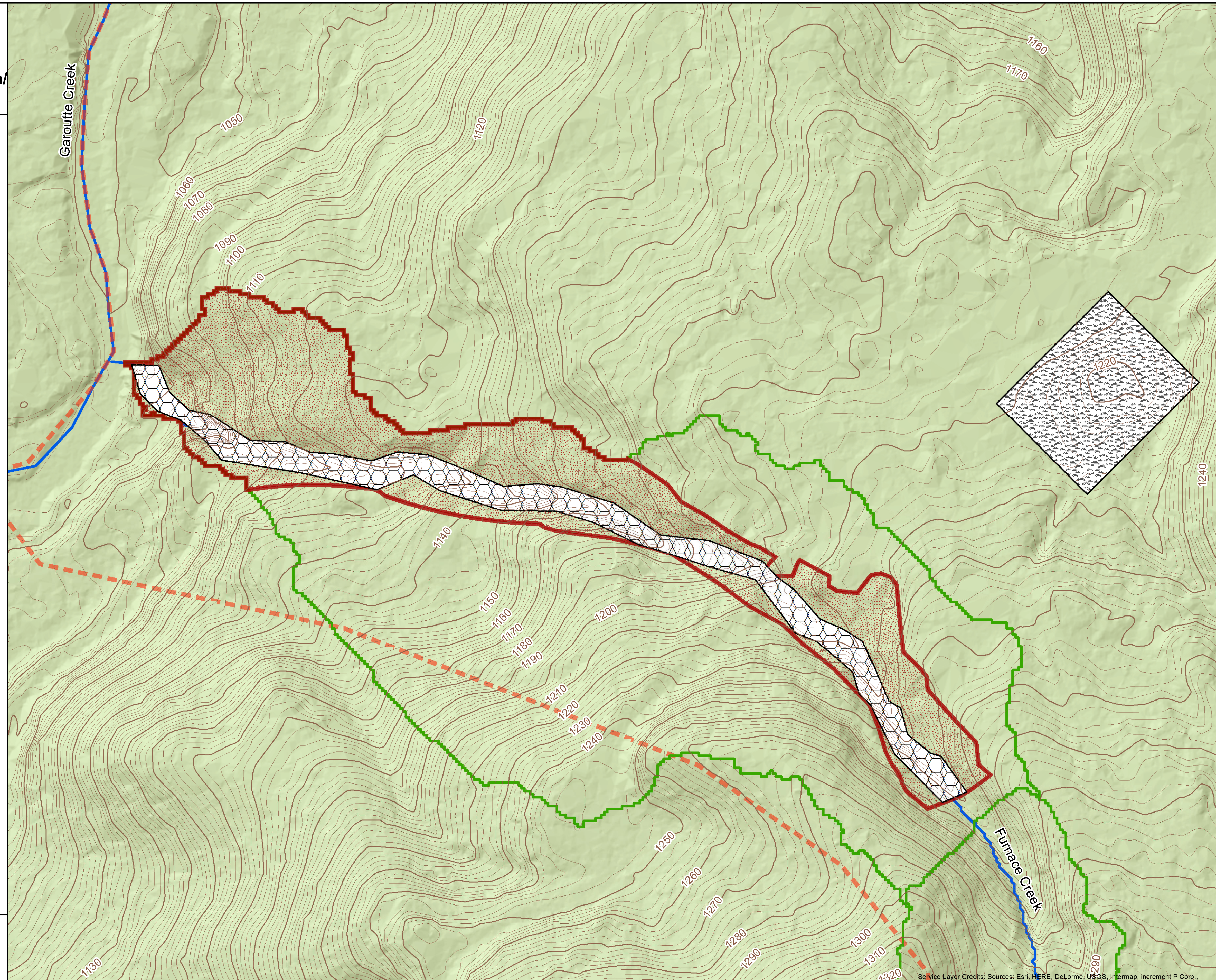
Figure 4-7
Alternative RA3:
Excavation and Onsite Disposal of Mercury Source Material with Reclamation/ Rehabilitation of Excavated Surfaces

Legend

- Creek/Stream/ Drainage
- Proposed Furnace Creek Removal Action Boundary
- OU1 Boundary
- Furnace Creek Catchment Boundary
- Creek Corridor Rehabilitation
- Upland Area Reclamation
- Extent of New Repository Cover



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3/26/2016

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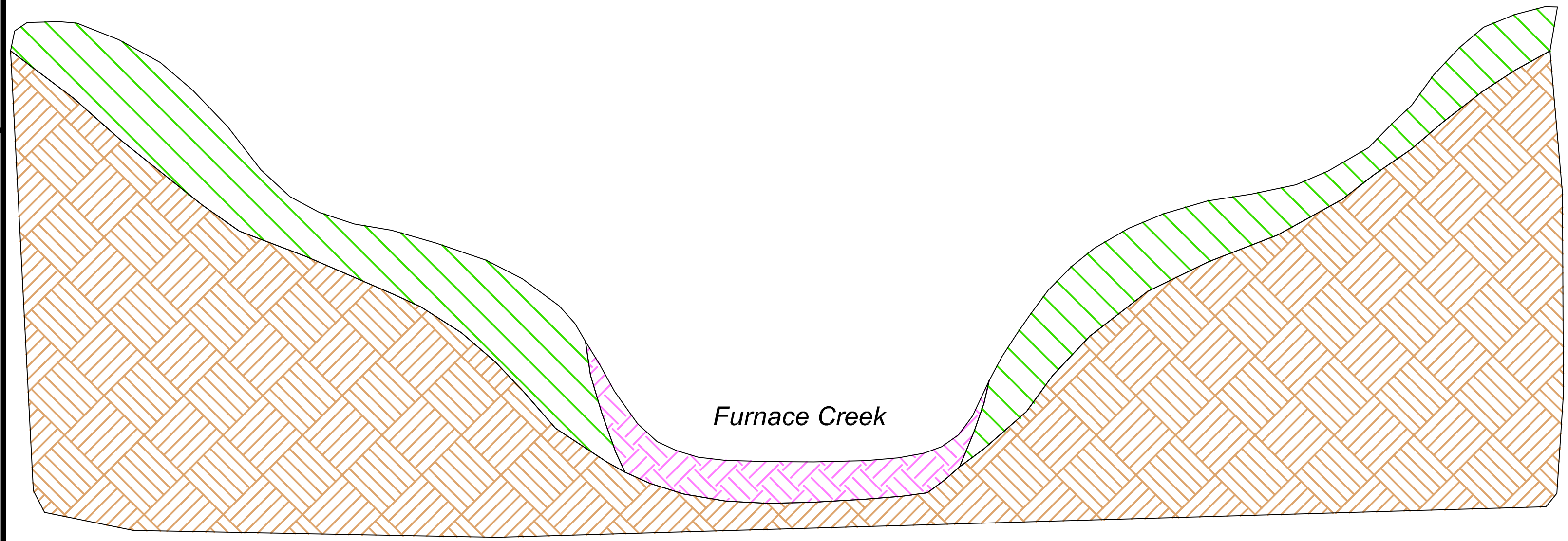
Figure 4-8

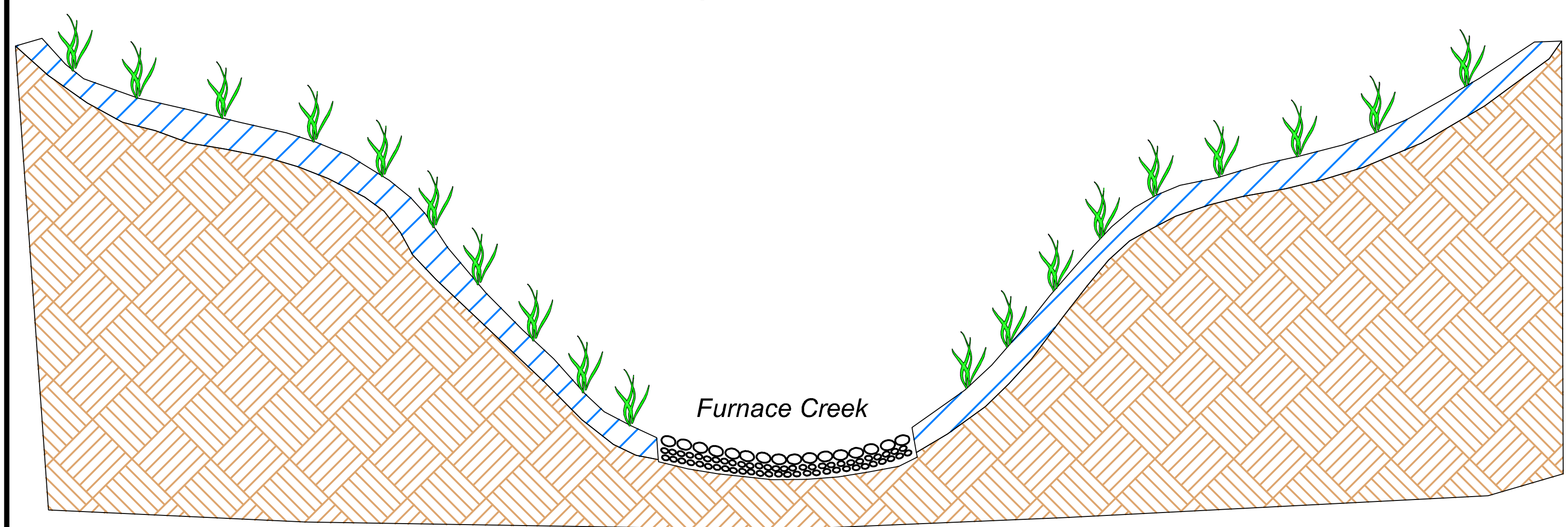
Excavation and Reclamation/Rehabilitation Concept for Alternative RA3

Legend

- Tailings/Contaminated Sediment
- Tailings/Contaminated Soil
- Upland Area Reclamation and Creek Bank Rehabilitation
- Underlying Native Material
- Vegetation
- Creek Bed Rehabilitation



Excavation of Tailings/Contaminated Soil and Tailings/Contaminated Sediment



Reclamation and Rehabilitation

Note: The concept provided in this figure is for illustrative purposes only and does not reflect an earthwork design for a specific location or design requirements. The concept requires additional development that can be initiated during the removal design phase of the project.

NOT TO SCALE

EA CDM Smith

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Figure 4-9

Onsite Disposal Concept for Alternative RA3

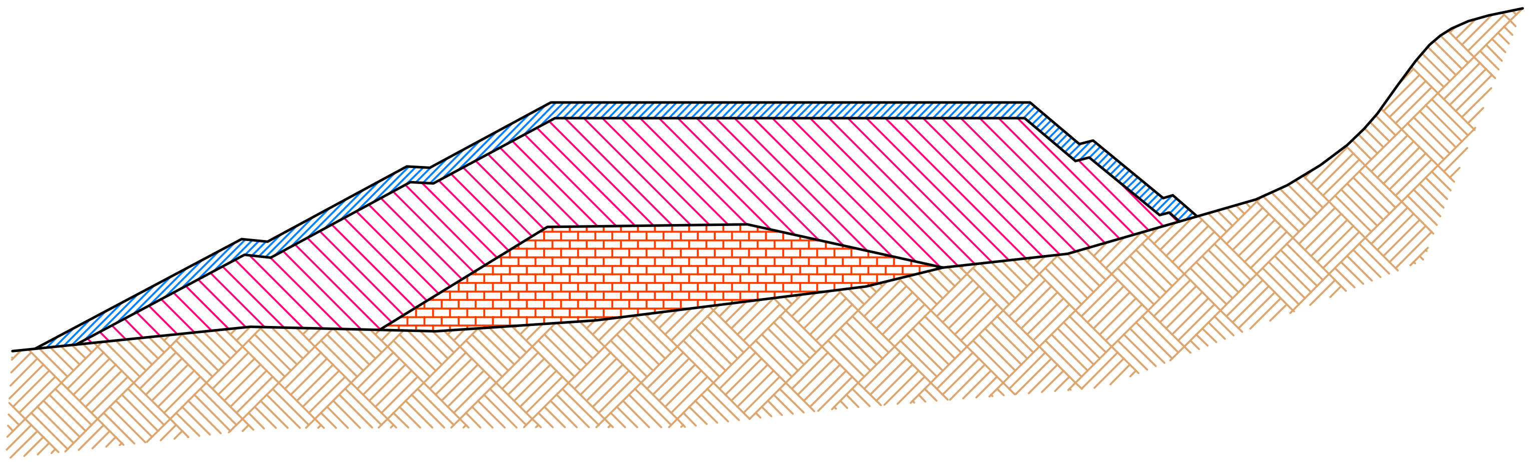
Legend

Existing Tailings Repository

New Repository Cover

Placed Tailings/Soil/Sediment

Existing Topography



Onsite Disposal Repository

NOT TO SCALE

EA CDM Smith

Note: The onsite disposal repository concept provided in this figure is for illustrative purposes only and does not reflect a repository design. The concept requires additional development that can be initiated during the removal design phase of the project.

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Appendix A

XRF and Lumex Mercury Results for Soil from the 2007 Removal Action

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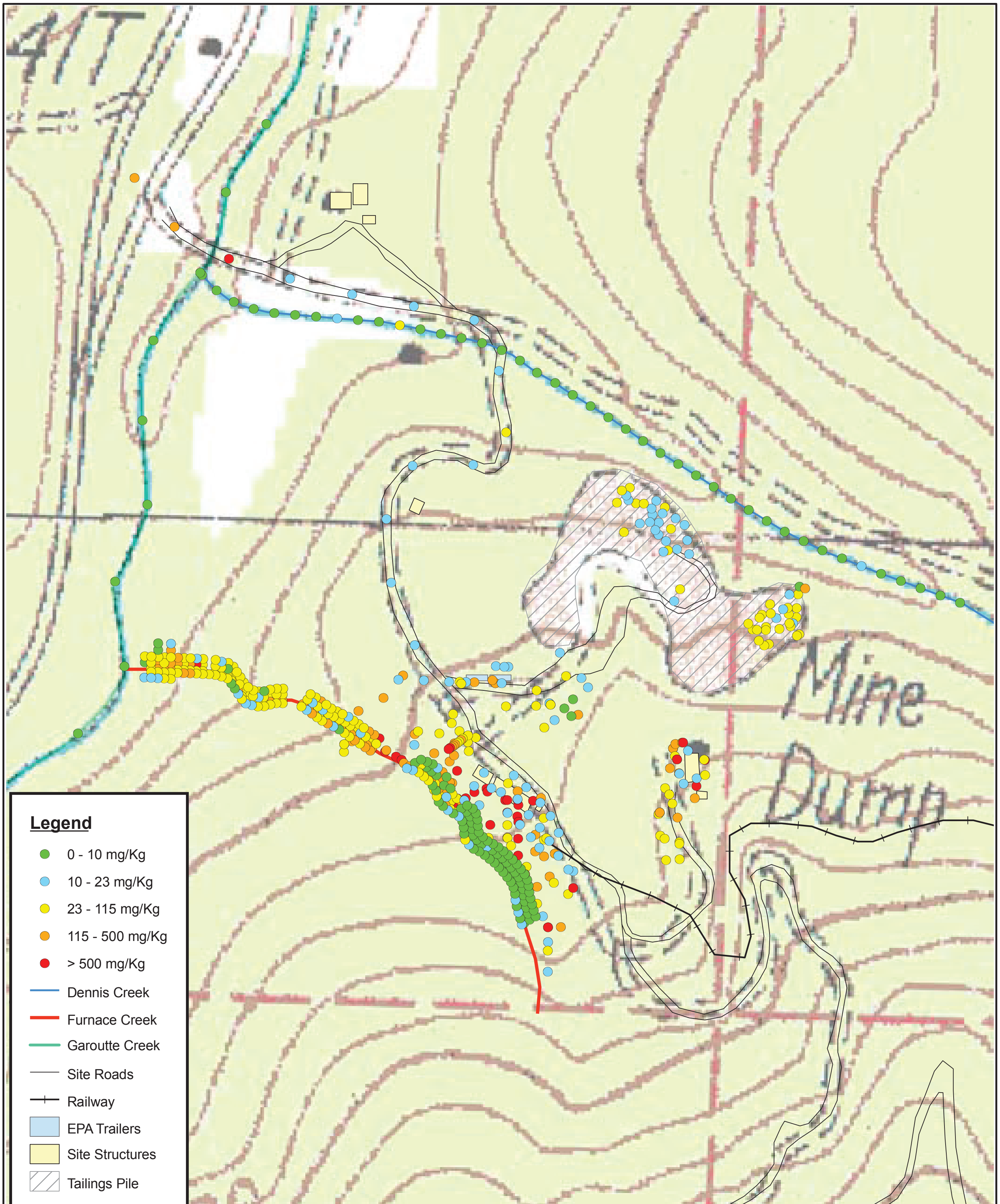

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Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2

Field Mercury Concentrations Site Map

Job Id: 002233.0026.01IA	
Date: 10/15/2007	GIS Analyst: avh
Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .	

\EDMS-Projects\Black Butte Mine\removal_aug07\figure 1 site map.mxd

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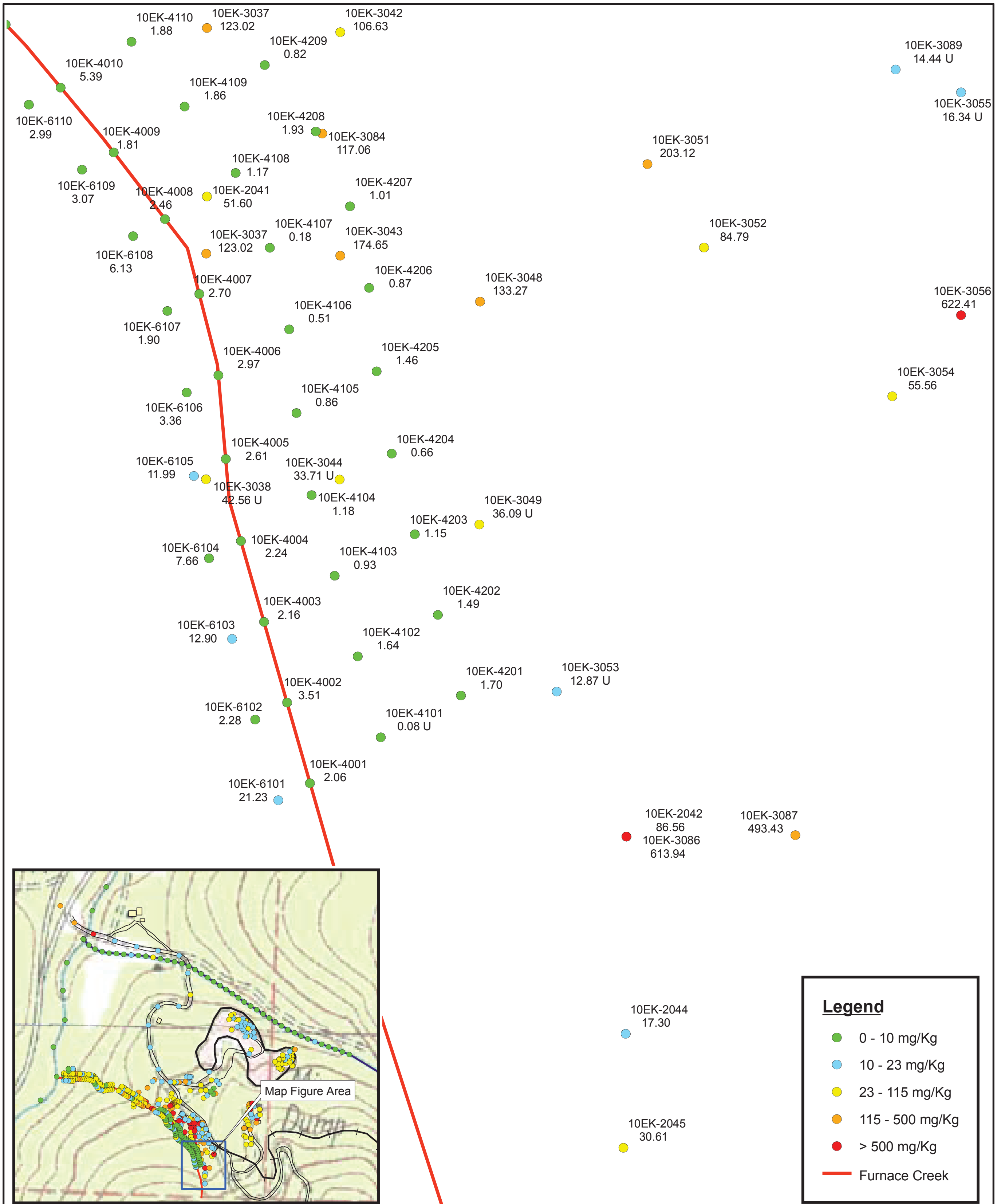

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Scale 1:300

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Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2C

Field Mercury Concentrations Furnace Creek Section 1 (East End)

Job Id: 002233.0026.01IA	
Date: 10/15/2007	GIS Analyst: avh
Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .	

\EDMS-Projects\Black Butte Mine\removal_aug07\figure 1c.mxd

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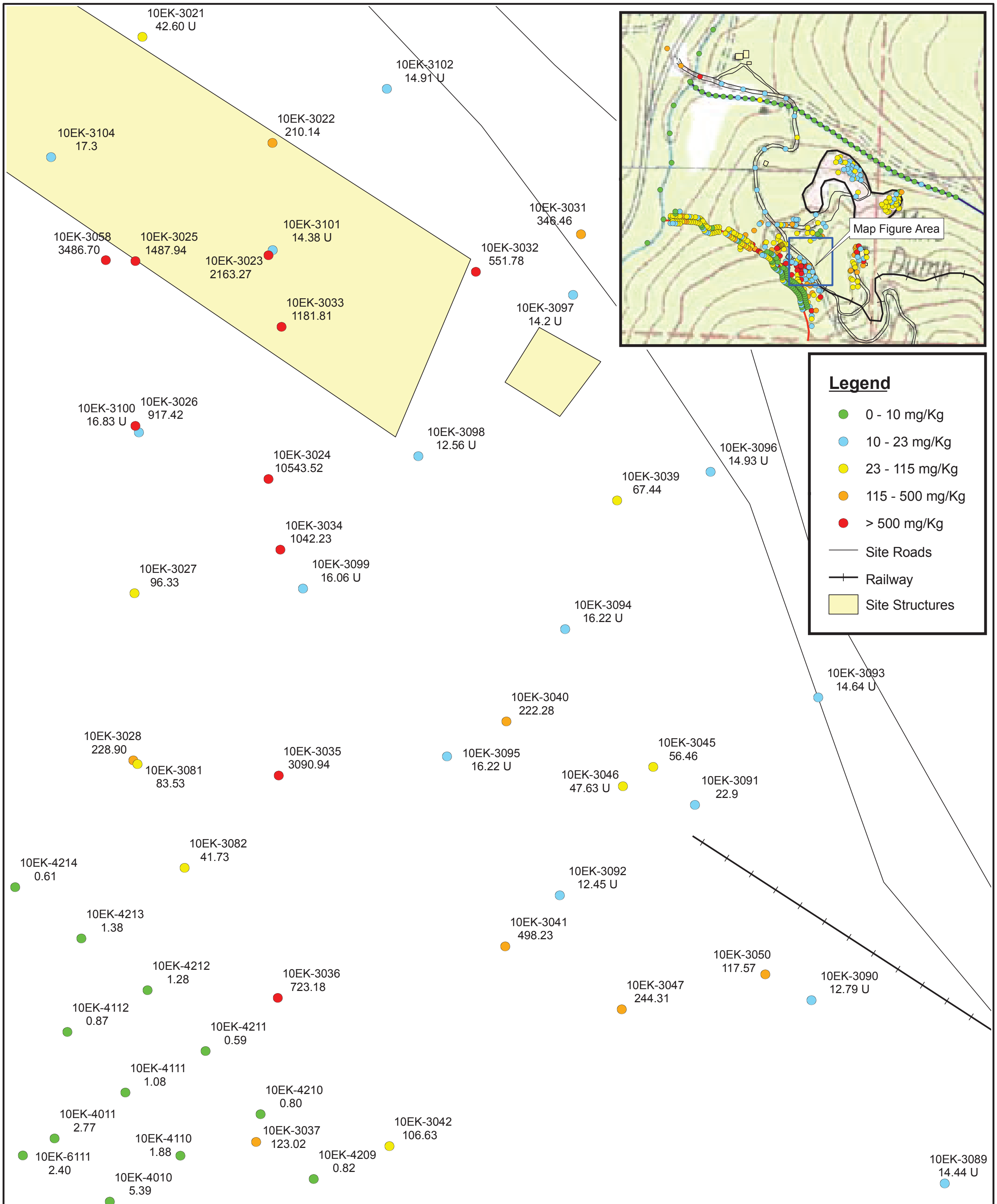

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BLACK BUTTE MINE

Lane County, Oregon

Figure 2D

Field Mercury Concentrations Old Furnace Area Furnace Creek Section 2

Job Id:
002233.0026.01IA

Date:
10/15/2007

GIS Analyst:
avh

Map Source Information: USGS Topographic Map.
Harness Mountain, Oregon. Scale 1-24,000 .

\EDMS-Projects\Black Butte Mine\removal_aug07\figure 1d.mxd

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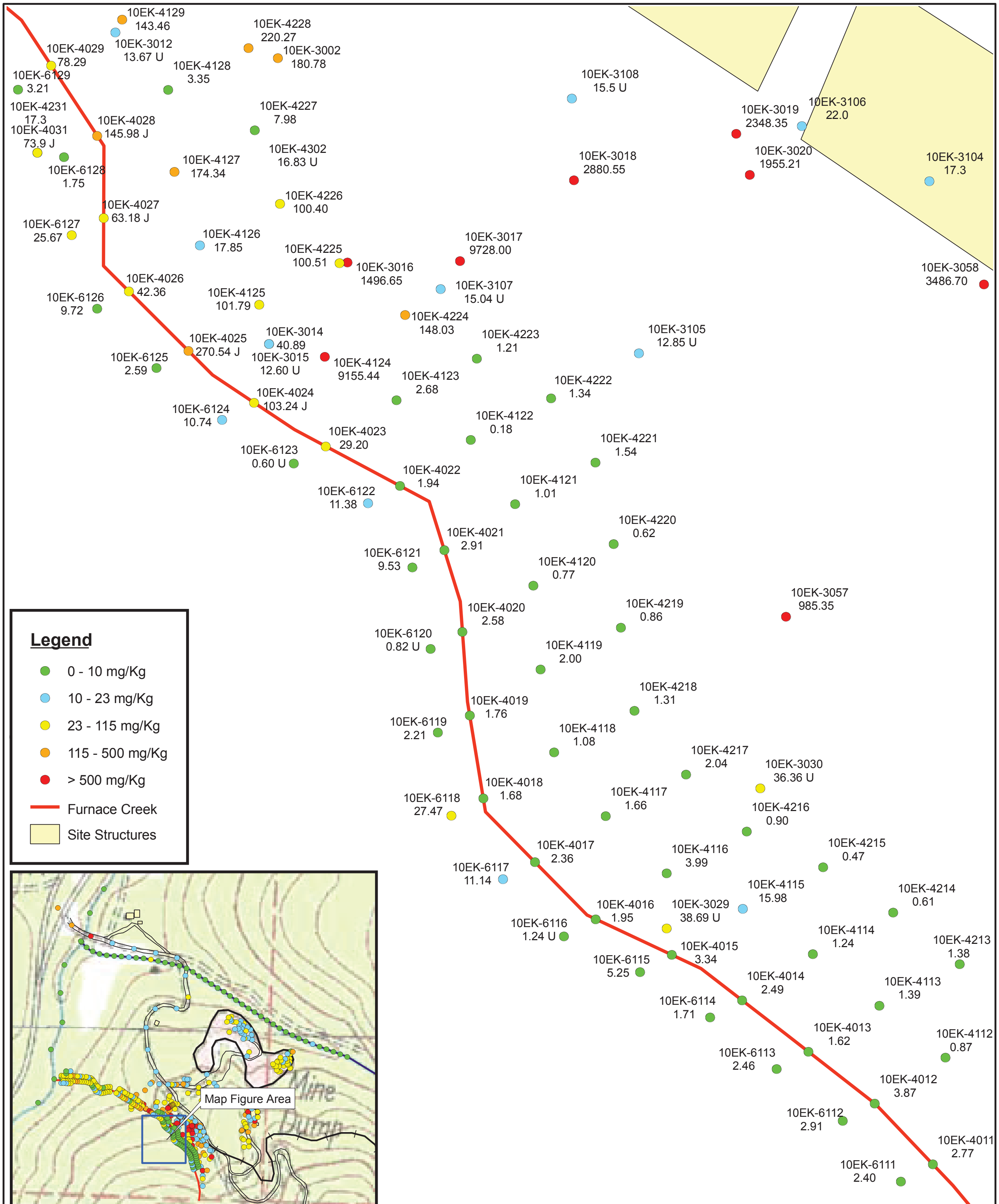

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BLACK BUTTE MINE

Lane County, Oregon

Figure 2E

Field Mercury Concentrations
Furnace Creek Section 3

Job Id:
002233.0026.01IA

Date:	GIS Analyst:
10/15/2007	avh

Map Source Information: USGS Topographic Map.
Harness Mountain, Oregon. Scale 1-24,000 .

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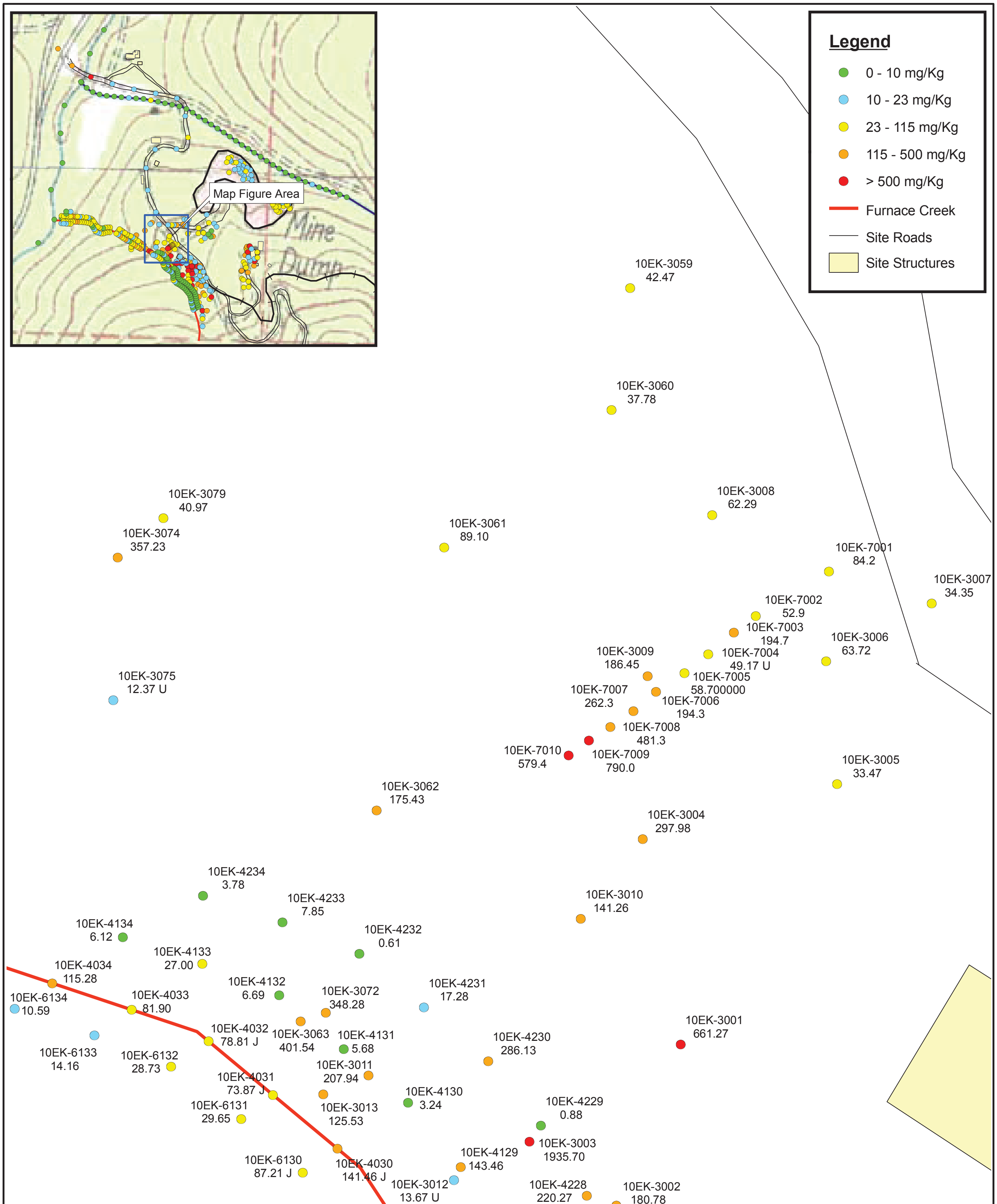

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BLACK BUTTE MINE

Lane County, Oregon

Figure 2F

Field Mercury Concentrations Furnace Creek Section 4

Job Id:
002233.0026.01IA

Date:	GIS Analyst:
10/15/2007	avh

Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .

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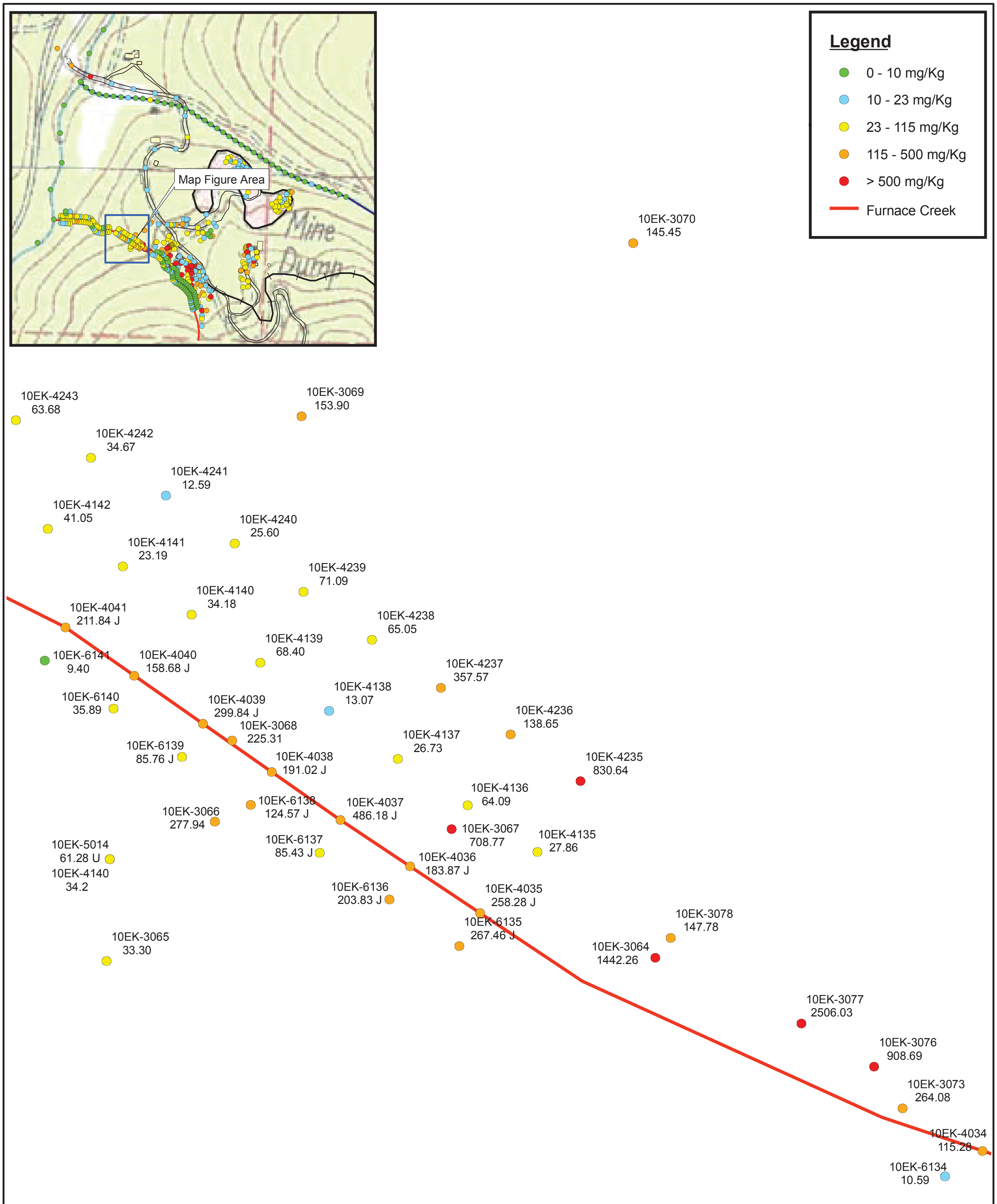

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Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2G

Field Mercury Concentrations Furnace Creek Section 5

Job Id:
002233.0026.01IA

Date:
10/15/2007

GIS Analyst:
avh

Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .

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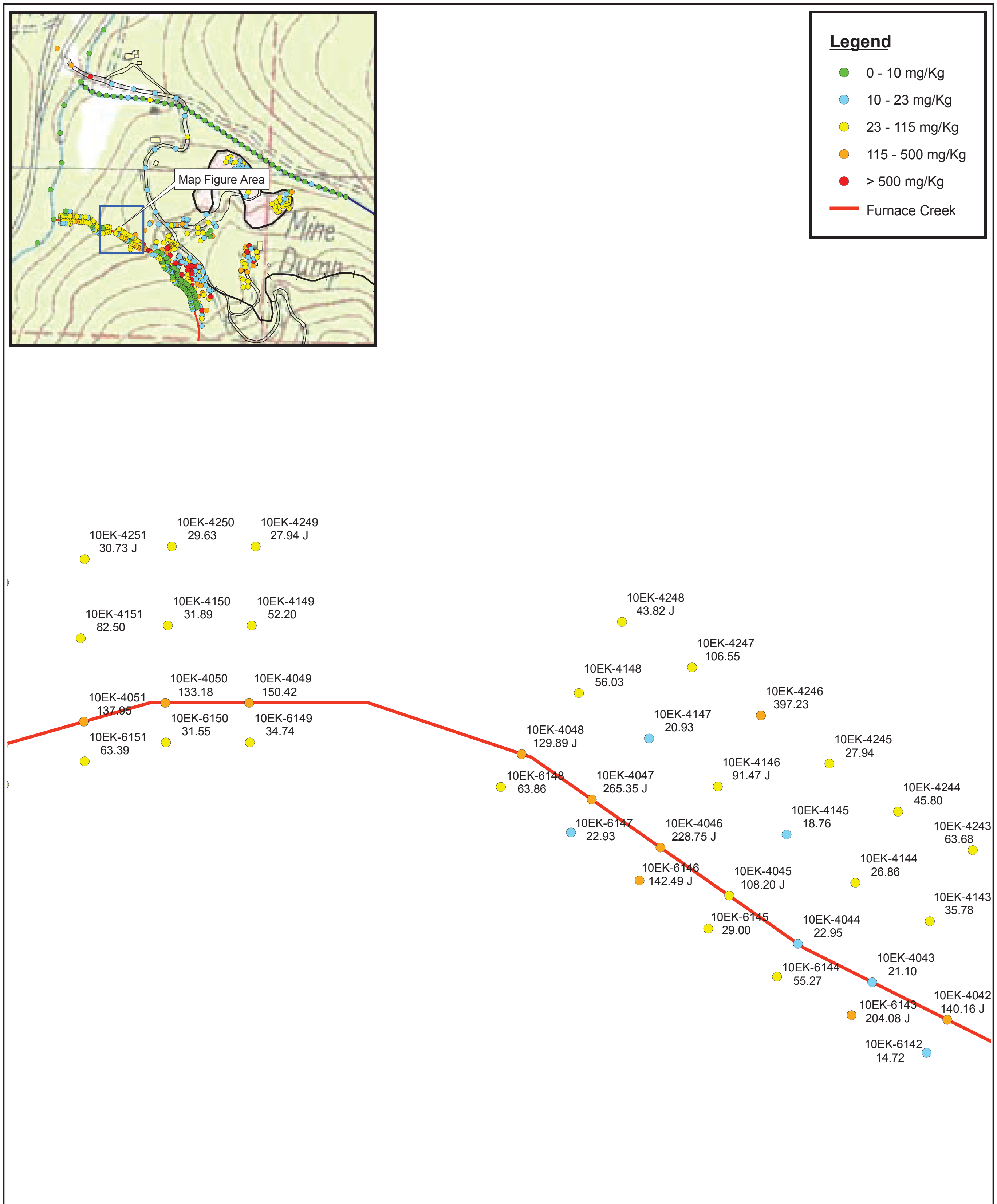

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Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2H

Field Mercury Concentrations
Furnace Creek Section 6

Job Id: 002233.0026.01IA	
Date: 10/15/2007	GIS Analyst: avh
Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .	

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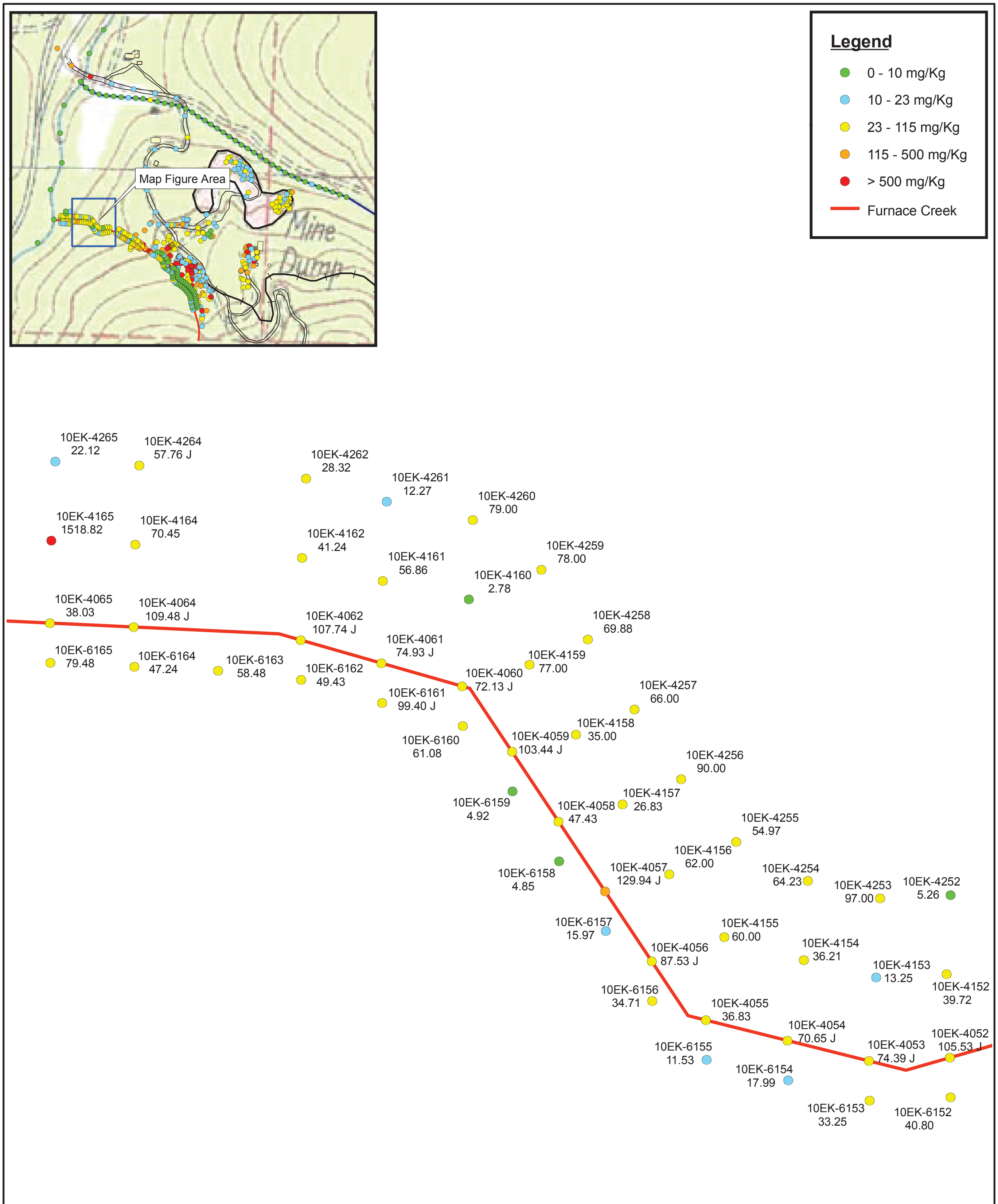

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0 5 10 20 30
Feet

Scale 1:300

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Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2I

Field Mercury Concentrations
Furnace Creek Section 7

Job Id:
002233.0026.01IA

Date:
10/15/2007

GIS Analyst:
avh

Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .

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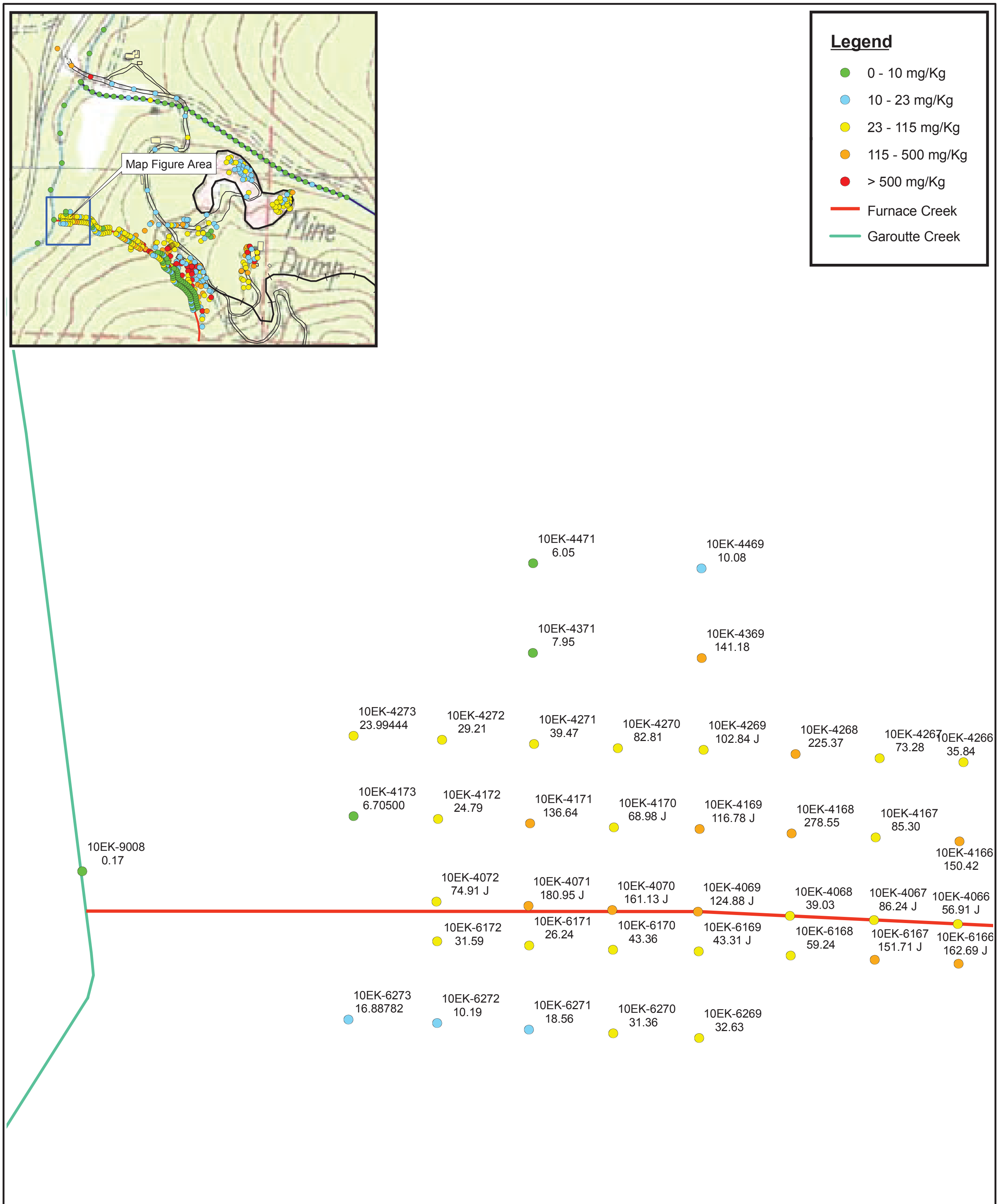

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Scale 1:300

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

BLACK BUTTE MINE

Lane County, Oregon

Figure 2J

Field Mercury Concentrations Furnace Creek Section 8 (West End)

Job Id:
002233.0026.01IA

Date:
10/15/2007

GIS Analyst:
avh

Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .

\EDMS-Projects\Black Butte Mine\removal_aug07\figure 1j.mxd

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Table I-2
TOTAL MERCURY IN SAMPLES FROM OLD ORE FURNACE AREA
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF Result	XRF Reporting Limit	Qualifier
121	10EK-3001	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	661	18.86	
122	10EK-3002	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	181	9.66	
123	10EK-3003	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	1940	32.34	
124	10EK-3004	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	298	11.99	
125	10EK-3005	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	33.5	5.66	
126	10EK-3006	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	63.7	7.09	
127	10EK-3007	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	34.4	5.93	
128	10EK-3008	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	62.3	7.20	
129	10EK-3009	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	186	9.50	
130	10EK-3010	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	141	10.38	
131	10EK-3011	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	208	10.44	
132	10EK-3012	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	13.7	13.67	U
133	10EK-3013	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	126	9.14	
134	10EK-3014	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	40.9	5.72	
135	10EK-3015	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	12.6	12.60	U
136	10EK-3016	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	1500	29.03	
137	10EK-3017	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	9730	109.93	
138	10EK-3018	Old Ore Furnace/Immediately Adjacent	Tailings	8/21/07	mg/kg	2880	41.06	
139	10EK-3019	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	2350	36.16	
140	10EK-3020	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	1960	32.03	
141	10EK-3021	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	42.6	42.60	U
142	10EK-3022	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	210	29.27	
143	10EK-3023	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	2160	76.39	
144	10EK-3024	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	10500	319.74	
145	10EK-3025	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	1490	66.14	
146	10EK-3026	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	917	58.57	
147	10EK-3027	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	96.3	23.63	
148	10EK-3028	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	229	24.15	
149	10EK-3029	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	38.7	38.69	U
150	10EK-3030	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	36.4	36.36	U
151	10EK-3031	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	346	30.60	
152	10EK-3032	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	552	41.01	

Table I-2
TOTAL MERCURY IN SAMPLES FROM OLD ORE FURNACE AREA
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF Result	XRF Reporting Limit	Qualifier
153	10EK-3033	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	1180	61.40	
154	10EK-3034	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	1040	70.80	
155	10EK-3035	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	3090	127.80	
156	10EK-3036	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	723	48.87	
157	10EK-3037	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	123	21.08	
157	10EK-3037	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	123	21.08	
158	10EK-3038	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	42.6	42.56	U
159	10EK-3039	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	67.4	18.44	
160	10EK-3040	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	222	23.80	
161	10EK-3041	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	498	51.49	
162	10EK-3042	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	107	21.00	
163	10EK-3043	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	175	24.17	
164	10EK-3044	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	33.7	33.71	U
165	10EK-3045	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	56.5	16.11	
166	10EK-3046	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	47.6	47.63	U
167	10EK-3047	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	244	26.44	
168	10EK-3048	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	133	26.93	
169	10EK-3049	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	36.1	36.09	U
170	10EK-3050	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	118	21.44	
171	10EK-3051	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	203	10.55	
172	10EK-3052	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	84.8	7.57	
173	10EK-3053	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	12.9	12.87	U
174	10EK-3054	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	55.6	6.31	
175	10EK-3055	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	16.3	16.34	U
176	10EK-3056	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	622	18.90	
177	10EK-3057	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	985	20.15	
178	10EK-3058	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	3490	47.17	
179	10EK-3059	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	42.5	5.79	
180	10EK-3060	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	37.8	6.29	
181	10EK-3061	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	89.1	7.83	
182	10EK-3062	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	175	10.01	
183	10EK-3063	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	402	14.11	

Table I-2
TOTAL MERCURY IN SAMPLES FROM OLD ORE FURNACE AREA
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF Result	XRF Reporting Limit	Qualifier
184	10EK-3064	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	1440	31.19	
185	10EK-3065	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	33.3	5.52	
186	10EK-3066	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	278	12.55	
187	10EK-3067	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	709	18.15	
188	10EK-3068	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	225	10.31	
189	10EK-3069	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	154	8.71	
190	10EK-3070	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	145	8.67	
191	10EK-3071	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	148	8.67	
192	10EK-3072	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	348	13.88	
193	10EK-3073	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	264	11.86	
194	10EK-3074	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	357	13.33	
195	10EK-3075	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	12.4	12.37	U
196	10EK-3076	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	909	21.25	
197	10EK-3077	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	2510	40.44	
198	10EK-3078	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	148	9.42	
199	10EK-3079	Old Ore Furnace/Upgradient	Tailings	8/21/07	mg/kg	41.0	6.23	
201	10EK-3081	Old Ore Furnace/Upgradient	Tailings	8/30/07	mg/kg	83.5	7.71	
202	10EK-3082	Old Ore Furnace/Upgradient	Tailings	8/30/07	mg/kg	41.7	5.57	
204	10EK-3084	Old Ore Furnace/Upgradient	Tailings	8/30/07	mg/kg	117	7.74	
206	10EK-3086	Old Ore Furnace/Upgradient	Tailings	8/30/07	mg/kg	614	15.56	
207	10EK-3087	Old Ore Furnace/Upgradient	Tailings	8/30/07	mg/kg	493	14.28	
619	10EK-3089	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.4	14.44	U
620	10EK-3090	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	12.8	12.79	U
621	10EK-3091	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	22.9	6.54	
622	10EK-3092	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	12.5	12.45	U
623	10EK-3093	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.6	14.64	U
624	10EK-3094	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	16.2	16.22	U
625	10EK-3095	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	16.2	16.22	U
626	10EK-3096	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.9	14.93	U
627	10EK-3097	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.2	14.20	U
628	10EK-3098	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	12.6	12.56	U
629	10EK-3099	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	16.1	16.06	U

Table I-2
TOTAL MERCURY IN SAMPLES FROM OLD ORE FURNACE AREA
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF Result	XRF Reporting Limit	Qualifier
630	10EK-3100	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	16.8	16.83	U
631	10EK-3101	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.4	14.38	U
632	10EK-3102	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	14.9	14.91	U
633	10EK-3103	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	16.1	16.11	U
634	10EK-3104	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	17.3	4.88	
635	10EK-3105	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	12.9	12.85	U
636	10EK-3106	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	22.0	5.79	
637	10EK-3107	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	15.0	15.04	U
638	10EK-3108	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	15.5	15.50	U
639	10EK-3109	Old Ore Furnace/Confirmation	Tailings	9/3/07	mg/kg	15.0	15.04	U
552	10EK-7001	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	84	18.45	
553	10EK-7002	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	53	15.17	
554	10EK-7003	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	195	29.05	
555	10EK-7004	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg		49.17	U
556	10EK-7005	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	59	15.51	
557	10EK-7006	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	194	25.55	
558	10EK-7007	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	262	32.42	
559	10EK-7008	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	481	39.84	
560	10EK-7009	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	790	55.97	
561	10EK-7010	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	579	37.83	
562	10EK-7011	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	111	19.82	
563	10EK-7012	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	1205	63.26	
564	10EK-7013	Old Ore Furnace/Downgradient	Tailings	8/28/07	mg/kg	1124	64.25	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
209	10EK-4001	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.06	0.50	
210	10EK-4002	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	3.51	0.50	
211	10EK-4003	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.16	0.50	
212	10EK-4004	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.24	0.50	
213	10EK-4005	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.61	0.50	
214	10EK-4006	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.97	0.50	
215	10EK-4007	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.70	0.50	
216	10EK-4008	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.46	0.50	
217	10EK-4009	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.81	0.50	
218	10EK-4010	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	5.39	0.50	
219	10EK-4011	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.77	0.50	
220	10EK-4012	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	3.87	0.50	
221	10EK-4013	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.62	0.50	
222	10EK-4014	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.49	0.50	
223	10EK-4015	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	3.34	0.50	
224	10EK-4016	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.95	0.50	
225	10EK-4017	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.36	0.50	
226	10EK-4018	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.68	0.50	
227	10EK-4019	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.76	0.50	
228	10EK-4020	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.58	0.50	
229	10EK-4021	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	2.91	0.50	
231	10EK-4022	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	1.94	0.50	
232	10EK-4023	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	29.2	0.50	
233	10EK-4024	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	103	0.50	
234	10EK-4025	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	271	0.50	J
235	10EK-4026	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	42.4	0.50	
236	10EK-4027	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	63.2	0.50	
237	10EK-4028	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	146	0.50	
238	10EK-4029	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	78.3	0.50	
239	10EK-4030	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	141	0.50	
240	10EK-4031	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	73.9	0.50	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
	10EK-4031	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	73.9	0.50	
241	10EK-4032	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	78.8	0.50	
242	10EK-4033	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	81.9	0.50	
243	10EK-4034	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	115	0.50	
244	10EK-4035	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	258	0.50	J
245	10EK-4036	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	184	0.50	J
246	10EK-4037	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	486	0.50	J
247	10EK-4038	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	191	0.50	J
248	10EK-4039	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	300	0.50	J
249	10EK-4040	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	159	0.50	J
250	10EK-4041	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	212	0.50	J
251	10EK-4042	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	140	0.50	
252	10EK-4043	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	21.1	0.50	
253	10EK-4044	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	23.0	0.50	
254	10EK-4045	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	108	0.50	
255	10EK-4046	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	229	0.50	J
256	10EK-4047	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	265	0.50	J
257	10EK-4048	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	130	0.50	
258	10EK-4049	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	150	0.50	
259	10EK-4050	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	133	0.50	
260	10EK-4051	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	138	0.50	
261	10EK-4052	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	106	0.50	
262	10EK-4053	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	74.4	0.50	
263	10EK-4054	Furnace Creek/within Creek	Sediment/Tailings	8/23/07	mg/kg	70.7	0.50	
264	10EK-4055	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	36.8	0.50	
265	10EK-4056	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	87.5	0.50	
266	10EK-4057	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	130	0.50	
267	10EK-4058	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	47.4	0.50	
269	10EK-4059	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	103	0.50	
270	10EK-4060	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	72.1	0.50	
271	10EK-4061	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	74.9	0.50	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
272	10EK-4062	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	108	0.50	
273	10EK-4064	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	109	0.50	
274	10EK-4065	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	38.0	0.50	
275	10EK-4066	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	56.9	0.50	
276	10EK-4067	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	86.2	0.50	
277	10EK-4068	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	39.0	0.50	
278	10EK-4069	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	70.8	5.61	
279	10EK-4070	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	104	6.75	
280	10EK-4071	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	181	0.50	J
281	10EK-4072	Furnace Creek/within Creek	Sediment/Tailings	8/28/07	mg/kg	74.9	0.50	
282	10EK-4101	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.08	0.50	U
283	10EK-4102	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.64	0.50	
284	10EK-4103	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.93	0.50	
285	10EK-4104	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.18	0.50	
286	10EK-4105	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.86	0.50	
287	10EK-4106	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.51	0.50	
288	10EK-4107	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.18	0.50	U
289	10EK-4108	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.17	0.50	
290	10EK-4109	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.86	0.50	
291	10EK-4110	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.88	0.50	
292	10EK-4111	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.08	0.50	
293	10EK-4112	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.87	0.50	
294	10EK-4113	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.39	0.50	
295	10EK-4114	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.24	0.50	
296	10EK-4115	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	16.0	0.50	
297	10EK-4116	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	3.99	0.50	
298	10EK-4117	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.66	0.50	
299	10EK-4118	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.08	0.50	
300	10EK-4119	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	2.00	0.50	
301	10EK-4120	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.77	0.50	
302	10EK-4121	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	1.01	0.50	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
303	10EK-4122	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.18	0.50	U
304	10EK-4123	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	10.6	10.60	U
305	10EK-4124	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	9160	107.27	
306	10EK-4125	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
307	10EK-4126	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	45.2	5.67	
308	10EK-4127	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
309	10EK-4128	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	55.0	6.01	
310	10EK-4129	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
311	10EK-4130	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	3.24	0.50	
312	10EK-4131	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	5.68	0.50	
313	10EK-4132	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	6.69	0.50	
314	10EK-4133	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	27.0	0.50	
315	10EK-4134	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	6.12	0.50	
316	10EK-4135	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	30.7	5.39	
317	10EK-4136	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
318	10EK-4137	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	26.7	0.50	
319	10EK-4138	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	14.3	14.27	U
320	10EK-4139	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
321	10EK-4140	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	34.2	0.50	
	10EK-4140	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	34.2	0.50	
322	10EK-4141	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	23.2	0.50	
323	10EK-4142	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	41.1	0.50	
324	10EK-4143	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	35.8	0.50	
325	10EK-4144	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	26.9	0.50	
326	10EK-4145	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	18.8	0.50	
327	10EK-4146	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	91.5	0.50	
328	10EK-4147	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	20.9	0.50	
329	10EK-4148	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	56.0	0.50	
330	10EK-4149	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	52.2	0.50	
331	10EK-4150	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	31.9	0.50	
332	10EK-4151	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	82.5	6.73	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
333	10EK-4152	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	39.7	0.50	
334	10EK-4153	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	13.3	0.50	
335	10EK-4154	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/23/07	mg/kg	36.2	0.50	
336	10EK-4155	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	60.0	0.00	
337	10EK-4156	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	62.0	0.00	
338	10EK-4157	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	26.8	0.50	
339	10EK-4158	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	35.0	0.00	
340	10EK-4159	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	77.0	0.00	
341	10EK-4160	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	2.78	0.50	
342	10EK-4161	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	56.9	0.50	
343	10EK-4162	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	41.2	0.50	
344	10EK-4164	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	70.5	7.34	
345	10EK-4165	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	1520	25.52	
346	10EK-4166	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	150	8.39	
347	10EK-4167	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	85.3	7.14	
348	10EK-4168	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	279	10.76	
349	10EK-4169	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	117	0.50	
350	10EK-4170	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	69.0	0.50	
351	10EK-4171	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	137	8.15	
352	10EK-4172	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	24.8	0.50	
353	10EK-4173	Furnace Creek/Bank Sample NE Side - 5 ft	Tailings/Soil	8/28/07	mg/kg	6.71	0.50	
354	10EK-4201	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.70	0.50	
355	10EK-4202	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.49	0.50	
356	10EK-4203	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.15	0.50	
357	10EK-4204	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.66	0.50	
358	10EK-4205	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.46	0.50	
359	10EK-4206	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.87	0.50	
360	10EK-4207	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.01	0.50	
361	10EK-4208	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.93	0.50	
362	10EK-4209	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.82	0.50	
363	10EK-4210	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.80	0.50	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
364	10EK-4211	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.59	0.50	
365	10EK-4212	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.28	0.50	
366	10EK-4213	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.38	0.50	
367	10EK-4214	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.61	0.50	
368	10EK-4215	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.47	0.50	U
369	10EK-4216	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.90	0.50	
370	10EK-4217	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	2.04	0.50	
371	10EK-4218	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.31	0.50	
372	10EK-4219	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.86	0.50	
373	10EK-4220	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.62	0.50	
374	10EK-4221	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.54	0.50	
375	10EK-4222	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.34	0.50	
376	10EK-4223	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	1.21	0.50	
377	10EK-4224	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	148	8.23	
378	10EK-4225	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	101	7.38	
379	10EK-4226	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	100	7.46	
380	10EK-4227	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	7.98	0.50	
381	10EK-4228	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	220	10.87	
382	10EK-4229	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.88	0.50	
383	10EK-4230	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	286	11.96	
384	10EK-4231	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	17.3	0.50	
	10EK-4231	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	17	0.50	
385	10EK-4232	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.61	0.50	
386	10EK-4233	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	7.85	0.50	
387	10EK-4234	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	3.78	0.50	
388	10EK-4235	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
389	10EK-4236	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	139	8.59	
390	10EK-4237	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	358	12.35	
391	10EK-4238	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	47.6	5.73	
392	10EK-4239	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
393	10EK-4240	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	37.1	5.21	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
394	10EK-4241	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	12.6	0.50	
395	10EK-4242	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	34.7	0.50	
396	10EK-4243	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
397	10EK-4244	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	54.7	5.90	
398	10EK-4245	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	27.9	0.50	
399	10EK-4246	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.00	
400	10EK-4247	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	107	5.55	
401	10EK-4248	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	36.0	5.01	
402	10EK-4249	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	27.9	0.50	
403	10EK-4250	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	29.6	0.50	
404	10EK-4251	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	30.7	0.50	
405	10EK-4252	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	5.26	0.50	
406	10EK-4253	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	0.00	0.50	
407	10EK-4254	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/23/07	mg/kg	40.0	0.00	
408	10EK-4255	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	55.0	0.50	
409	10EK-4256	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	0.00	0.50	
410	10EK-4257	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	66.0	0.00	
411	10EK-4258	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	51.0	0.00	
412	10EK-4259	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	0.00	0.50	
413	10EK-4260	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	79.0	0.00	
414	10EK-4261	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	18.4	4.87	
415	10EK-4262	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	28.3	0.50	
416	10EK-4264	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	57.8	0.50	
417	10EK-4265	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	22.1	0.50	
418	10EK-4266	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	35.8	0.50	
419	10EK-4267	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	0.00	0.50	
420	10EK-4268	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	225	10.17	
421	10EK-4269	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	28.9	4.28	
422	10EK-4270	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	0.00	0.50	
423	10EK-4271	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	34.1	5.38	
424	10EK-4272	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	29.2	0.50	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

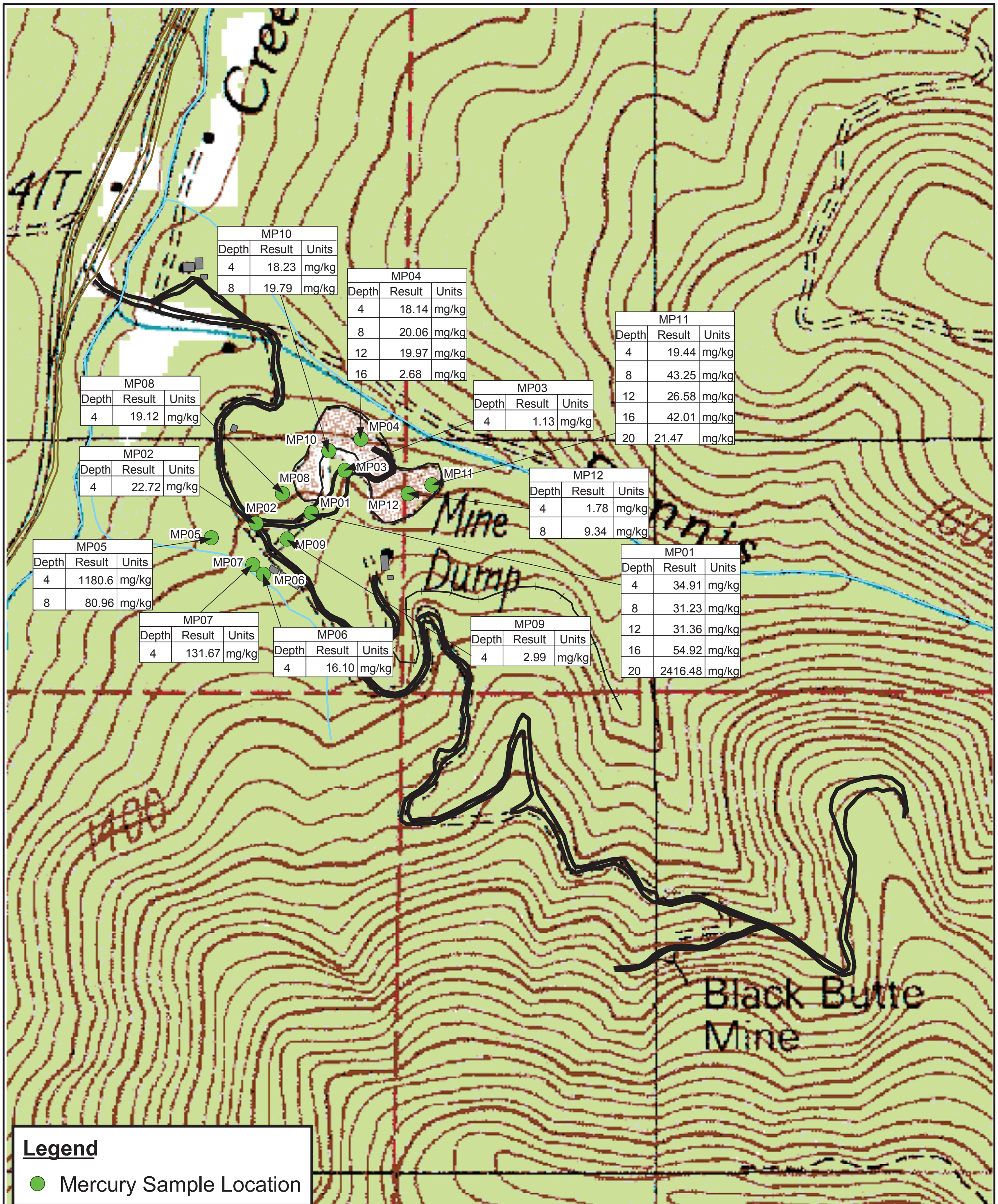
Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
425	10EK-4273	Furnace Creek/Bank Sample NE Side - 10 ft	Tailings/Soil	8/28/07	mg/kg	24.0	0.50	
426	10EK-4301	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	0.00	0.00	
427	10EK-4302	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	16.8	16.83	U
428	10EK-4303	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	12.6	3.87	
429	10EK-4304	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	25.4	5.29	
430	10EK-4305	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	99.9	7.66	
431	10EK-4306	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	384	13.08	
432	10EK-4307	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	750	17.41	
433	10EK-4308	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	2470	36.27	
434	10EK-4309	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/29/07	mg/kg	2920	41.18	
435	10EK-4369	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/28/07	mg/kg	141	8.29	
437	10EK-4371	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/28/07	mg/kg	7.95	0.50	
438	10EK-4469	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/28/07	mg/kg	10.1	0.50	
439	10EK-4471	Furnace Creek/Specific Target on NE Side	Sediment/Tailings	8/28/07	mg/kg	6.05	0.50	
475	10EK-6101	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	21.2	0.5	
476	10EK-6102	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.28	0.5	
477	10EK-6103	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	12.9	0.5	
478	10EK-6104	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	7.66	0.5	
479	10EK-6105	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	12.0	0.5	
480	10EK-6106	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	3.36	0.5	
481	10EK-6107	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	1.90	0.5	
482	10EK-6108	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	6.13	0.5	
483	10EK-6109	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	3.07	0.5	
484	10EK-6110	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.99	0.5	
485	10EK-6111	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.40	0.5	
486	10EK-6112	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.91	0.5	
487	10EK-6113	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.46	0.5	
488	10EK-6114	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	1.71	0.5	
489	10EK-6115	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	5.25	0.5	
490	10EK-6116	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	1.24	0.5	U
491	10EK-6117	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	11.1	0.5	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
492	10EK-6118	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	27.5	0.5	
493	10EK-6119	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.21	0.5	
494	10EK-6120	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	0.82	0.5	U
495	10EK-6121	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	9.53	0.5	
496	10EK-6122	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	11.4	0.5	
497	10EK-6123	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	0.60	0.5	U
498	10EK-6124	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	10.7	0.5	
499	10EK-6125	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	2.59	0.5	
500	10EK-6126	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	9.72	0.5	
501	10EK-6127	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	25.7	0.5	
502	10EK-6128	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	1.75	0.5	
503	10EK-6129	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	3.21	0.5	
504	10EK-6130	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	87.2	0.5	J
505	10EK-6131	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	29.7	0.5	
506	10EK-6132	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	28.7	0.5	
507	10EK-6133	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	14.2	0.5	
508	10EK-6134	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	10.6	0.5	
509	10EK-6135	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	267	0.5	J
510	10EK-6136	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	204	0.5	J
511	10EK-6137	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	85.4	0.5	J
512	10EK-6138	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	125	0.5	J
513	10EK-6139	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	85.8	0.5	J
514	10EK-6140	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	35.9	0.5	
515	10EK-6141	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	9.40	0.5	
516	10EK-6142	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	14.7	0.5	
517	10EK-6143	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	334	11.4	
518	10EK-6144	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	55.3	0.5	
519	10EK-6145	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	29.0	0.5	
520	10EK-6146	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	142	0.5	J
521	10EK-6147	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	22.9	0.5	
522	10EK-6148	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	63.9	0.5	

TABLE I-4
TOTAL MERCURY IN TAILINGS/SEDIMENT/SOIL FROM FURNACE CREEK AND FURNACE CREEK BANKS
BLACK BUTTE MINE
LANE COUNTY, OREGON

Record Number	Sample Number	Sample Location	Sample Type	Collection Date	Result units	XRF/ Lumex Result	XRF/ Lumex Reporting Limit	Qualifier
523	10EK-6149	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	34.7	0.5	
524	10EK-6150	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	31.5	0.5	
525	10EK-6151	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	63.4	0.5	
526	10EK-6152	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	40.8	0.5	
527	10EK-6153	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	33.3	0.5	
528	10EK-6154	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	18.0	0.5	
529	10EK-6155	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	11.5	0.5	
530	10EK-6156	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	34.7	0.5	
531	10EK-6157	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	16.0	0.5	
532	10EK-6158	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	4.85	0.5	
533	10EK-6159	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	4.92	0.5	
534	10EK-6160	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	61.1	0.5	
535	10EK-6161	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	99.4	0.5	J
536	10EK-6162	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	49.4	0.5	
537	10EK-6163	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	58.5	0.5	
538	10EK-6164	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	47.2	0.5	
539	10EK-6165	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	79.5	0.5	
540	10EK-6166	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	212	10.0	
541	10EK-6167	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	266	10.6	
542	10EK-6168	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/29/07	mg/kg	59.2	0.5	
543	10EK-6169	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	43.3	0.5	J
544	10EK-6170	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	43.4	0.5	
545	10EK-6171	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	26.2	0.5	
546	10EK-6172	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	31.6	0.5	
547	10EK-6269	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	32.6	0.5	
548	10EK-6270	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	31.4	0.5	
549	10EK-6271	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	18.6	0.5	
550	10EK-6272	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	10.2	0.5	
551	10EK-6273	Furnace Creek/Bank Sample SW Side - 5 ft	Sediment/Tailings	8/28/07	mg/kg	16.9	0.5	



MP10

Depth	Result	Units
4	18.23	mg/kg
8	19.79	mg/kg

MP04

Depth	Result	Units
4	18.14	mg/kg
8	20.06	mg/kg
12	19.97	mg/kg
16	2.68	mg/kg

MP11

Depth	Result	Units
4	19.44	mg/kg
8	43.25	mg/kg
12	26.58	mg/kg
16	42.01	mg/kg
20	21.47	mg/kg

MP08

Depth	Result	Units
4	19.12	mg/kg

MP03

Depth	Result	Units
4	1.13	mg/kg

MP02

Depth	Result	Units
4	22.72	mg/kg

MP12

Depth	Result	Units
4	1.78	mg/kg
8	9.34	mg/kg

MP05

Depth	Result	Units
4	1180.6	mg/kg
8	80.96	mg/kg

MP01

Depth	Result	Units
4	34.91	mg/kg
8	31.23	mg/kg
12	31.36	mg/kg
16	54.92	mg/kg
20	2416.48	mg/kg

MP07

Depth	Result	Units
4	131.67	mg/kg

MP06

Depth	Result	Units
4	16.10	mg/kg

MP09

Depth	Result	Units
4	2.99	mg/kg

N W E S

0 125 250 500 750

Feet

Scale 1:7,500

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Portland, Oregon

Figure 5-1a

WASTE ROCK/TAILINGS SAMPLE LOCATION MAP AND TOTAL MERCURY RESULTS

BLACK BUTTE MINE

Lane County, Oregon

Job Id: 002233.0026.01IA

Date: 1/20/06

GIS Analyst: avh

Map Source Information: USGS Topographic Map. Harness Mountain, Oregon. Scale 1-24,000 .

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Table 5-2

TOTAL MERCURY AND ARSENIC IN WASTE ROCK/TAILINGS SAMPLES FROM REMOVAL ASSESSMENT AND SITE INSPECTION BLACK BUTTE MINE LANE COUNTY, OREGON

Sample Number	Sample Location/Identification (depth)	Units	Total Mercury			
			XRF	+/-	Lumex	Fixed Laboratory
	Environmental Protection Agency Region 9 PRGs	mg/kg	23			
Removal Assessment (September 2005)						
MP01SS04	Main Tailings Pile/Borehole 1 (0 - 4 ft bgs)	mg/kg	**34.91**	5.64	**30.7**	--
MP01SS08	Main Tailings Pile/Borehole 1 (4 - 8 ft bgs)	mg/kg	**31.23**	5.26	12.9	--
MP01SS12	Main Tailings Pile/Borehole 1 (8 - 12 ft bgs)	mg/kg	**31.36**	5.21	**39.3**	7.35
MP01SS16	Main Tailings Pile/Borehole 1 (12 - 16 ft bgs)	mg/kg	**54.92**	6.22	12.7	--
MP01SS20	Main Tailings Pile/Borehole 1 (16 - 20 ft bgs)	mg/kg	**2,416.48**	43.79	1.7	0.808
MP02SS04	Main Tailings Pile/Borehole 2 (0 - 4 ft bgs)	mg/kg	22.72	4.94	16.8	--
MP02SS08	Main Tailings Pile/Borehole 2 (4 - 8 ft bgs)	mg/kg	N/A	N/A	0.75 J	--
MP03SS04	Main Tailings Pile/Borehole 3 (0 - 4 ft bgs)	mg/kg	1.13	5.32	0.14 J	--
MP04SS04	Main Tailings Pile/Borehole 4 (0 - 4 ft bgs)	mg/kg	18.14	6.6	0.95 J	--
MP04SS08	Main Tailings Pile/Borehole 4 (4 - 8 ft bgs)	mg/kg	20.06	4.7	6.1	--
MP04SS12	Main Tailings Pile/Borehole 4 (8 - 12 ft bgs)	mg/kg	19.97	5.67	3.1	--
MP04SS16	Main Tailings Pile/Borehole 4 (12 - 16 ft bgs)	mg/kg	2.68	3.51	0.8 J	--
MP05SS04	Old Furnace Area/Borehole 5 (0 - 4 ft bgs)	mg/kg	**1,180.6**	26.85	**68.6**	17.7
MP05SS08	Old Furnace Area/Borehole 5 (4 - 8 ft bgs)	mg/kg	**80.96**	7.95	**45**	--
MP06SS04	Old Furnace Area/Borehole 6 (0 - 4 ft bgs)	mg/kg	16.1	4.15	**386**	--
MP07SS04	Old Furnace Area/Borehole 7 (0 - 4 ft bgs)	mg/kg	**131.67**	8.7	**145**	3.83
MP08SS04	Main Tailings Pile/Borehole 8 (0 - 4 ft bgs)	mg/kg	19.12	4.57	6.5	--
MP09SS04	Main Tailings Pile/Borehole 9 (0 - 4 ft bgs)	mg/kg	2.99	3.99	1.5	5.42
MP10SS04	Main Tailings Pile/Borehole 10 (0 - 4 ft bgs)	mg/kg	18.23	4.74	0.89 J	--
MP10SS08B	Main Tailings Pile/Borehole 10 (4 - 8 ft bgs)	mg/kg	14.42	4.46	4.6	--
MP10SS08A	Main Tailings Pile/Borehole 10 (4 - 8 ft bgs)	mg/kg	19.79	6.6	5.2	--
MP11SS04	Main Tailings Pile/Borehole 11 (0 - 4 ft bgs)	mg/kg	19.44	4.64	2.8	--
MP11SS08	Main Tailings Pile/Borehole 11 (4 - 8 ft bgs)	mg/kg	**43.25**	5.86	0.95 J	--
MP11SS12	Main Tailings Pile/Borehole 11 (8 - 12 ft bgs)	mg/kg	**26.58**	5.44	2.5	--
MP11SS16	Main Tailings Pile/Borehole 11 (12 - 16 ft bgs)	mg/kg	**42.01**	5.89	2.4	--
MP11SS20	Main Tailings Pile/Borehole 11 (16 - 20 ft bgs)	mg/kg	21.47	5.01	1.2 J	--
MP12SS04	New Furnace Area/Borehole 12 (0 - 4 ft bgs)	mg/kg	1.78	3.23	8.8	--
MP12SS08	New Furnace Area/Borehole 12 (4 - 8 ft bgs)	mg/kg	9.34	4	N/A	0.952

DRILLING LOG OF BORING NO. MP05

DATE DRILLED: 9/8/2005
LOGGED BY: M. Longtine
CHECKED BY: E. Lynch
DRILLING CONTRACTOR: E&E/START
DRILLED BY: A. Jensen
DRILLING METHOD: GEOPROBE DIRECT PUSH

VERTICAL DATUM:
LOCATION: BLACK BUTTE MINE

PROJECT: Black Butte Mine
TDD #: 05-04-0005
PROJECT LOCATION: Cottage Grove, Oregon

EPA PROJ MGR: M. Callaghan
START-2 PROJ MGR: E. Lynch
E & E PROJ #: 001281.0478.01IA

ELEVATION	DEPTH (feet)	USCS	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE COLLECTION TIME	SAMPLE ID	COMMENTS
				Top of Ground Surface (GS) Elevation			This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
	0–4			Native soil - Tailings appear at surface (see comment section), Clay silt with local rock fragments, Yellowish brown; Hard, compact; Dry.	1440	MP05SS04	Tailings evident on the surface at this location, possibly moved into place by the front end loader this morning during clearing operations. However, no tailings present in subsurface. Scotch broom, an otherwise useful indicator of recently vegetated tailings, misleading here.
	4–8	ML			1450	MP05SS08	
	8.0–10			8.0			Total depth 8 feet BGS. Abandoned by backfilling to surface with 3/8 inch bentonite chips.

START BBM BORING LOG BBM2005.GPJ E&E PORTLAND.GDT 1/20/06

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Suite 608
Portland, OR 97204
Phone: 503-248-5600 Fax: 503-248-5577

*** DRAFT ***

DRILLING LOG OF BORING NO. MP06

DATE DRILLED: 9/8/2005
LOGGED BY: M. Longtine
CHECKED BY: E. Lynch
DRILLING CONTRACTOR: E&E/START
DRILLED BY: A. Jensen
DRILLING METHOD: GEOPROBE DIRECT PUSH

VERTICAL DATUM:
LOCATION: BLACK BUTTE MINE

PROJECT: Black Butte Mine
TDD #: 05-04-0005
PROJECT LOCATION: Cottage Grove, Oregon

EPA PROJ MGR: M. Callaghan
START-2 PROJ MGR: E. Lynch
E & E PROJ #: 001281.0478.01IA

ELEVATION	DEPTH (feet)	USCS	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE COLLECTION TIME	SAMPLE ID	COMMENTS
				Top of Ground Surface (GS) Elevation			This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
	0.3	FILL		Fill - Silt; Grayish Purple; Dry			
	0–4.0	ML		Native Soil - silt - clay mixture with minor local rock fragments, Rusty brown; Dry.	1530	MP06SS04	
	4.0						Total depth 4 feet BGS. Abandoned by backfilling to surface with 3/8 inch bentonite chips.

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

START BBM BORING LOG BBM2005.GPJ E&E PORTLAND.GDT 1/20/06

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Phone: 503-248-5600 Fax: 503-248-5577

*** DRAFT ***

DRILLING LOG OF BORING NO. MP07

DATE DRILLED: 9/8/2005
LOGGED BY: M. Longtine
CHECKED BY: E. Lynch
DRILLING CONTRACTOR: E&E/START
DRILLED BY: A. Jensen
DRILLING METHOD: GEOPROBE DIRECT PUSH

VERTICAL DATUM:
LOCATION: BLACK BUTTE MINE

PROJECT: Black Butte Mine
TDD #: 05-04-0005
PROJECT LOCATION: Cottage Grove, Oregon

EPA PROJ MGR: M. Callaghan
START-2 PROJ MGR: E. Lynch
E & E PROJ #: 001281.0478.01IA

ELEVATION	DEPTH (feet)	USCS	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE COLLECTION TIME	SAMPLE ID	COMMENTS
				Top of Ground Surface (GS) Elevation			This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
	0–0.5	ML		Native Soil - Silt; Grayish purple.	1655	MP07SS04	
	0.5–1.2	CL		Native Soil - Silty clay; Brown			
	1.2–4.0	ML		Native Soil - Silt - clay mixture; Mottled gray - rusty brown			
	4.0						Total depth 4 feet BGS; Abandoned by backfilling to surface with 3/8 inch bentonite chips.

Depth scale (feet): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

START BBM BORING LOG BBM2005.GPJ E&E PORTLAND.GDT 1/20/06

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Phone: 503-248-5600 Fax: 503-248-5577

*** DRAFT ***

2003, U.S.ACE study published in the report: "Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir for U.S. Army Corps of Engineers, Portland, Oregon" by L.R. Curtis, Oregon State University, May 20, 2003; also demonstrates that the BBM is the source of mercury contamination found in the Cottage Grove Reservoir. On page 37 in the Conclusions Section, the report states "Elevated mercury concentrations in soils surrounding the Black Butte Mine supports the conclusion that the Black Butte Mine is a point source of contamination to the reservoir".

EPA Site Activities:

In July 2004, ODEQ asked EPA to conduct a removal assessment.

September 2005, EPA OSC Mark Callaghan and START completed a Removal Assessment which characterized mining-related impacts. Sampling data was collected from the five main areas: the Main Tailings Pile, the New Furnace area, the Old Furnace Area, the three creeks (Dennis Creek, Garoutte Creek, Furnace Creek), Dennis Creek Adit and the "404" Adit. Results indicated four of the areas should be addressed due to mercury contamination getting into the watershed or potential direct human contact.

May 2006, OSCs Parker and Kitz performed a Removal Assessment site visit with ERRS, START and ODEQ Bryn Thoms.

June 27, 2007 Removal Action Memo signed by Dan Opalski

August 20 to September 5, 2007 OSC Kathy Parker conducted Removal Action with 10 ERRS, 4 START and performed the following tasks: reduced slopes of east and west main tailings piles over Dennis Creek and installed sediment controls; capped contaminated soils around the New Furnace Structure and blocked off the road to the area; removed trees and brush over Old Furnace area and capped contaminated soils and mining artifacts; delineated mercury contamination in Furnace Creek, Dennis Creek and Garoutte Creeks using on-site analysis by XRF and Lumex instruments.

Significant mercury contamination remains in the Furnace Creek bed and slopes.

- Samples were collected in the creek bed and slopes above the creek every 15 feet for the length of the creek. Mercury concentrations above 10 ppm were seen for 1030 linear feet of creek bed and slopes.
- The depth of contamination in the creek bed was over four feet in the two test pits dug in the creek bed and the mercury concentration increased with depth (hole#1 at 4 foot depth was 384 ppm, hole#2 at 3 foot depth was 2926ppm). No native soil was reached.
- A nine foot test pit was dug in the top of a tailings pile overlooking Furnace Creek in an attempt to determine the depth of the pile at the apex. Mercury concentration increased with depth to 1205 ppm at nine feet. No native soil was reached.
- A twenty foot trench was dug from the apex of the pile back along the top of the bank to determine where the tailings pile started. No native soil was reached.
- In total 1249 samples were analyzed on-site during the course of the removal action. The average mercury concentration in surface sediment in the bed of the creek in the contaminated stretch was 124ppm and ranged from 21ppm to 486 ppm.

A possible solution for addressing the mercury contamination in Furnace Creek is to lay back all the tailings slopes and cap with clean soil, cap the creek bed with clean material, install and key in filter fabric covered with heavy rock. An estimate for this work is nine months and $5.4 million.

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Appendix B

Summary of Federal and State ARARs and TBCs

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Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
National Historic Preservation Act (NHPA) National Register of Historic Places Determinations of eligibility for inclusion in the National Register of Historic Places Protection of historic properties Requirements for environmental information documents and third-party agreements for EPA actions subject to NEPA	16 United States Code (U.S.C). 470 36 Code of Federal Regulations (CFR) 60 36 CFR 63, 36 CFR 800 40 CFR 6.301(b)	Potentially Applicable	This statute and implementing regulations require federal agencies to take into account the effect of this response action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally, 50 years old or older).Federal agencies required to take into account their undertakings on historic properties and afford the Advisory Council on Historic Preservation or its designees a reasonable time to comment.	If cultural resources on or eligible for the national register are present, it will be necessary to determine if there will be an adverse effect and, if so, how the effect may be minimized or mitigated, in consultation with the appropriate State Historic Preservation Office. It is not anticipated that cultural resources eligible for the National Register of Historic Places would be found within the removal action area for Furnace Creek.		✓		RA1 RA2 RA3
Archaeological and Historic Preservation Act Requirements for environmental information documents and third-party agreements for EPA actions subject to NEPA Protection of archaeological resources	16 U.S.C. 469 40 CFR 6.301(c) 43 CFR 7	Potentially Applicable	This statute and implementing regulations establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit and any archaeological investigations at a site must be conducted by a professional archaeologist.	The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit and any archaeological investigations at a site must be conducted by a professional archaeologist.		✓		RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
Endangered Species Act (ESA) Endangered and threatened wildlife and plants Interagency cooperation- Endangered Species Act of 1973, as amended	16 USC § 1531 50 CFR 17 50 CFR 402	Potentially Applicable	This statute and implementing regulations provide that federal activities not jeopardize the continued existence of any threatened or endangered species. ESA Section 7 requires consultation with the United States Fish and Wildlife Service (USFWS) to identify the possible presence of protected species and mitigate potential impacts on such species.	If threatened or endangered species are identified within the removal areas, activities must be designed to conserve the species and their habitat. There is a potential for one or more threatened or endangered species to be found within the site; however to date no threatened or endangered species have been identified atOU1.		✓		RA1 RA2 RA3
Fish and Wildlife Coordination Act Rules implementing the Fish and Wildlife Conservation Act of 1980	16 USC § 661 et seq., 50 CFR 83	Applicable	This statute and implementing regulations require coordination with federal and state agencies for federally funded projects to ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provides for adequate protection of fish and wildlife resources.	If the alternatives involve activities that affect wildlife and/or non-game fish, federal agencies must first consult with the USFWS and the relevant state agency with jurisdiction over wildlife resources. The alternatives contemplated for Furnace Creek would involve a Federally-funded modification of a stream.		✓	✓	RA1 RA2 RA3
Migratory Bird Treaty Act List of Migratory Birds	16 USC § 703, et seq. 50 CFR 10.13	Potentially Applicable	Makes it unlawful to “hunt, take, capture, kill,” or take other various actions adversely affected a broad range of migratory birds, without the prior approval of the Department of the Interior.	There is a potential for migratory birds (i.e. ducks) to be present within the site. The alternatives would be carried out in a manner to avoid adversely affecting migratory bird species, including individual birds or their nests		✓		RA1 RA2 RA3
Executive Order (EO) 11990 - Protection of Wetlands 11988 - Floodplain Management	40 CFR Part 6, Appendix A	Relevant and Appropriate Applicable	40 CFR Part 6, Appendix A contains EPA’s regulations for implementing these EOs, which require Federal agencies, wherever possible, to avoid or minimize adverse impacts upon wetlands and floodplains	A portion of Furnace Creek is identified as within the special flood hazard area (Zone A) which indicates floodplain. It is not anticipated that wetlands exist but a wetland delineation study has not been performed. The selected removal action will		✓	✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
Executive Order (EO) – 11990 and 11988 *(continued)*			(actions including dredge-and-fill activities).	be evaluated in light of these requirements and the alternative modified, if necessary, to avoid or minimize adverse impacts.				
Clean Water Act, Section 301 Ore Mining and Dressing Point Source Category- Subpart D- Mercury Ore Subcategory	33 USC § 1311; 40 CFR § 440.40-440.45	Relevant and Appropriate	Sets standards for discharge of treated effluent waters of the U.S. Provides effluent limitations criteria for mines and mills producing mercury.	The substantive provisions under this Section are relevant and appropriate to this removal action. CWA section 301(b) requires that, at a minimum, all direct discharges meet technology-based limits. Dewatering performed during removal actions and the stormwater detention basins (RA1 only) may involve direct discharges of mercury and TSS to Furnace Creek or other surface water bodies. Sediment filtration systems (RA1) or Geotubes® could be used to filter out sediment during dewatering operations or operation of stormwater detention basins.			✓	RA1 RA2 RA3
Clean Water Act, Section 402 National Pollutant Discharge Elimination System (NPDES)	40 CFR 122.26	Applicable	Provides comprehensive framework for addressing processing water and stormwater discharges. Requires that point-source discharges not cause the exceedance of surface water quality standards outside the mixing zone. Specifies requirements under 40 CFR 122.26 for point-source discharge of stormwater from construction sites to surface water and provides for Best Management Practices such as erosion control for removal and management of sediment to prevent run-on and runoff.	Dewatering performed during removal actions and the stormwater detention basins (RA1 only) may involve direct discharges of mercury and TSS to Furnace Creek or other surface water bodies. An on-site discharge from a CERCLA Site to surface waters must meet the substantive NPDES requirements, but need not obtain an NPDES permit nor comply with the administrative requirements of the permitting process, consistent with CERCLA Section 121(e)(1).			✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
Clean Water Act, Section 404	33 USC § 1251 et seq., 40 CFR 230 and 231	Relevant and Appropriate	Provides requirements to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material.	The construction of stormwater detention basins (RA1), Furnace Creek bed and bank covers (RA2), and creek bank and bed rehabilitation (RA3) involve discharges of fill material to waters of the U.S. (i.e. Furnace Creek). The substantive provisions under this Section and NWP 38 (Cleanup of Hazardous and Toxic Waste) are applicable to this removal action. Activities undertaken entirely on a CERCLA site by authority of CERCLA as approved or required by EPA, are not required to obtain permits under Section 404 of the CWA or Section 10 of the Rivers and Harbors Act.			✓	RA1 RA2 RA3
Clean Water Act, Water Quality Standards	40 CFR 131	Not an ARAR	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Not an ARAR since the State of Oregon has been delegated this program.	✓			RA1 RA2 RA3
Resource Conservation and Recovery Act (RCRA), Subtitle C Exemption for Extraction, Beneficiation and Processing Mining Waste	40 CFR 261.4(b)(7)	Potentially Applicable	EPA exempts mining wastes from the extraction, beneficiation, and some processing of ores and minerals, in accordance with the Bevill amendment to RCRA.	Mercury source material such as tailings and co-mingled contaminated soils/sediment that were not processed through the furnace may meet this exemption. Mercury source material identified as exempt would be addressed as nonhazardous solid waste rather than RCRA hazardous waste. However no delineation/determination of mercury source material that may qualify for this exemption has occurred within the Furnace Creek catchment area.		✓	✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
RCRA, Subtitle C Hazardous Waste Characteristics	40 CFR 261.20	Applicable	Generators of solid waste must determine whether the waste is hazardous. A solid waste is hazardous if it exhibits the toxicity characteristic (based on extraction procedure Method 1311).	Applicable to solid waste generated during removal action.	✓			RA1 RA2 RA3
RCRA, Subtitle C Hazardous Waste Treatment, Storage, and Disposal Facility	42 USC §6901, et seq 40 CFR 264, Subparts B and N	Relevant and Appropriate	Provides requirements for the generation, transportation, storage, and disposal of hazardous waste, including design and operating standards for hazardous waste treatment, storage, and disposal units. Specifically Subpart B is pertinent to general facility standards such as location standards and Subpart N is pertinent to landfills such as design requirements.	Involves onsite disposal of mercury source material in upland areas (RA1) or in an onsite disposal repository (RA3). Even though this material could be characterized as RCRA hazardous waste, it would not be placed/disposed for purposes of the RCRA regulations since the materials would be managed within an area of contamination and within the same land-disposal unit. Thus the onsite disposal repository would only need to comply with substantive relevant and appropriate requirements identified from Subparts B and N.			✓	RA1 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements [a]	Citations or References [a]	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
Federal ARARs and TBCs								
Clean Air Act (CAA) National Primary and Secondary Ambient Air Quality Standards	42 USC §7401, et seq. 40 CFR § 50.4–50.12	Applicable	National Ambient air quality standards (NAAQS) may be applicable, specifically particle pollution.	The alternatives may involve air emissions related to dust generated during excavation of mercury source material or fill placement activities. The selected removal actions will be carried out in a manner that will comply with NAAQS. The CAA establishes the National Ambient Air Quality Standards (NAAQS) in 40 CFR § 50.4–50.12. NAAQS are not enforceable in and of themselves; they are translated into source-specific emissions limitations by the state (U.S. EPA 1990). Substantive requirements of the (OAR 340, et. seq.) rules that have been approved by U.S. EPA, as part of the SIP under the CAA are potential federal ARARs for air emissions (CAA Section 110).	✓	✓	✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Indian Graves And Protected Objects Historic Property Historic Preservation Plan Preservation Of Property Of Historic Significance Oregon Property Management Program For Historic Sites And Properties Archaeological Objects And Sites Archaeological Sites and Historical Material	Oregon Revised Statutes (ORS) 97.740-97.750 Protection of Indian Graves ORS 358.475 Policy Special Assessment of Historic Property ORS 358.612 Authorities of State Historic Preservation Officer ORS 358.622 (State Advisory Committee on Historic Preservation) ORS 358.635 (Preservation of state-owned historic property) ORS 358.680-690 (Oregon Property Management Program) ORS 358.905 (General Archaeology) ORS 390.235 (Issuance of Archeological Permits)	Potentially Applicable	Governs Oregon Historical Preservation. Analogous to Federal Historic Preservation Act (36 CFR; Parts 60 and 61), and National Historic Preservation Act (NHPA) and Archeological and Historic Preservation Act.	If cultural resources on or eligible for the national register are present, it will be necessary to determine if there will be an adverse effect and, if so, how the effect may be minimized or mitigated, in consultation with the appropriate State Historic Preservation Office. It is not anticipated that cultural resources eligible for the National Register of Historic Places would be found within the removal action area for Furnace Creek. The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit and any archaeological investigations at a site must be conducted by a professional archaeologist The Oregon statutes may not be more stringent that the Federal requirements of the NHPA and Archeological and Historic Preservation Act.		✓	✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Oregon Threatened or Endangered Wildlife Species	ORS 496.171-192	Potentially Applicable	Sets forth standards for the State Fish and Wildlife Commission to list species as threatened or endangered; authorizes the Commission to enact regulations necessary to ensure survival of listed species, such as protecting habitat; expressly provides that this regulation does not, by itself, require an owner of private land to take action to protect an endangered or threatened species.	If threatened or endangered species are identified within the removal areas, activities must be designed to conserve the species and their habitat. There is a potential for one or more threatened or endangered species to be found within the site; however to date no threatened or endangered species have been identified atOU1. The statute does not contain substantive requirements and is not more stringent than the Federal ESA. The listed species might be different from the federal ESA. Both lists will be checked.		✓		RA1 RA2 RA3
Dam Safety	OAR 690-020-0000 and 690-020-0100 OAR 690-020-0035 through 0038 OAR 690-020-0042 through 0043 OAR 690-020-0060 OAR 690-020-0150 and 0250	Applicable	Dam safety rules apply to dams that are ten feet or higher than ten feet OR store more than 3 million gallons (9.2 acre feet). Dams shall be assigned a hazard rating of high, significant, or low, and are based on potential damage to life and property downstream of a dam in the event of a dam failure. "High Hazard Rating" means that if a dam were to fail, loss of human life would be expected. "Significant Hazard Rating" means that if a dam were to fail, loss of life would be unlikely but damage to property would be extensive. "Low Hazard Rating" means that if a dam were to fail, loss of life would be unlikely and damage to property would not be extensive. Provides general standards for Minimum Engineering Design Requirements (-0035), Site Suitability and/or Geotechnical Evaluation (-0036), Hydrology and Inflow	The stormwater detention basins for RA1 are anticipated to require dams greater than ten feet in height. The applicability of specific citations within these regulations is affected by the hazard rating assigned to the dams. It is anticipated that the stormwater detention basins constructed within Furnace Creek will have low overall storage capacities that would minimally affect stream levels if they were to fail and flow directly into Garoutte Creek. In addition other than the (b) residence (which is well above stream level), there are no developed properties within ¼ mile downstream of Furnace Creek on Garoutte Creek. Thus, it is anticipated that the dams would be assigned a hazard rating of low; i.e., loss of life or damage to property would be unlikely.			✓	RA1

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Dam Safety *(continued)*			Design Flood (-0037), Embankment Dam Structures (-0038), Spillways (-0042), Penetrating Conduit(s) and Control of Flow Through Conduits (-0043), Construction Specifications (-0060), Routine Inspection (-0150) and Maintenance of Dams (-0250).	Stormwater detention basins constructed within the Furnace Creek will be designed, constructed, inspected, and maintained using substantive requirements indicated in these regulations.				
General Emission Standards and Air Quality [b]	ORS 468A OAR 340-226-0100 Policy and application	Relevant and Appropriate	Provides general emission standards for fugitive emissions of air contaminants and requires highest and best practicable treatment or control of such emissions. EPA has established national ambient air quality standards (NAAQS) for several pollutants. NAAQS may be applicable for conditions at a site that results in emissions to air of criteria pollutants. If a remedial activity may exceed regulatory criteria, the activity may be subject to preconstruction review in designated attainment areas. The source may qualify for emission exemption under OAR 340-020-0245. Under ORS 465.315, DEQ has statutory authority to waive preconstruction permit, if required.	The alternatives may involve air emissions related to dust generated during excavation of mercury source material or fill placement activities. The Black Butte Mine site, in Lane County, is not within a designated non-attainment or air quality maintenance area. Therefore, emission criteria and rules for Special Control Areas (defined in OAR-340-204) are not applicable. OAR 340-226-0100 are potential relevant and appropriate requirements for remedial alternatives being considered because the U.S. EPA delegated them into the State Implementation Plan (SIP) per the Clean Air Act (CAA), 42 USC §7401–7671.	✓	✓	✓	RA1 RA2 RA3
Visible Emissions and Nuisance Requirements	OAR 340-208-0210 - Fugitive Emission Requirements	Potentially Applicable	Prohibits any handling, transporting, or storage of materials, or use of a road, or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. These rules include areas other than "special control areas" where fugitive emissions may cause a nuisance and control measures are practicable.	The alternatives may involve air emissions related to dust generated during excavation of mercury source material or fill placement activities. Potentially applicable parts pertain to areas and sources outside Special Control Areas defined in OAR-340-204. Substantive provisions of OAR 340-208-0210 are potentially applicable state requirements because they are not included in the SIP.			✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Noise Control Regulations	OAR 340-035-0035	Relevant and Appropriate	Sets noise standards for equipment, facilities, operations or activities including the production, storage, handling, sale, purchase, exchange, or maintenance of a product, commodity, or service, including the storage or disposal of waste products.	Potentially relevant and appropriate to removal action activities related to excavation of mercury source material or fill placement activities since they may be similar to the commercial operations indicated in the regulation.			✓	RA1 RA2 RA3
Oregon Hazardous Waste Management Act	ORS 466.005 – 466.225 Hazardous Waste Management Rules; OAR 340-100 *et. seq.*	Relevant and Appropriate	Establish a regulatory structure for the generation, transportation, treatment, storage, and disposal of hazardous wastes. OAR Chapter 340, Divisions 100 to 106, 109, 111, 113, 120, 124 and 142 incorporate, by reference, hazardous waste management regulations of the federal program, included in 40 CFR Parts 260 to 266, 268, 270, 273 and Subpart A and Subpart B of Part 124, into Oregon Administrative Rules.	Mercury source material identified as exempt would be addressed as nonhazardous solid waste rather than RCRA hazardous waste. However no delineation/determination of mercury source material that may qualify for this exemption has occurred within the Furnace Creek catchment area. Alternative involves onsite disposal of mercury source material in upland areas (RA1) or in an onsite disposal repository (RA3). Even though this material could be characterized as RCRA hazardous waste, it would not be placement/disposal for purposes of the RCRA regulations since the materials would be managed within an area of contamination and within the same land-disposal unit. Thus the onsite disposal repository would only need to comply with substantive relevant and appropriate requirements identified from Subparts B and N. Substantive requirements may be relevant and appropriate to removal actions that generate listed or characteristic hazardous wastes including environmental media such as mercury source material.	✓		✓	RA1 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Solid Waste Management Solid Waste: General Provisions	ORS 459.005 – 459.418 OAR 340-093 - 097	Relevant and Appropriate	Regulations under this statute establish a regulatory structure for the collection, transportation, treatment, storage, and disposal of solid wastes.	Potentially relevant and appropriate to the on-site management and disposal of Mercury source material that does not contain RCRA hazardous waste.			✓	RA1 RA3
Water Quality Standards, Division 41	OAR 340-041-0004, -0007, -0032, -0033, and -0036	Potentially Applicable	It set forth Oregon's plans for management of the quality of public waters within the State of Oregon.	Potentially applicable to manage water quality by evaluating discharges and activities during removal action. These are similar to Section 404 requirements of the CWA.	✓			RA1 RA2 RA3
Administrative Rules Governing the Issuance and Enforcement of Removal-Fill Authorizations within Waters of Oregon Including Wetlands Division 85	OAR 141-085 ORS 196.795-990	Relevant and Appropriate	The rule regulates removal or fill of material in any waters of the state. Oregon´s Removal-Fill Law (ORS 196.795-990) requires people who plan to remove or fill material in waters of the state to obtain a permit from the Department of State Lands.	The construction of stormwater detention basins (RA1), Furnace Creek bed and bank covers (RA2), and removal and rehabilitation within creek bank and bed (RA3) involve removal and discharges of fill material within waters of Oregon (i.e. Furnace Creek). The substantive provisions under this Section will be met. Activities undertaken entirely on a CERCLA site by authority of CERCLA as approved or required by EPA, are not required to obtain permits.			✓	RA1 RA2 RA3
Hazardous Substance Remedial Action Rules Division 122	OAR 340-122-0115	Potentially ARAR	Standards for degree of cleanup required. Establishes acceptable risk levels for human health at 1E-06 for individual carcinogens, 1E-05 for multiple carcinogens; and Hazard Index of less than or equal to 1.0 for noncarcinogens. Identifies selection of remedial action by balancing factors: effectiveness, implementability, long term reliability, short term implementation risk, and cost reasonableness. Allows waiver of state and local permits so long as substantive requirements are met.	This ARAR was not evaluated in the EE/CA because the substantive requirements are not practicable to be addressed as part of this action due to lack of comprehensive baseline risk assessments to demonstrate pre- and post-removal compliance with risk levels or lack of any media-specific remediation goals. The EE/CA also lacks definitive site-specific background for mercury in the affected media.	✓		✓	RA1 RA2 RA3

Summary of Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Information (TBCs) Furnace Creek Removal Action, Black Butte Mine Superfund Site (OU1)

Statutes, Regulations, Standards, or Requirements	Citations or References	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific	Removal Alternative
State of Oregon ARARs and TBCs								
Hazardous Substance Remedial Action Rules *(continued)*				Thus, it is highly unlikely to be an ARAR at this stage of the project (NTCRA) but, this rule will be included as an ARAR for the final site actions at OU1.				

[a] Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate acceptance of the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading. Only substantive requirements of the specific citations are considered potential ARARs.

[b] The preamble to the NCP indicates that state regulations that are components of a federally authorized or delegated state program are generally considered federal requirements and potential federal ARARs for the purposes of ARARs analysis (55 Fed. Reg. 8666, 8742 [1990]). The Oregon DEQ received final authorization for the regulation of hazardous wastes on 15 August 1995 (Federal Register Volume 60, Number 116 (Friday, June 16, 1995) and established rules in OAR 340-100 et. seq. For the Clean Air Act, EPA approved Oregon's State Implementation Plan and the air statutes were promulgated as ORS 468 and 468A.

Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
OAR	Oregon Administrative Rules
Oregon DEQ	State of Oregon Department of Environmental Quality
ORS	Oregon Revised Statutes
OSWER	Office of Solid Waste and Emergency Response
RCRA	Resource Conservation and Recovery Act
SIP	State Implementation Plan
TBCs	to be considered information
U.S.C	United States Code
USFWS	United States Fish and Wildlife Services

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Appendix C

Analysis of Removal Action Alternatives

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Alternative RA1

Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

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Table C-1. Evaluation Summary for the Effectiveness Factors – Alternative RA1

Evaluation Factors for Effectiveness		Evaluation Summary
Overall Protection of Human Health and the Environment	Adequate protection of human health and the environment shall be evaluated for long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ PRAO 1 for the Furnace Creek removal action would be addressed through erosion control measures on the side slopes and banks within the Furnace Creek catchment area. ▪ PRAO 2 for the Furnace Creek removal action would be addressed through retention of sediments within the Furnace Creek using stormwater detention basins along with erosion control measures. ▪ Achievement of PRAOs would potentially reduce the risk to human health from ingestion of fish from Garoutte Creek and/or Cottage Grove Lake. ▪ Tailings and co-mingled contaminated soils/sediment are left exposed within the Furnace Creek removal action area; thus, it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. ▪ Protection to human health and the environment is dependent on retention of sediments within the Furnace Creek using stormwater detention basins, erosion control measures, and access controls. ▪ Tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area; thus, long-term effectiveness and permanence is not entirely ensured. ▪ With proper construction and maintenance, the retention and erosion control measures would reduce the mobility and migration of particulate-bound mercury to Furnace Creek and from Furnace Creek to Garoutte Creek, thus meeting the PRAOs. ▪ Monitoring and maintenance would be performed during and after construction to ensure protectiveness of the remedy.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	Compliance with chemical-specific ARARs	▪ No chemical-specific ARARs exist for concentrations of mercury in tailings or comingled soil/sediment in an in situ condition. ▪ Chemical-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ The activities under this alternative would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA1.
	Compliance with location-specific ARARs	▪ Location-specific ARARs for the remedy would be addressed during implementation of the removal action.
	Compliance with action-specific ARARs	▪ Action-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ Activities under this alternative (construction of dams for detention basins and installation of erosion control measures) would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA1.

Table C-1. Evaluation Summary for the Effectiveness Factors – Alternative RA1 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Long-Term Effectiveness and Permanence	Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the removal activities	▪ Long-term effectiveness and permanence is not entirely ensured since tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area. Protection to human health and the environment is dependent on retention of particulate-bound mercury within stormwater detention basins and erosion control measures. ▪ Removal action under this alternative would not reduce the exposure of tailings and co-mingled contaminated soils/sediment to humans and ecological receptors, but would reduce the particulate-bound mercury loading in the Furnace Creek and the Garoutte Creek. ▪ This alternative would require continuous removal and management of sediments from within the detention basins that would pose exposure risks. ▪ During high intensity storm events these contaminated sediments could wash in the Garoutte Creek. ▪ With proper design, detention basins can provide attenuation to flood peaks and achieve enough retention time for particulate to settle out. ▪ If the sediment filtration system are not maintained, there is a potential of stormwater ponding within the basins causing anoxic conditions to occur. These conditions could promote methylation of mercury. ▪ BMPs, erosion control measures, and access controls implemented for the remedy would require monitoring and maintenance under post removal site controls (PRSC) till OU1 record of decision (ROD) is in place. Long-term effectiveness of access controls cannot be ensured since people could ignore them. ▪ Monitoring and maintenance would be performed to maintain the long-term effectiveness and permanence of the remedy. ▪ During PRSC, maintenance would be conducted for removing contaminated sediments from the stormwater detention basins. The removed sediment would be spread along the upland areas, stabilized using erosion control measures such as erosion control blankets and surficial treatment using tackifiers, and would be vegetated.

Table C-1. Evaluation Summary for the Effectiveness Factors – Alternative RA1 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Long-Term Effectiveness and Permanence (continued)	Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ Stormwater detention basins and erosion control measures are reliable controls for reducing loading of particulate-bound mercury in the Furnace Creek and Garoutte Creek, but would not reduce the exposure of tailings and co-mingled contaminated soils/sediment to humans and ecological receptors. ▪ The retention approach would require installation of multiple in-line stormwater detention basins with particulate/sediment filtration mechanism within the Furnace Creek. ▪ Erosion control measures such as separation of stormwater run-on with tailings and co-mingled contaminated soils/sediment includes installation of run-on diversion swales upgradient of tailings and co-mingled contaminated soils/sediment areas. ▪ Runoff swales would also be installed on the upland areas and on the creek banks within the Furnace Creek removal action area to minimize erosion of tailings and co-mingled contaminated soils/sediment. ▪ Other erosion control measures such as reclamation would target highly erodible areas of tailings and co-mingled contaminated soils/sediment to minimize erosion and particulate migration by recontouring, revegetation, and through limited surficial treatment using chemical agents or soil tackifiers. ▪ Adequacy and reliability of this alternative is dependent on continued integrity of the installed remedy. Reliability may decrease over time if woody vegetation became established. Preventive maintenance to address woody vegetation would be required to maintain integrity of the installed remedy. ▪ Maintenance activities would be periodically required to maintain the installed remedy. Additional monitoring and maintenance for clearing of sediment/debris inside the stormwater detention basins and assuring proper erosion control measures are in place would be required for proper functioning of the installed remedy.
Reduction of Toxicity. Mobility or Volume through Treatment	The treatment processes, the alternative uses, and materials they will treat	▪ The response action approach is retention of tailings and comingled soil/sediments using stormwater detention and erosion control measures without treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment of tailings and comingled soil/sediments. ▪ There could be incidental dewatering and processing of dewater before discharge necessary to perform the removal action. However the removal and disposal of filtered particulate mercury in an upland area does not constitute treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment from dewatering. ▪ The statutory preference for treatment as a principal element of the removal action would not be met.
	The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated	
	The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
	The degree to which the treatment is irreversible	
	The type and quantity of residuals that will remain following treatment	
	Whether the alternative will satisfy the preference for treatment	

Table C-1. Evaluation Summary for the Effectiveness Factors – Alternative RA1 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Short-Term Effectiveness	Short-term risks that might be posed to the community during implementation of an alternative	▪ The removal action will be performed within the Furnace Creek catchment area; thus, short-term risks to the community would be minimal except trespassers within the Furnace Creek area of OU1. Access controls would be used to warn the community of hazards in the removal action area. ▪ There would be minor impacts to the community, as truck traffic would only be required to transport uncontaminated materials for the installation of stormwater detention basins and erosion control measures. ▪ No tailings and co-mingled contaminated soils/sediment would be transported outside of the Furnace Creek catchment area.
	Potential impacts on workers during removal action and the effectiveness and reliability of protective measures	▪ The alternative requires minimal earthwork/excavation for constructing stormwater detention basins and grading for installation of erosion control measures. ▪ Clearing vegetation, construction of berms for stormwater detention basins, and installation of separation measures on steep slopes could pose short-term risks to workers. ▪ Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation. ▪ Dust control measure would be required when workers are removing vegetation and are working in contaminated zones. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as slips and falls, biological hazards, and mechanical hazards. ▪ In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk to workers from an uncontrolled slope failure. ▪ During implementation of PRSC additional exposers would mitigated through worker protection.
	Potential adverse environmental impacts from implementation of an alternative and the reliability of mitigation measures in preventing or reducing the potential impacts	▪ Construction of a stormwater detention basin has the potential for environmental impact, which can result from vegetation removal, stormwater management and construction processes. ▪ Although minimal, the removal action alternative would involve surface disturbance of tailings and co-mingled contaminated soils/sediment which could potentially increase the short-term loading of particulate-bound mercury in the Furnace Creek and Garoutte Creek. ▪ Construction of detention basin dams would have adverse environmental impacts on the hydrology of the Furnace Creek as well as Garoutte Creek. ▪ Erosion control measures and BMPs would be used to minimize the impacts to the Furnace Creek and Garoutte Creek. ▪ There could also be impacts to the environment during the implementation of the removal action due to the use of heavy construction and hauling equipment. Use of fuel efficient and low emission equipment. ▪ Dispersion of dust could pose potential adverse impacts. Water- or chemical- based suppression would be used for controlling mercury contaminated soils and dust during construction. ▪ Limited surficial treatment of tailings and contaminated soils using chemical agents such as magnesium chloride and soil tackifiers could pose potential adverse impacts to surface water. ▪ Removal of dense vegetation in order to implement the removal action within the Furnace Creek may have short-term impact on environment.

Table C-1. Evaluation Summary for the Effectiveness Factors – Alternative RA1 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Short-Term Effectiveness (continued)	Time until protection is achieved	▪ The construction of the removal action alternative could be implemented in approximately one year or less. However there is some uncertainty whether the PRAOs could be met at that time or if adjustments would need to be made to the stormwater detention basin or other erosion control measure approaches given variability in creek flows and erosion from upland areas.

Table C-2. Implementability Evaluation Summary – Alternative RA1

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Construction of stormwater detention basins, construction of dams and installation of articulating concrete blocks are generally straightforward, but may be challenging and technically difficult within the Furnace Creek banks and creek bed due to steep and narrow topography. ▪ It is anticipated that the minimum height of the berm would be 10 feet. Constructing a stable berm for the purpose of stormwater detention would be difficult within the steep and narrow topography. ▪ Presence of steep slopes and bedrock would make it difficult to construct access road. ▪ Construction of stormwater detention basins and erosion control measures may require use of specialty equipment and practices to ensure worker safety. ▪ Installation of retention and erosion control measures within the Furnace Creek may require dewatering. Water from the dewatering process would be pumped through a sediment filter/Geotube® prior to discharge.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Installation of the dam structure for the detention basin and erosion control measures within the Furnace Creek banks and creek bed may lead to schedule delays due to steep and narrow topography. ▪ Weather conditions generating large storm events may have adverse effect on the construction of stormwater dentention basins within the Furnace Creek, causing schedule delays. ▪ Removal action involves working within the Furnace Creek; thus, monitoring and maintenance of stormwater management features and erosion control BMPs becomes a critical aspect of the removal action which may lead to schedule delays. ▪ Suitable construction materials (uncontaminated soil, riprap, soil amendments, etc.) should be available outside of OU1, but could potentially delay the schedule.
	Potential future remedial action, difficulty to implement PRSC measures or operation and maintenance (O&M) or future remedial actions	▪ Potential future or additional remedial action would be required under this removal action alternative, because tailings and co-mingled contaminated soils/sediment are left exposed within the Furnace Creek removal action area which could potentially pose a risk to human and ecological receptors. Thus, the overall removal action activities under this alternative would be least compatible with the overall OU1 remedial strategy. ▪ Operation of PRSC measures or operation and maintenance (O&M) of installed remedy would be a continuous process. This would require continuous removal and management of sediments from within the detention basins; thus, it would be difficult for EPA to implement future remedial actions under OU1.

Table C-2. Implementability Evaluation Summary – Alternative RA1 (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Ability to monitor the effectiveness of the alternative	▪ Inspection and monitoring of stormwater detention basins, erosion control measures, and access controls is relatively straightforward and can be implemented using available materials, equipment, and labor resources. However the presence of stormwater detention basins and erosion control measures in locations such as the Furnace Creek banks and bed could complicate monitoring during storm events.
Administrative feasibility	Evaluate alternative for compliance with the statutory limits which requires the alternative to remain under $2 million or completed within a 12-month limit	▪ This is a Fund-financed removal action; thus the statutory limit of 2 million dollars and 12-month duration limit applies. ▪ It is anticipated that the removal action would comply with this statutory limit.
	Evaluate whether alternative will require off-site permits or other factors including easements, right-of-way agreements, or zoning variances	▪ The stormwater detention and erosion control measures construction activities of the removal action will be performed within the removal action area inside the OU1 boundary; thus, no off-site permits would be required. ▪ Borrow material would be required from locations outside of OU1; offsite permits to develop borrow resources may be required depending on whether they are located within the Site boundary.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ This alternative would not require offsite treatment, storage and disposal services. Thus this criterion is not applicable.
	Availability of personnel and technology to maintain the removal schedule Availability of services and materials (i.e. laboratory testing capacity, turnaround for chemical analyses, adequate supplies and equipment for on-site activities, or installation of extra utilities) Availability of prospective technologies	▪ Labor, equipment, materials, and technical specialists for construction of stormwater detention basins and erosion control measures should be available. ▪ Use of worker safety measures such as PPE and establishment of work zones required to protect human receptors and implementation of dust suppression mechanism are standard practice and can be implemented using available equipment and labor resources. ▪ Suitable rock and soil materials would be required from an offsite source and should be available. ▪ Technical equipment and specialists are available for implementation of institutional controls, inspection and monitoring under PRSC. ▪ Total volume of suitable rock and soil material required is approximately 3,600 loose cubic yard. ▪ Approximately 200 truckloads of suitable rock and soil material would be required to haul in from offsite borrow sources.
State (Support Agency) Acceptance	State concerns will be considered in determining the recommended alternative in the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.5.
Community Acceptance	Acceptance from the community will be considered in determining a recommendation for the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.6.

Table C-3. Cost Evaluation Summary – Alternative RA1

Evaluation Factors for Cost	Approximate Cost (Dollars)
Total capital cost	$822,000
Total annual PRSC cost	$310,000
Total cost (excluding present value discounting)	$1,132,000
Total present value cost	$1,040,000

Note: Total costs are for the assumed period of analysis (Years 0 through 10). Costs are rounded to the nearest $1,000.

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Alternative RA2

In-Place Containment of Mercury Source Material using Covers

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Table C-4. Evaluation Summary for the Effectiveness Factors – Alternative RA2

Evaluation Factors for Effectiveness		Evaluation Summary
Overall Protection of Human Health and the Environment	Adequate protection of human health and the environment shall be evaluated for long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ PRAO 1 and 2 for the Furnace Creek removal action would be addressed through in-place containment of tailings and co-mingled contaminated soils/sediment using covers on the upland areas, Furnace Creek banks, and Furnace Creek bed. ▪ Achievement of PRAOs would potentially reduce the risk to human health from ingestion of fish from Garoutte Creek and/or Cottage Grove Lake. ▪ Erosion of tailings and co-mingled contaminated soils into the Furnace Creek would be eliminated by installing in-place containment system using covers for upland and creek bank areas. ▪ Re-suspension of contaminated channel bottom sediments into the water column would be eliminated by installing in-place containment system using covers within the Furnace Creek bed. ▪ Tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area (although covered); thus, it could potentially pose a risk to human and ecological receptors in the future as part of overall OU1 exposures to mercury. ▪ Protection to human health and the environment is dependent on in-place containment of tailings and co-mingled contaminated soils/sediment using covers. ▪ With proper construction and maintenance, the covers would eliminate exposure of tailings and co-mingled contaminated soils/sediment to humans and ecological receptors. ▪ Monitoring and maintenance would be performed during and after construction to ensure protectiveness of the remedy.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	Compliance with chemical-specific ARARs	▪ No chemical-specific ARARs exist for concentrations of mercury in tailings or comingled soil/sediment in an in situ condition. ▪ Chemical-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ The activities under this alternative would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA2.
	Compliance with location-specific ARARs	▪ Location-specific ARARs for the remedy would be addressed during implementation of the removal action.
	Compliance with action-specific ARARs	▪ Action-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ Activities under this alternative (in-place containment of tailings or co-mingled contaminated soil/sediment) would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA2.

Table C-4. Evaluation Summary for the Effectiveness Factors – Alternative RA2 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Long-Term Effectiveness and Permanence	Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the removal activities	▪ Long-term effectiveness and permanence is not entirely ensured since tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area (although covered). Protection to human health and the environment is partially dependent on long-term effectiveness and permanence of the installed remedy. ▪ Tailings and co-mingled contaminated soils/sediment would be primarily addressed through in-place containment using covers. The horizontal extent of the covering is defined by the Furnace Creek removal action boundary and is approximately 2.1 acres. ▪ With proper construction and maintenance, the covers would break the exposure pathway; thus, reducing the exposure risk to humans and ecological receptors. ▪ Erosion of tailings and co-mingled contaminated soils into the Furnace Creek would be eliminated by installing in-place containment system using covers for upland and creek bank areas. ▪ Re-suspension of channel bottom contaminated sediments into the water column would be eliminated by installing in-place containment system using covers within the Furnace Creek bed. ▪ Leaching of mercury from tailings and co-mingled contaminated soils/sediment into groundwater and surface water would be reduced. ▪ The use of erosion control measures including recontouring tailing slopes, lateral stormwater bench swales, and erosion control blankets or turf reinforced mats would be used to increase the long-term effectiveness and permanence of the remedy; thus, reducing the exposure risk to humans and ecological receptors. ▪ BMPs, erosion control measures, and access controls implemented for the remedy would require monitoring and maintenance under PRSC till OU1 ROD is in place. Long-term effectiveness of access controls cannot be ensured since people could ignore them. ▪ Monitoring would be performed to maintain long-term effectiveness and permanence of the remedy.

Table C-4. Evaluation Summary for the Effectiveness Factors – Alternative RA2 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Long-Term Effectiveness and Permanence (continued)	Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ In-place containment of tailings and co-mingled contaminated soils/sediment using covers is a reliable control if properly maintained. ▪ Different types of covers would be utilized for in-place containment approaches for containing tailings and co-mingled contaminated soils/sediment within the Furnace Creek bed, creek banks and upland areas to provide long-term adequacy and reliability. ▪ Weather conditions generating large storm events may have adverse effect on the long-term effectiveness and permanence of creek bed and creek bank covers as compared to the upland covers. ▪ Long-term effectiveness and permanence is not entirely ensured since tailings and co-mingled contaminated soils/sediment potentially posing a risk is left beneath the covered areas; thus, long-term adequacy and reliability is dependent on continued integrity of the covers and adherence to PRSC. ▪ O&M activities would be periodically required to repair damage to the covers. The remedy would require monitoring and maintenance under PRSC till OU1 ROD is in place. ▪ Geotechnical monitoring may also need to be conducted after construction to ensure the stability and continued reliability of covers on existing steep slopes. ▪ Long-term effectiveness of covers may decrease over time if woody vegetation became established and penetrated the covers. Preventive maintenance to address woody vegetation would be required to maintain integrity.
Reduction of Toxicity. Mobility or Volume through Treatment	The treatment processes, the alternative uses, and materials they will treat	▪ The response action approach is in-place containment of tailings and comingled soil/sediments without treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment of tailings and comingled soil/sediments. ▪ There could be incidental dewatering and processing of dewater before discharge necessary to perform the removal action. However the removal and disposal of filtered particulate mercury in an upland area does not constitute treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment from dewatering. ▪ The statutory preference for treatment as a principal element of the removal action would not be met.
	The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated	
	The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
	The degree to which the treatment is irreversible	
	The type and quantity of residuals that will remain following treatment	
	Whether the alternative will satisfy the preference for treatment	
Short-Term Effectiveness	Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be minor impacts to the community under this alternative, as truck traffic would only be required to transport uncontaminated materials for the installation of covers. No tailings and co-mingled contaminated soils/sediment will be transported offsite. ▪ Short-term risks posed to the community during implementation of the alternative relate to trespassers within the exclusion zones of the Furnace Creek area of the Site.

Table C-4. Evaluation Summary for the Effectiveness Factors – Alternative RA2 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Short-Term Effectiveness (continued)	Potential impacts on workers during removal action and the effectiveness and reliability of protective measures	▪ The alternative requires minimal excavation for grading purposes. Tailings and co-mingled contaminated soils/sediment would be graded and contained in-place using covers. ▪ Surface disturbance of tailings and contaminated soils/sediment could pose short-term risks to workers installing covers or clearing vegetation prior to construction. ▪ Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation. ▪ Dust control measure would be required when workers are recontouring tailing slopes, removing vegetation and are working in contaminated zones. ▪ The transport of materials (uncontaminated soil and riprap material) for construction of covers would pose short-term risks to workers from traffic. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as slips and falls, biological hazards, and mechanical hazards. ▪ In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk to workers from an uncontrolled slope failure. ▪ During implementation of PRSC additional exposers would mitigated through worker protection.
	Potential adverse environmental impacts from implementation of an alternative and the reliability of mitigation measures in preventing or reducing the potential impacts	▪ The alternative would involve surface disturbance (in-place grading) of tailings and co-mingled contaminated soils/sediment which could potentially increase the short-term loading of particulate-bound mercury in the Furnace Creek and Garoutte Creek. ▪ In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk of an uncontrolled slope failure that could discharges tailings/co-mingled soil directly to Furnace Creek. ▪ Erosion control measures and BMPs would be used to minimize the impacts to the Furnace Creek and the Garoutte Creek. ▪ Dispersion of dust could pose potential adverse impacts. Water- or chemical- based suppression would be used for controlling mercury contaminated soils and dust during construction. ▪ Use of heavy construction and hauling equipment could impact the environment during implementation of the removal action and import of borrow and cover materials from off-site. Use of fuel efficient and low emission equipment. ▪ Removal of dense vegetation in order to implement the removal action within the Furnace Creek may have short-term impact on environment.
	Time until protection is achieved	▪ The construction of the removal action alternative could be implemented in approximately one year or less. However there is some uncertainty whether the PRAOs could be met at that time or if adjustments would need to be made to the in-place containment approaches given steep and narrow topography of the Furnace Creek.

Table C-5. Implementability Evaluation Summary – Alternative RA2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Installation of in-place containment using covers is generally straightforward, but may be challenging and technically difficult within the Furnace Creek banks and creek bed due to steep and narrow topography. ▪ In-place containment within creek banks with steep slopes would require reinforcement or use of stability measures such as geogrid or geoweb cellular confinement system to maintain slope stability, which may be challenging and technically difficult. ▪ Logistics for working with number of heavy equipment and trucks at the site having dense vegetation and steep slopes could be difficult to manage. ▪ Presence of steep slopes and bedrock would make it difficult to construct access road. ▪ In-place grading and installation of creek bank and creek bed covers may require use of specialty equipment and practices to ensure worker safety. ▪ Installation of in-place containment within the Furnace Creek may require dewatering. Water from the dewatering process could be pumped through a sediment filter/Geotube® prior to discharge. Retained particulate mercury would be placed within the upland area for containment.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ In-place grading of tailings and co-mingled contaminated soils/sediment is generally straightforward, but would require removal of dense vegetation and working on steep slopes. ▪ Once the area is cleared and graded to stable slopes then installation of containment system using covers should be relatively straightforward but challenging due to steep slopes and narrow topography and can be implemented using available equipment and labor resources. ▪ Weather conditions generating large storm events may have adverse effect on the construction of in-place containment system within the Furnace Creek, causing schedule delays. ▪ Removal action involves working within the Furnace Creek; thus, monitoring and maintenance of stormwater management features and erosion control BMPs becomes a critical aspect of the removal action which may lead to schedule delays. ▪ Suitable cover construction materials (uncontaminated soil, riprap, soil amendments, etc.) should be available outside of OU1, but could potentially delay the schedule.
	Potential future remedial action, difficulty to implement PRSC measures or operation and maintenance (O&M) or future remedial actions	▪ Potential future or additional remedial action may be required under this removal action alternative, because tailings and co-mingled contaminated soils/sediment are left within the Furnace Creek removal action area under cover which could potentially pose a risk to human and ecological receptors. Thus, the overall removal action activities under this alternative would be more compatible with the overall OU1 remedial strategy, as compared to Alternative RA1. ▪ Operation of PRSC measures or operation and maintenance (O&M) of installed remedy would be a continuous process. This would require continuous inspection and maintenance of in-place containment system; thus, it would be difficult for EPA to implement future remedial actions under OU1.

Table C-5. Implementability Evaluation Summary – Alternative RA2 (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Ability to monitor the effectiveness of the alternative	▪ Inspection and monitoring of cover systems and access controls is relatively straightforward and can be implemented using available materials, equipment, and labor resources. However the presence of covers in locations such as the Furnace Creek banks and bed could complicate monitoring during storm events.
Administrative feasibility	Evaluate alternative for compliance with the statutory limits which requires the alternative to remain under $2 million or completed within a 12-month limit	▪ This is a Fund-financed removal action; thus the statutory limit of 2 million dollars and 12-month duration limit applies. ▪ It is anticipated that the removal action would comply with this statutory limit.
	Evaluate whether alternative will require off-site permits or other factors including easements, right-of-way agreements, or zoning variances	▪ The in-place containment activities of the removal action will be performed within the removal action area inside the OU1 boundary; thus, no off-site permits would be required. ▪ Borrow material would be required from locations outside of OU1; offsite permits to develop borrow resources may be required depending on whether they are located within the Site boundary.
Availability of services and materials)	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ This alternative would not require offsite treatment, storage and disposal services. Thus this criterion is not applicable.
	Availability of personnel and technology to maintain the removal schedule	▪ Labor, equipment, materials, and technical specialists for construction of in-place containment system (covers) should be available. ▪ Use of worker safety measures such as PPE and establishment of work zones required to protect the community and workers and implementation of dust suppression mechanism are standard practices and can be implemented using available equipment and labor resources. ▪ Labor, equipment, materials, and technical specialists for installing temporary slope stability measures such as concrete block retention walls are available. ▪ Suitable rock and soil materials would be required from a source outside of OU1 but are not specialty materials and thus should be available. ▪ Technical equipment and specialists are available for implementation of inspection and monitoring under PRSC. ▪ Total volume of suitable cover material required is approximately 8,640 loose cubic yards. ▪ Approximately 480 truckloads of suitable cover material would be required to haul in from borrow sources outside of OU1.
	Availability of services and materials (i.e. laboratory testing capacity, turnaround for chemical analyses, adequate supplies and equipment for on-site activities, or installation of extra utilities)	
	Availability of prospective technologies	
State (Support Agency) Acceptance	State concerns will be considered in determining the recommended alternative in the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.5.
Community Acceptance	Acceptance from the community will be considered in determining a recommendation for the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.6.

Table C-6. Cost Evaluation Summary – Alternative RA2

Evaluation Factors for Cost	Approximate Cost (Dollars)
Total capital cost	$1,236,000
Total annual PRSC cost	$330,000
Total cost (excluding present value discounting)	$1,566,000
Total present value cost	$1,468,000

Note: Total costs are for the assumed period of analysis (Years 0 through 10). Costs are rounded to the nearest $1,000

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Alternative RA3

Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

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Table C-7 Evaluation Summary for the Effectiveness Factors – Alternative RA3

Evaluation Factors for Effectiveness		Evaluation Summary
Overall Protection of Human Health and the Environment	Adequate protection of human health and the environment shall be evaluated for long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ PRAO 1 and 2 for the Furnace Creek removal action would be addressed through excavation of tailings and co-mingled contaminated soils/sediment and onsite disposal outside the Furnace Creek catchment area but within the OU1 boundary. ▪ Achievement of PRAOs would potentially reduce the risk to human health from ingestion of fish from Garoutte Creek and/or Cottage Grove Lake. ▪ Excavation of tailings and co-mingled contaminated soils/sediment would provide adequate protection of human health and the environment. ▪ Limited or de minimis amount of tailings and co-mingled contaminated soils/sediment may require in-place containment using covers or would be left within the Furnace Creek removal action area unaddressed due to inaccessibility; thus, long-term effectiveness and permanence is not entirely ensured. ▪ Erosion of tailings and co-mingled contaminated soils into the Furnace Creek would be eliminated from upland and creek bank areas. ▪ Re-suspension of channel bottom contaminated sediments into the water column would be eliminated within the Furnace Creek bed. ▪ The onsite disposal repository would be contained using a cover specifically designed for the repository conditions. With proper construction and maintenance, the covers at the onsite disposal repository would eliminate exposure of tailings and co-mingled contaminated soils/sediment to humans and ecological receptors. ▪ Monitoring and maintenance would be performed during and after construction to ensure protectiveness of the remedy.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	Compliance with chemical-specific ARARs	▪ No chemical-specific ARARs exist for concentrations of mercury in tailings or comingled soil/sediment in an in situ condition. ▪ Chemical-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ The activities under this alternative would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA3.
	Compliance with location-specific ARARs	▪ Location-specific ARARs for the remedy would be addressed during implementation of the removal action.
	Compliance with action-specific ARARs	▪ Action-specific ARARs for the remedy would be addressed during implementation of the removal action. ▪ Activities under this alternative (excavation of tailings or co-mingled contaminated soil/sediment) would be carried out in a manner that will comply with substantive requirements of ARARs that are identified in Appendix B for Alternative RA3.

Table C-7 Evaluation Summary for the Effectiveness Factors – Alternative RA3 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Long-Term Effectiveness and Permanence	Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the removal activities	▪ Long-term effectiveness and permanence would be ensured since tailings and co-mingled contaminated soils/sediment would be excavated and transported for disposal outside the Furnace Creek catchment area. The excavated tailings and co-mingled contaminated soils/sediment would be disposed onsite within the OU1 boundary. ▪ Tailings and co-mingled contaminated soils/sediment would be primarily addressed through excavation and onsite disposal. The horizontal extent of the removal is defined by the Furnace Creek removal action boundary and is approximately 2.1 acres. ▪ Removal of tailings and co-mingled contaminated soils would eliminate the transport of particulate mercury into Furnace Creek via erosion. ▪ Removal of contaminated sediments would eliminate the re-suspension of channel bottom contaminated sediments into the water column; thus, reducing the migration of particulate-bound mercury from the Furnace Creek to Grouttte Creek. ▪ The excavated tailings and co-mingled contaminated soils/sediment would be contained using a cover specifically designed for the repository conditions. The covers would break the exposure pathway; thus, reducing the exposure risk to humans and ecological receptors. The approximate volume of excavation and disposal of tailings and co-mingled contaminated soils/sediment at the onsite repository is 7,000 loose cubic yards. ▪ BMPs, erosion control measures, and access controls implemented for the remedy (onsite disposal repository) would require monitoring and maintenance of under PRSC till OU1 ROD is in place. Long-term effectiveness of access controls cannot be ensured since people could ignore them. ▪ Monitoring would be performed to evaluate long-term effectiveness and permanence of the remedy.
	Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ Excavation and onsite disposal coupled with reclamation/rehabilitation of excavated area with uncontaminated soil to support vegetation is a reliable control if properly maintained. ▪ The onsite disposal repository would be contained using a cover specifically designed for the repository conditions to provide long-term adequacy and reliability. ▪ Regular maintenance would be required to prevent growth of woody vegetation to maintain integrity of the cover. ▪ Long-term effectiveness and permanence of reclaimed/rehabilitated areas is ensured once the vegetation is established along with erosion control BMPs. ▪ Even with maintenance and monitoring, long-term effectiveness of access controls cannot be ensured since people could ignore them. ▪ Weather conditions generating large storm events may have adverse effect on the long-term effectiveness and permanence of onsite disposal repository cover.

Table C-7 Evaluation Summary for the Effectiveness Factors – Alternative RA3 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Reduction of Toxicity. Mobility or Volume through Treatment	The treatment processes, the alternative uses, and materials they will treat	▪ The response action approach is removal and onsite disposal of tailings and comingled soil/sediments without treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment of tailings and comingled soil/sediments. ▪ There could be incidental dewatering and processing of dewater before discharge necessary to perform the removal action. However the removal and disposal of filtered particulate mercury in an upland area does not constitute treatment. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment from dewatering. ▪ The statutory preference for treatment as a principal element of the removal action would not be met.
	The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated	
	The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
	The degree to which the treatment is irreversible	
	The type and quantity of residuals that will remain following treatment	
	Whether the alternative will satisfy the preference for treatment	
Short-Term Effectiveness	Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be minor impacts to the community under this alternative, as truck traffic would only be required to transport uncontaminated materials for the installation of a vegetated simple soil cover for the onsite disposal repository and for reclamation of excavated area within the Furnace Creek. No tailings and co-mingled contaminated soils/sediment will be transported offsite. ▪ Short-term risks posed to the community during implementation of the alternative relate to trespassers within the exclusion zones of the Furnace Creek area of the Site.
	Potential impacts on workers during removal action and the effectiveness and reliability of protective measures	▪ The alternative requires extensive excavation of tailings and co-mingled contaminated soils/sediment and transportation for onsite disposal which would pose short-term risks to workers. ▪ Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation. ▪ Dust control measure would be required when workers are working in contaminated zones (excavating, hauling, and disposing) as well as when removing vegetation. ▪ The transport of materials (uncontaminated soil and riprap material) for construction of covers would pose short-term risks to workers from traffic. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as slips and falls, biological hazards, and mechanical hazards. ▪ In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk to workers from an uncontrolled slope failure. ▪ During implementation of PRSC additional exposers would mitigated through worker protection.

Table C-7 Evaluation Summary for the Effectiveness Factors – Alternative RA3 (continued)

Evaluation Factors for Effectiveness		Evaluation Summary
Short-Term Effectiveness (continued)	Potential adverse environmental impacts from implementation of an alternative and the reliability of mitigation measures in preventing or reducing the potential impacts	▪ The alternative would involve extensive excavation of tailings and co-mingled contaminated soils/sediment which could potentially increase the short-term loading of particulate-bound mercury in the Furnace Creek and the Garoutte Creek. ▪ In steep locations, temporary retaining structures, such as stackable concrete block walls or Jersey barriers, may be needed to reduce the risk of an uncontrolled slope failure that could discharges tailings/co-mingled soil directly to Furnace Creek. ▪ Erosion control BMPs would be used to minimize the impacts to the Furnace Creek and the Garoutte Creek. ▪ Construction of an onsite disposal repository would increase extent of the existing tailings repository. ▪ Dispersion of dust could pose potential adverse impacts. Water- or chemical- based suppression would be used for controlling mercury contaminated soils and dust during construction. ▪ Use of heavy construction and hauling equipment could impact the environment during implementation of the removal action and import of borrow and cover materials from off-site. Use of fuel efficient and low emission equipment. ▪ Removal of dense vegetation in order to implement the removal action within the Furnace Creek may have short-term impact on environment.
	Time until protection is achieved	▪ The construction of the removal action alternative could be implemented in approximately one year or less. However there is some uncertainty whether the PRAOs could be met at that time or if adjustments would need to be made to the excavation and onsite disposal approaches given steep and narrow topography of the Furnace Creek.

Table C-8. Implementability Evaluation Summary – Alternative RA3

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Excavation and reclamation/rehabilitation of excavation area is generally straightforward, but may be challenging and technically difficult within the Furnace Creek banks and creek bed due to steep and narrow topography. ▪ Logistics for working with number of heavy equipment and trucks at the site having dense vegetation and steep slopes could be difficult to manage. ▪ Presence of steep slopes and bedrock would make it difficult to construct access road. ▪ Excavation of tailings and co-mingled contaminated soils/sediment from steep slopes and from creek bed may require use of specialty equipment and practices to ensure worker safety and prevent releases to Furnace Creek and Garoutte Creek. ▪ Excavation within the Furnace Creek bed and banks may require dewatering. Water from the dewatering process would be pumped through a sediment filter/Geotube® prior to discharge. Retained particulate mercury would be placed within the upland area for containment. ▪ Excavation of buried tailings and contaminated sediments in areas of debris flow deposits during the high flow event within the Furnace Creek catchment may be challenging and technically difficult.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Excavation and reclamation/rehabilitation of excavation area within the Furnace Creek banks and creek bed may lead to schedule delays due to steep and narrow topography. ▪ Excavation and disposal of tailings and co-mingled contaminated soils/sediment, and reclamation/rehabilitation of excavation area is generally straightforward, but would require removal of dense vegetation. ▪ Weather conditions generating large storm events may have adverse effect on the excavation within the Furnace Creek, causing schedule delays. ▪ Removal action involves working within the Furnace Creek; thus, monitoring and maintenance of stormwater management features and erosion control BMPs becomes a critical aspect of the removal action which may lead to schedule delays. ▪ Suitable cover construction materials (uncontaminated soil, riprap, soil amendments, etc.) for the onsite disposal repository should be available outside of OU1, but could potentially delay the schedule.
	Potential future remedial action, difficulty to implement PRSC measures or operation and maintenance (O&M) or future remedial actions	▪ Potential future or additional remedial action may not be required under this removal action alternative, because tailings and co-mingled contaminated soils/sediment would be excavated (removed) from within the Furnace Creek removal action area and disposed at an onsite repository outside the Furnace Creek catchment area. Thus, the overall removal action activities under this alternative would be compatible with the overall OU1 remedial strategy.

Table C-8. Implementability Evaluation Summary – Alternative RA3 (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)		▪ Operation of PRSC measures or operation and maintenance (O&M) of installed remedy would be a continuous process. The continuous inspection and maintenance of the onsite disposal repository would not be difficult for EPA, since the existing tailings repository would be expanded for the new onsite disposal repository.
	Ability to monitor the effectiveness of the alternative	▪ Inspection, monitoring and maintenance of the cover system on the onsite disposal repository are relatively straightforward and can be easily implemented using available materials, equipment, and labor resources. ▪ Reclaimed and rehabilitated excavation areas would not require monitoring.
Administrative feasibility	Evaluate alternative for compliance with the statutory limits which requires the alternative to remain under $2 million or completed within a 12-month limit	▪ This is a Fund-financed removal action; thus the statutory limit of 2 million dollars and 12-month duration limit applies. ▪ It is anticipated that the removal action would comply with this statutory limit.
	Evaluate whether each alternative will require off-site permits or other factors including easements, right-of-way agreements, or zoning variances	▪ The excavation and onsite disposal activities of the removal action will be performed within the OU1 boundary; thus, no off-site permits would be required. ▪ Borrow material would be required from locations outside of OU1; offsite permits to develop borrow resources may be required depending on whether they are located within the Site boundary.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ This alternative would not require offsite treatment, storage and disposal services. Thus this criterion is not applicable.
	Availability of personnel and technology to maintain the removal schedule	▪ Labor, equipment, materials, and technical specialists for excavation, hauling, and onsite disposal should be available. ▪ Use of worker safety measures such as PPE and establishment of work zones required to protect human receptors and dust suppression mechanism are standard practice and can be implemented using available equipment and labor resources. ▪ Labor, equipment, materials, and technical specialists for installing temporary slope stability measures such as concrete block retention walls are available. ▪ Labor, equipment, materials, and technical specialists for installation of the repository cover system for the onsite disposal repository should be available. ▪ Suitable rock and soil materials would be required from a source outside of OU1 but are not specialty materials and thus should be available. ▪ Technical equipment and specialists are available for implementation of inspection and monitoring of the repository cover during PRSC. ▪ Total volume of suitable cover material required is approximately 5,100 loose cubic yard. ▪ Approximately 285 truckloads of suitable cover material would be required to haul in from borrow sources outside of OU1.
	Availability of services and materials (i.e. laboratory testing capacity, turnaround for chemical analyses, adequate supplies and equipment for on-site activities, or installation of extra utilities)	
	Availability of prospective technologies	

Table C-8. Implementability Evaluation Summary – Alternative RA3 (continued)

Evaluation Factors for Implementability		Evaluation Summary
State (Support Agency) Acceptance	State concerns will be considered in determining the recommended alternative in the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.5.
Community Acceptance	Acceptance from the community will be considered in determining a recommendation for the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 4.6.

Table C-9. Cost Evaluation Summary – Alternative RA3

Evaluation Factors for Cost	Approximate Cost (Dollars)
Total capital cost	$1,402,000
Total annual PRSC cost	$240,000
Total cost (excluding present value discounting)	$1,642,000
Total present value cost	$1,571,000

Note: Total costs are for the assumed period of analysis (Years 0 through 10). Costs are rounded to the nearest $1,000.

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Appendix D

Removal Action Alternative Cost Information

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The cost spreadsheets included in this appendix were developed in accordance with EPA 540-R-00-002 (OSWER 9355.0-75) July 2000.

These costs should be used to compare alternative relative costs. Costs for project management, remedial design, and construction management were determined as percentages of capital cost per the guidance. Costs for these work items may not reflect costs for implementation. These costs are determined based on specific client requirements during implementation.

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TABLE CS-ALT

ALTERNATIVE COST SUMMARY

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

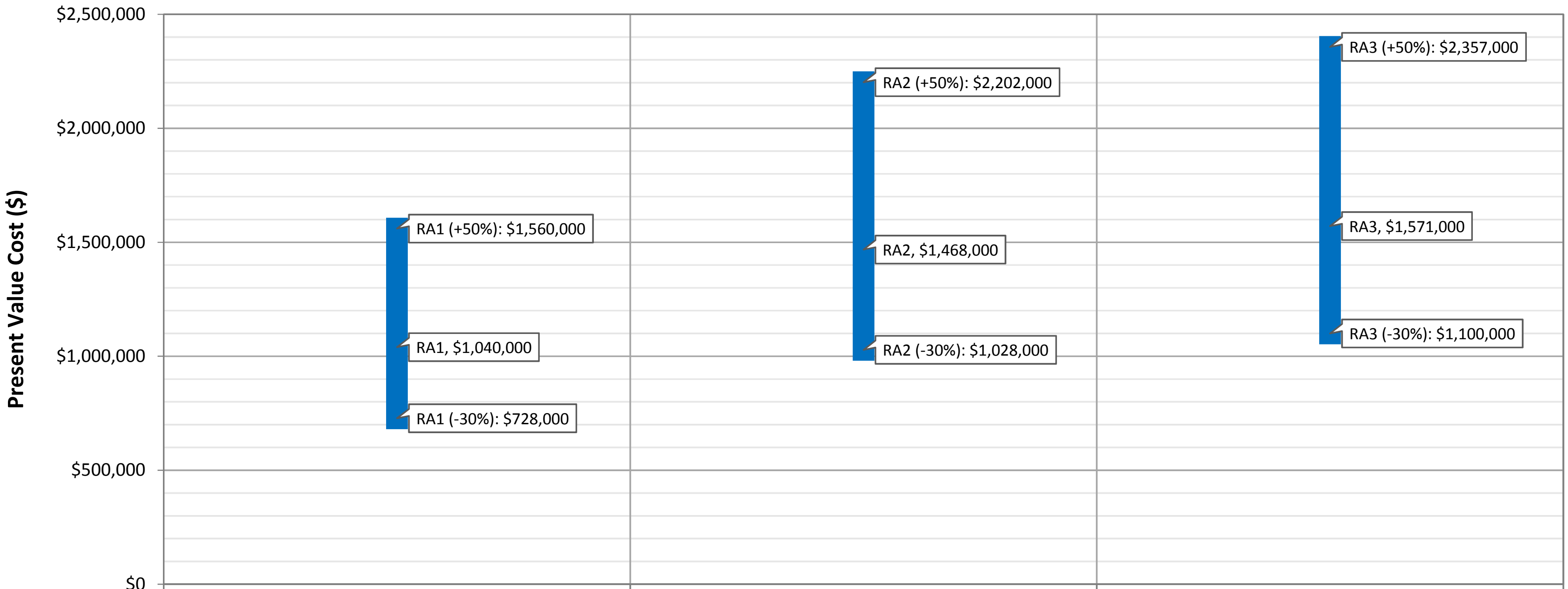
Alternative	Total Capital Cost	Total PRSC Cost	Total Non-Discounted Cost	Present Value (PV) Cost	Cost Accuracy Minus 30% Plus 50% Range
RA1	$822,000	$310,000	$1,132,000	$1,040,000	**$728,000 to $1,560,000**
RA2	$1,236,000	$330,000	$1,566,000	$1,468,000	**$1,028,000 to $2,202,000**
RA3	$1,402,000	$240,000	$1,642,000	$1,571,000	**$1,100,000 to $2,357,000**

PRSC- Post-Removal Site Control

Notes:

1. Capital costs, annual costs, and periodic costs are presented on Tables CS-1 through CS-3
2. Present value analysis for each removal action alternative are provided on Tables PV-1 through PV-3
3. The non-discounted total cost demonstrates the impact of a discount rate on the total present value cost and the relative amount of future annual expenditures. Non-discounted costs are presented for comparison purposes only and should not be used in place of present value costs in the CERCLA remedy selection process.
4. Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

Exhibit CS-ALT
Alternative Cost Accuracy Ranges
Present Value (PV) Cost



	RA1	RA2	RA3
Total PV (+50%)	$1,560,000	$2,202,000	$2,357,000
Total PV	$1,040,000	$1,468,000	$1,571,000
Total PV (-30%)	$728,000	$1,028,000	$1,100,000

Removal Action Alternative

Present Value and Cost Estimate Summary

Removal Alternative RA1

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TABLE PV-1

PRESENT VALUE ANALYSIS

Alternative RA1

Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Year[1]	Capital Costs[2]	Annual PRSC Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$822,000	$0	$822,000	1.0000	$822,000
1	$0	$31,000	$31,000	0.9346	$28,973
2	$0	$31,000	$31,000	0.8734	$27,075
3	$0	$31,000	$31,000	0.8163	$25,305
4	$0	$31,000	$31,000	0.7629	$23,650
5	$0	$31,000	$31,000	0.7130	$22,103
6	$0	$31,000	$31,000	0.6663	$20,655
7	$0	$31,000	$31,000	0.6227	$19,304
8	$0	$31,000	$31,000	0.5820	$18,042
9	$0	$31,000	$31,000	0.5439	$16,861
10	$0	$31,000	$31,000	0.5083	$15,757
TOTALS:	$822,000	$310,000	$1,132,000		$1,039,725
TOTAL PRESENT VALUE OF ALTERNATIVE RA1 [5]					**$1,040,000**

Notes:

[1] For this EE/CA, it is assumed that PRSC would continue for 10-years after the completion of removal action. Thus, the period of analysis was assumed to be 10 years (Years 0 through 10).

[2] Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-1.

[3] Total annual expenditure is the total cost per year with no discounting.

[4] Present value is the total cost per year including a 7.0% real discount rate factor for that year. See Table PV-ADRFT for details.

[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

TABLE CS-1

Alternative **RA1**
Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

COST ESTIMATE SUMMARY

Site Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016
Date: Jun-2016

Description: Alternative RA1 uses retention of sediments within the Furnace Creek using stormwater detention basins and erosion control measures for sheet flow and channelized flow on the side slopes and banks within the Furnace Creek catchment area along with implementing best management practices (BMPs) during construction and PRSC as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes both the contact of stormwater run-on with tailings and contaminated soils/sediments and mobilization and control of particulate-bound mercury entering Furnace Creek by retaining mercury source material within the Furnace Creek catchment area. This alternative also minimizes mobilization of particulate-bound mercury entering Furnace Creek from migrating to Garoutte Creek. However, these approaches would minimally reduce the potential for leaching of mercury into groundwater and surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.

EARTHWORK CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Mobilization/Demobilization	CW1-12	1	LS	$11,708	$11,708	
Construction Erosion Control	CW1-13	1	LS	$11,711	$11,711	
Clearing and Grubbing	CW1-3	1	LS	$7,112	$7,112	
Access Controls	CW1-2	1	LS	$2,585	$2,585	
Construction Access Road	CW1-4	1	LS	$21,218	$21,218	
Rough Grading for Stormwater Detention Basins	CW1-5	1	LS	$2,357	$2,357	
Construction of Stormwater Detention Basins	CW1-6	1	LS	$348,981	$348,981	
Erosion Control Measures for Channelized Flow	CW1-7	1	LS	$11,011	$11,011	
Installation of Temporary Retaining Wall	CW1-18	1	LS	$14,452	$14,452	
Erosion Control Measures for Sheet Flow	CW1-8	1	LS	$967	$967	
Surveying for Construction Control	CW1-9	1	LS	$10,423	$10,423	
Dust Control	CW1-10	1	LS	$10,873	$10,873	
Dewatering during Removal Action	CW1-11	1	LS	$21,114	$21,114	
Onsite Supervisory Staff and Equipment	CW1-17	1	LS	$69,438	$69,438	
SUBTOTAL					$543,950	
Contingency (Scope and Bid)		20%			$108,790	10% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$652,740	
Project Management		6%			$39,164	Percentage from Exhibit 5-8 was used.
Remedial Design		12%			$78,329	Percentage from Exhibit 5-8 was used.
Construction Management		8%			$52,219	Percentage from Exhibit 5-8 was used.
TOTAL					$822,452	
TOTAL CAPITAL COST					**$822,000**	Total capital cost is rounded to the nearest $1,000.

ANNUAL POST-REMOVAL SITE CONTROLS (PRSC)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Annual Post-Removal Site Control	CW1-14	1	LS	$20,620	$20,620	
SUBTOTAL					$20,620	
Contingency (Scope and Bid)		20%			$4,124	10% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$24,744	
Project Management		10%			$2,474	Percentage from Exhibit 5-8 was used.
Technical Support		15%			$3,712	Middle value of the recommended range in EPA 540-R-00-002 was used.
TOTAL					$30,930	
TOTAL ANNUAL O&M COST					**$31,000**	

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

Abbreviations:
LS Lump Sum
QTY Quantity

Present Value and Cost Estimate Summary

Removal Alternative RA2

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TABLE PV-2

PRESENT VALUE ANALYSIS

Alternative RA2
In-Place Containment of Mercury Source Material using Covers

Site:	**Furnace Creek, Black Butte Mine OU1**
Location:	**Lane County, Oregon**
Phase:	**Final EE/CA for Furnace Creek NTCRA**
Base Year:	**2016**

Year[1]	Capital Costs[2]	Annual PRSC Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,236,000	$0	$1,236,000	1.0000	$1,236,000
1	$0	$33,000	$33,000	0.9346	$30,842
2	$0	$33,000	$33,000	0.8734	$28,822
3	$0	$33,000	$33,000	0.8163	$26,938
4	$0	$33,000	$33,000	0.7629	$25,176
5	$0	$33,000	$33,000	0.7130	$23,529
6	$0	$33,000	$33,000	0.6663	$21,988
7	$0	$33,000	$33,000	0.6227	$20,549
8	$0	$33,000	$33,000	0.5820	$19,206
9	$0	$33,000	$33,000	0.5439	$17,949
10	$0	$33,000	$33,000	0.5083	$16,774
TOTALS:	$1,236,000	$330,000	$1,566,000		$1,467,773
TOTAL PRESENT VALUE OF ALTERNATIVE RA2[5]					**$1,468,000**

Notes:

[1] For this EE/CA, it is assumed that PRSC would continue for 10-years after the completion of removal action. Thus, the period of analysis was assumed to be 10 years (Years 0 through 10).

[2] Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-2.

[3] Total annual expenditure is the total cost per year with no discounting.

[4] Present value is the total cost per year including a 7.0% real discount rate factor for that year. See Table PV-ADRFT for details.

[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

TABLE CS-2

Alternative **RA2**
In-Place Containment of Mercury Source Material using Covers

COST ESTIMATE SUMMARY

Site	Furnace Creek, Black Butte Mine OU1	**Description:**	Alternative RA2 focuses on in-place containment for areas of tailings and co-mingled contaminated soils/sediment using covers as the strategy to manage particulate-bound mercury to achieve PRAOs. This alternative minimizes mobilization of particulate-bound mercury from entering Furnace Creek through re-contouring areas of tailings and co-mingled contaminated soils/sediment, installation of covers, and implementing BMPs during construction and PRSC. These approaches would contain mercury source material in the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with tailings/contaminated sediment within the Furnace Creek bed.
Location:	Lane County, Oregon		
Phase:	Final EE/CA for Furnace Creek NTCRA		
Base Year:	2016		
Date:	Jun-2016		

EARTHWORK CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	**WORKSHEET**	**QTY**	**UNIT(S)**	**UNIT COST**	**TOTAL**	**NOTES**
Mobilization/Demobilization	CW2-13	1	LS	$15,698	$15,698	
Construction Erosion Control	CW2-14	1	LS	$24,879	$24,879	
Clearing and Grubbing	CW2-3	1	LS	$29,871	$29,871	
Access Controls	CW2-2	1	LS	$1,437	$1,437	
Construction Access Road	CW2-4	1	LS	$21,218	$21,218	
Rough Grading for Cover Installation	CW2-5	1	LS	$23,848	$23,848	
In-Place Containment using Upland Cover	CW2-6	1	LS	$290,456	$290,456	
Stormwater Control Measures for Upland Covers	CW2-7	1	LS	$11,011	$11,011	
In-Place Containment using Creek Bed Cover	CW2-8	1	LS	$39,175	$39,175	
In-Place Containment using Creek Bank Cover	CW2-9	1	LS	$84,608	$84,608	
Installation of Temporary Retaining Wall	CW2-19	1	LS	$33,570	$33,570	
Surveying for Construction Control	CW2-10	1	LS	$10,423	$10,423	
Dust Control	CW2-11	1	LS	$21,745	$21,745	
Dewatering during Removal Action	CW2-12	1	LS	$70,482	$70,482	
Onsite Supervisory Staff and Equipment	CW2-18	1	LS	$138,876	$138,876	
SUBTOTAL					$817,297	
Contingency (Scope and Bid)		20%			$163,459	10% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$980,756	
Project Management		6%			$58,845	Percentage from Exhibit 5-8 was used.
Remedial Design		12%			$117,691	Percentage from Exhibit 5-8 was used.
Construction Management		8%			$78,460	Percentage from Exhibit 5-8 was used.
TOTAL					$1,235,752	
TOTAL CAPITAL COST					**$1,236,000**	Total capital cost is rounded to the nearest $1,000.

ANNUAL POST-REMOVAL SITE CONTROLS (PRSC)

DESCRIPTION	**WORKSHEET**	**QTY**	**UNIT(S)**	**UNIT COST**	**TOTAL**	**NOTES**
Annual Post-Removal Site Control	CW2-15	1	LS	$21,771	$21,771	
SUBTOTAL					$21,771	
Contingency (Scope and Bid)		20%			$4,354	10% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$26,125	
Project Management		10%			$2,613	Percentage from Exhibit 5-8 was used.
Technical Support		15%			$3,919	Middle value of the recommended range in EPA 540-R-00-002 was used.
TOTAL					$32,657	
TOTAL ANNUAL O&M COST					**$33,000**	

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Abbreviations:
LS Lump Sum
QTY Quantity

Present Value and Cost Estimate Summary

Removal Alternative RA3

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TABLE PV-3

PRESENT VALUE ANALYSIS

Alternative RA3

Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Year[1]	Capital Costs[2]	Annual PRSC Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,402,000	$0	$1,402,000	1.0000	$1,402,000
1	$0	$24,000	$24,000	0.9346	$22,430
2	$0	$24,000	$24,000	0.8734	$20,962
3	$0	$24,000	$24,000	0.8163	$19,591
4	$0	$24,000	$24,000	0.7629	$18,310
5	$0	$24,000	$24,000	0.7130	$17,112
6	$0	$24,000	$24,000	0.6663	$15,991
7	$0	$24,000	$24,000	0.6227	$14,945
8	$0	$24,000	$24,000	0.5820	$13,968
9	$0	$24,000	$24,000	0.5439	$13,054
10	$0	$24,000	$24,000	0.5083	$12,199
TOTALS:	$1,402,000	$240,000	$1,642,000		$1,570,562
TOTAL PRESENT VALUE OF ALTERNATIVE RA3[5]					**$1,571,000**

Notes:

[1] For this EE/CA, it is assumed that PRSC would continue for 10-years after the completion of removal action. Thus, the period of analysis was assumed to be 10 years (Years 0 through 10).

[2] Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-3.

[3] Total annual expenditure is the total cost per year with no discounting.

[4] Present value is the total cost per year including a 7.0% real discount rate factor for that year. See Table PV-ADRFT for details.

[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

TABLE CS-3

Alternative **RA3**
Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

COST ESTIMATE SUMMARY

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016
Date: Jun-2016

Description: Alternative RA3 focuses on excavation and onsite disposal of tailings and co-mingled contaminated soils/sediment with reclamation of upland and creek bank areas and rehabilitation of the creek bed along with erosion and sediment control BMPs to manage particulate-bound mercury and thus achieve PRAOs. These approaches would remove mercury source material from the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for leaching of mercury into groundwater, and reduce surface water and shallow groundwater interaction with contaminated sediment within the Furnace Creek bed.

EARTHWORK CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Mobilization/Demobilization	CW3-16	1	LS	$18,396	$18,396	
Construction Erosion Control	CW3-17	1	LS	$24,879	$24,879	
Clearing and Grubbing	CW3-3	1	LS	$29,871	$29,871	
Access Controls	CW3-2	1	LS	$2,011	$2,011	
Construction Access Road	CW3-4	1	LS	$21,218	$21,218	
Excavation and Hauling of Mercury Source Material	CW3-5	1	LS	$85,330	$85,330	
Construction of Onsite Disposal Repository	CW3-6	1	LS	$145,065	$145,065	
Stormwater Control Measures for Onsite Disposal Repository	CW3-7	1	LS	$3,722	$3,722	
Rehabilitation of Furnace Creek Bed	CW3-8	1	LS	$48,277	$48,277	
Reclamation of Excavated Areas	CW3-9	1	LS	$105,063	$105,063	
Installation of Temporary Retaining Wall	CW3-21	1	LS	$33,570	$33,570	
Stormwater Control Measures within Reclamation Areas	CW3-10	1	LS	$11,011	$11,011	
Field Portable XRF Sampling	CW3-11	1	LS	$72,118	$72,118	
Onsite Supervisory Staff and Equipment	CW3-12	1	LS	$138,876	$138,876	
Surveying for Construction Control	CW3-13	1	LS	$10,423	$10,423	
Dust Control	CW3-14	1	LS	$21,745	$21,745	
Dewatering during Removal Action	CW3-15	1	LS	$84,608	$84,608	
SUBTOTAL					$856,183	
Contingency (Scope and Bid)		30%			$256,855	20% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$1,113,038	
Project Management		6%			$66,782	Percentage from Exhibit 5-8 was used.
Remedial Design		12%			$133,565	Percentage from Exhibit 5-8 was used.
Construction Management		8%			$89,043	Percentage from Exhibit 5-8 was used.
TOTAL					$1,402,428	
TOTAL CAPITAL COST					**$1,402,000**	Total capital cost is rounded to the nearest $1,000.

ANNUAL POST-REMOVAL SITE CONTROLS (PRSC)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Annual Post-Removal Site Control	CW3-18	1	LS	$16,253	$16,253	
SUBTOTAL					$16,253	
Contingency (Scope and Bid)		20%			$3,251	10% Scope, 10% Bid (Low end of recommended range in EPA 540-R-00-002).
SUBTOTAL					$19,504	
Project Management		10%			$1,950	Percentage from Exhibit 5-8 was used.
Technical Support		15%			$2,926	Middle value of the recommended range in EPA 540-R-00-002 was used.
TOTAL					$24,380	
TOTAL ANNUAL O&M COST					**$24,000**	

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for EE/CA evaluation purposes.

Abbreviations:
LS Lump Sum
QTY Quantity

Cost Worksheets

Removal Alternative RA1

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TABLE CW1-2

Alternative 1 **Cost Worksheet:** **CW1-2**
Capital Cost Sub-Element
Access Controls

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the cost associated with access controls on the site. Engineered controls include installation of warning signs along the perimeter of the Furnace Creek area.

Cost Analysis:
Cost for Access Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A50B	Sign Installation Crew	18	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$32.00	$32.00	$576.00	8%	9%	$678	MII	MII Assemblies	
M37	Signs, Sign Post	18	EA	1.00	$0.00	$0.00	$0.00	$0.00	$32.50	$0.00	$32.50	$585.00	8%	9%	$689	CW	RS Means	Assume 250 FT apart
M37A	Signs	18	EA	1.00	$0.00	$0.00	$0.00	$0.00	$57.50	$0.00	$57.50	$1,035.00	8%	9%	$1,218	CW	RS Means	Assume 250 FT apart
												TOTAL UNIT COST:			$2,585			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-3

Alternative 1 **Cost Worksheet:** **CW1-3**
Capital Cost Sub-Element
Clearing and Grubbing

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves clearing and grubbing. It includes costs for labor, material, and equipment. It is assumed that trees and brush would be chipped in-place and would be spread within the OU1 boundary but outside the Furnace Creek catchment area.

Cost Analysis:
Cost for Clearing and Grubbing (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A51A	Clearing and Grubbing	0.5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$12,083.19	$12,083.19	$6,041.60	8%	9%	$7,112	MII MII Assemblies	
												TOTAL UNIT COST:			$7,112		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-4

Alternative 1
Capital Cost Sub-Element
Construction Access Road

Cost Worksheet: **CW1-4**

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of a construction access road along the Furnace Creek. The following cost includes labor, material.

Cost Analysis:
Cost for Construction Access Road (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Grading of Access Road																	
A49C	Rough Grading - Access Road	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.14	$0.14	$2,310.00	8%	9%	$2,719	MII	MII Assemblies	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$2,091.60	8%	9%	$2,462	MII	MII Assemblies	
A19AA	Geotextile Installation	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	$0.16	$2,692.80	8%	9%	$3,170	MII	MII Assemblies	Installation only, no material cost
	Materials																	
M6B	Rock/Gravel/Fill Material, Delivered	590	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$7,375.00	8%	9%	$8,682	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$2,475.00	8%	9%	$2,914	V	Vendor Quote	Delivered cost
												TOTAL UNIT COST:			$21,218			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-5

Alternative 1 **Cost Worksheet:** **CW1-5**
Capital Cost Sub-Element
Rough Grading for Stormwater Detention Basins

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the grading for construction of stormwater detention basins. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Rough Grading for Stormwater Detention Basins (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A49B	Rough Grading	28,600	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$2,002.00	8%	9%	$2,357	MII MII Assemblies	
												TOTAL UNIT COST:			$2,357		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-6

Alternative 1 **Cost Worksheet: CW1-6**
Capital Cost Sub-Element
Construction of Stormwater Detention Basins

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of four stormwater detention basins. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Construction of Four Stormwater Detention Basins (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Placement of Soil and Fill Material for Berm																
A12A	Material Loading	2,670	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$4,298.70	8%	9%	$5,060	MII MII Assemblies	
A28A	Short Haul	2,670	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$3,711.30	8%	9%	$4,369	MII MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	2,670	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$15,512.70	8%	9%	$18,262	MII MII Assemblies	
A22A	Compaction - Small Areas	2,080	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.28	$6.28	$13,062.40	8%	9%	$15,377	MII MII Assemblies	
	Placement of Riprap																
A12A	Material Loading	480	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$772.80	8%	9%	$910	MII MII Assemblies	
A28A	Short Haul	480	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$667.20	8%	9%	$785	MII MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	480	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$4,891.20	8%	9%	$5,758	MII MII Assemblies	
	Installation of Articulating Concrete Blocks																
A16B	Articulating Concrete Blocks Placement	20,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.76	$1.76	$35,200.00	8%	9%	$41,437	MII MII Assemblies	Includes geotextile fabric
	Installation of Sediment Filters																
A54B	Standbox with Sediment Filter	4	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$633.45	$633.45	$2,533.80	8%	9%	$2,983	MII MII Assemblies	
	Materials																
M3A	Subsoil, Delivered	1,460	CY	1.00	$0.00	$0.00	$0.00	$0.00	$21.25	$0.00	$21.25	$31,025.00	8%	9%	$36,523	V Vendor Quote	Includes purchase and delivery
M6B	Rock/Gravel/Fill Material, Delivered	1,170	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$14,625.00	8%	9%	$17,217	V Vendor Quote	Includes purchase and delivery to the Site.
M6A	Riprap/River-Rock, Delivered	700	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$25,550.00	8%	9%	$30,077	V Vendor Quote	Includes purchase and delivery to the Site.
M2A	Standbox with Sediment Filter and Piping	4	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7,500.00	$0.00	$7,500.00	$30,000.00	8%	9%	$35,316	P Previous Work	
M18	Articulating Concrete Blocks	20,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$5.73	$0.00	$5.73	$114,600.00	8%	9%	$134,907	V Vendor Quote	Includes geotextile fabric
												TOTAL UNIT COST:			$348,981		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-7

Alternative 1 **Cost Worksheet: CW1-7**
Capital Cost Sub-Element
Erosion Control Measures for Channelized Flow

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of stormwater erosion control measures for channelized flow. It includes instalaltion of run-on swales and vegetated or riprap/hardened swales within upland areas and on the creek banks. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Erosion Control Measures for Channelized Flow (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Installation of Run-On Swales																	
A9A	Excavation - Swales	220	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$488.40	8%	9%	$575	MII	MII Assemblies	
A49B	Rough Grading	6,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$420.00	8%	9%	$494	MII	MII Assemblies	
A12A	Material Loading	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$128.80	8%	9%	$152	MII	MII Assemblies	
A28A	Short Haul	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$111.20	8%	9%	$131	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$815.20	8%	9%	$960	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	4,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$42.00	8%	9%	$49	MII	MII Assemblies	
	Installation of Swales on Upland and Creek Banks																	
A9A	Excavation - Swales	110	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$244.20	8%	9%	$287	MII	MII Assemblies	
A49B	Rough Grading	3,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$210.00	8%	9%	$247	MII	MII Assemblies	
A12A	Material Loading	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$48.30	8%	9%	$57	MII	MII Assemblies	
A28A	Short Haul	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$41.70	8%	9%	$49	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$305.70	8%	9%	$360	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	2,100	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$21.00	8%	9%	$25	MII	MII Assemblies	
	Materials																	
M6A	Riprap/River-Rock, Delivered	160	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$5,840.00	8%	9%	$6,875	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	2,700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$405.00	8%	9%	$477	V	Vendor Quote	Delivered cost
M8A	Seed Mix	6,300	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$63.00	8%	9%	$74	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$15.00	8%	9%	$18	V	Vendor Quote	
M10A	Hydromulching	440	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$154.00	8%	9%	$181	V	Vendor Quote	
												TOTAL UNIT COST:			$11,011			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-8

Alternative 1 **Cost Worksheet: CW1-8**
Capital Cost Sub-Element
Erosion Control Measures for Sheet Flow

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves erosion control measures for sheet flow, specifically the stabilization of mine tailings through chemical agents. Limited surficial treatment of highly contaminated soils using chemical agents such as magnesium chloride or soil tackifier. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Erosion Control Measures for Sheet Flow (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A49B	Rough Grading	9,100	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$637.00	8%	9%	$750	MII MII Assemblies	
M8A	Seed Mix	9,100.00	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$91.00	8%	9%	$107	P Previous Work	Materials only, 32 lbs/acre
A42AA	Surficial Treatment	0.21	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$349.36	$349.36	$73.37	8%	9%	$86	MII MII Assemblies	
M10B	Magnesium Chloride	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.50	$0.00	$0.50	$10.00	8%	9%	$12	V Vendor Quote	
M10C	Tackifier	30	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$10.50	8%	9%	$12	V Vendor Quote	
												TOTAL UNIT COST:			$967		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-9

Alternative 1 **Cost Worksheet: CW1-9**
Capital Cost Sub-Element
Surveying for Construction Control

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves cost for site surveying before and after the removal action alternative is constructed. Additional surveying efforts are required for construction of the stormwater detention basins to meet dam safety regulations.

Cost Analysis:
Cost for Site Surveying (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A63A	Survey	5	DAY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$497.54	$497.54	$2,487.71	100%	9%	$5,423	MII	MII Assemblies	
M133	Surveying Report Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A	Allowance	
												TOTAL UNIT COST:			$10,423			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-10

Alternative 1 **Cost Worksheet: CW1-10**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assume water for dust control can be obtained from Garoutte Creek at no cost under existing water rights.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A5A	Dust Control	80	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$115.45	$115.45	$9,236.00	8%	9%	$10,873	MII MII Assemblies	Assume 2 hrs per day for 2 months
												TOTAL UNIT COST:			$10,873		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-11

Alternative 1 **Cost Worksheet: CW1-11**
Capital Cost Sub-Element
Dewatering during Removal Action

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the dewatering during the removal action. Includes spreading of dewatered sediment within upland area.

Cost Analysis:
Cost for Dewatering (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A71A	Dewatering	80	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.93	$64.93	$5,194.00	8%	9%	$6,114	MII	MII Assemblies	
M89A	Geotubes	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$6,000.00	$0.00	$6,000.00	$12,000.00	8%	9%	$14,126	V	Vendor Quote	Delivered cost
A2A	General Site Work	10	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$742.20	8%	9%	$874	MII	MII Assemblies	
												TOTAL UNIT COST:			$21,114			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-12

Alternative 1
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW1-12**

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the site respectively. It is assumed that mobilization and demobilization would be required only once.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A58A	Tractor Trailer- Heavy Equipment	32	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$117.25	$117.25	$3,751.89	8%	9%	$4,417	MII MII Assemblies	
A59A	Tractor Trailer - Large Equipment	32	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$112.02	$112.02	$3,584.67	8%	9%	$4,220	MII MII Assemblies	
A60A	Self-Propelled Equipment	32	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$1,739.08	8%	9%	$2,047	MII MII Assemblies	
A61A	Pilot Car w/Driver	16	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$869.54	8%	9%	$1,024	MII MII Assemblies	
												TOTAL UNIT COST:			$11,708		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-13

Alternative 1 **Cost Worksheet: CW1-13**
Capital Cost Sub-Element
Construction Erosion Control

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the installation of erosion control measures at the site during construction.

Cost Analysis:
Cost for Installation of Construction Erosion Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A2A	General Site Work	40	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$2,968.80	8%	9%	$3,495	MII	MII Assemblies	
M41	Silt Fence	1,000	LF	1.00	$0.79	$0.79	$0.13	$0.13	$0.25	$0.00	$1.17	$1,170.00	8%	9%	$1,377	CW	RS Means	
M42	Hay Bales	500	LF	1.00	$0.39	$0.39	$0.10	$0.10	$3.53	$0.00	$4.02	$2,010.00	8%	9%	$2,366	CW	RS Means	
M43	Erosion Control Blankets	2,500	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$3,800.00	8%	9%	$4,473	CW	RS Means	
												TOTAL UNIT COST:			$11,711			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-14

Alternative 1 **Cost Worksheet:** **CW1-14**
Annual O&M Cost Sub-Element
Annual Post-Removal Site Control

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves inspection and maintenance pertaining to the upkeep of the removal action components during the post-removal site controls. It includes costs for sediment removal from detention basins, erosion control maintenance, and reseeding. Assume twice per year.

Cost Analysis:
Cost for Annual PRSC (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A1A	Site Operations and Maintenance	6	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,480.53	$1,480.53	$8,883.18	8%	9%	$10,457	MII MII Assemblies	
M119	Per Diem for 2 Person	6	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$1,980.00	0%	0%	$1,980	GSA www.gsa.gov	
A44A	Site Inspection Crew	30	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.99	$100.99	$3,029.70	100%	9%	$6,605	MII MII Assemblies	
M119	Per Diem for 2 Person	3	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$990.00	0%	0%	$990	GSA www.gsa.gov	
M10B	Magnesium Chloride	40	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.50	$0.00	$0.50	$20.00	8%	9%	$24	V Vendor Quote	
M10C	Tackifier	60	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$21.00	8%	9%	$25	V Vendor Quote	
M8A	Seed Mix	12,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$120.00	8%	9%	$141	P Previous Work	Quantities adjusted for application twice per year.
M9A	Hydromulch	40	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$30.00	8%	9%	$35	V Vendor Quote	Quantities adjusted for application twice per year.
M10A	Fertilizer (N2 and P2O5)	880	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$308.00	8%	9%	$363	V Vendor Quote	Quantities adjusted for application twice per year.
												TOTAL UNIT COST:			$20,620		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-17

Alternative 1 **Cost Worksheet:** **CW1-17**
Capital Cost Sub-Element
Onsite Supervisory Staff and Equipment

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element includes field crew to oversee the removal action. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Supervisory Staff and Equipment (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A1C	Onsite Supervisory Staff - Crew of 2	40	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$644.93	$644.93	$25,797.20	100%	9%	$56,238	MII MII Assemblies	
M119	Per Diem for 2 Person	40	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$13,200.00	0%	0%	$13,200	GSA www.gsa.gov	
												TOTAL UNIT COST:			$69,438		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW1-18

Alternative 1 | **Cost Worksheet:** **CW1-18**
Capital Cost Sub-Element
Installation of Temporary Retaining Wall

COST WORKSHEET

Site: Black Butte Mine Superfund Site OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element includes installation of temporary retaining wall using concrete blocks. These will be moved and re-installed as required to provide slope protection and prevent sluffing of mercury source material. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Temporary Retaining Wall (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A16C	Temporary Retaining Wall Placement	4	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,594.19	$2,594.19	$10,376.76	8%	9%	$12,216	MII	MII Assemblies	
M18A	Concrete Blocks	20	EA	1.00	$0.00	$0.00	$0.00	$0.00	$45.00	$0.00	$45.00	$900.00	8%	9%	$1,059	V	Vendor Quote	2' x 2' x 6' Concrete block
M18B	Concrete Blocks Delivery	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00	$1,000.00	$1,000.00	8%	9%	$1,177	A	Allowance	
												TOTAL UNIT COST:			$14,452			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

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Cost Worksheets

Removal Alternative RA2

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TABLE CW2-2

Alternative 2 **Cost Worksheet: CW2-2**
Capital Cost Sub-Element
Access Controls

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the cost associated with access controls on the site. Engineered controls include installation of warning signs along the perimeter of the Furnace Creek area.

Cost Analysis:
Cost for Access Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A50B	Sign Installation Crew	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$32.00	$32.00	$320.00	8%	9%	$377	MII	MII Assemblies	
M37	Signs, Sign Post	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$32.50	$0.00	$32.50	$325.00	8%	9%	$383	CW	RS Means	Assume 250 FT apart
M37A	Signs	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$57.50	$0.00	$57.50	$575.00	8%	9%	$677	CW	RS Means	Assume 250 FT apart
												TOTAL UNIT COST:			$1,437			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-3

Alternative 2 **Cost Worksheet:** **CW2-3**
Capital Cost Sub-Element
Clearing and Grubbing

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves clearing and grubbing. It includes costs for labor, material, and equipment. It is assumed that trees and brush would be chipped in-place and would be spread within the OU1 boundary but outside the Furnace Creek catchment area.

Cost Analysis:
Cost for Clearing and Grubbing (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A51A	Clearing and Grubbing	2.1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$12,083.19	$12,083.19	$25,374.70	8%	9%	$29,871	MII MII Assemblies	Assume 25% of excavated material
												TOTAL UNIT COST:			$29,871		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-4

Alternative 2 **Cost Worksheet: CW2-4**
Capital Cost Sub-Element
Construction Access Road

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of access road along the Furnace CreekThe following cost includes labor, material

Cost Analysis:
Cost for Construction Access Road (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Grading of Access Road																	
A49C	Rough Grading - Access Road	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.14	$0.14	$2,310.00	8%	9%	$2,719	MII	MII Assemblies	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$2,091.60	8%	9%	$2,462	MII	MII Assemblies	
A19AA	Geotextile Installation	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	$0.16	$2,692.80	8%	9%	$3,170	MII	MII Assemblies	Installation only, no material cost
	Materials																	
M6B	Rock/Gravel/Fill Material, Delivered	590	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$7,375.00	8%	9%	$8,682	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$2,475.00	8%	9%	$2,914	V	Vendor Quote	Delivered cost
												TOTAL UNIT COST:			$21,218			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-5

Alternative 2 **Cost Worksheet:** **CW2-5**
Capital Cost Sub-Element
Rough Grading for Cover Installation

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves surface grading for installaiton of in-place containment using covers. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Grading (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rough Surface Grading																
A49B1	Rough Grading	2.1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3,125.17	$3,125.17	$6,562.86	8%	9%	$7,726	MII MII Assemblies	
	Grading at Steep Slopes (Creek Banks)																
A49B2	Grading Steep Slopes	1,500	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.13	$9.13	$13,695.00	8%	9%	$16,122	MII MII Assemblies	
												TOTAL UNIT COST:			$23,848		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-6

Alternative 2 **Cost Worksheet: CW2-6**
Capital Cost Sub-Element
In-Place Containment using Upland Cover

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of a vegetated simple soil cover for in-place containment of tailing and contaminated soils. The cover would contain a multi-layer cover system (including barrier layer, growth media layer, and vegetative layer) over tailing and contaminated soils, and would include surface water run-on/runoff controls.

Cost Analysis:
Cost for Upland Covers (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Subsoil Placement																
A12A	Material Loading	4,960	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$7,985.60	8%	9%	$9,401	MII MII Assemblies	
A28A	Short Haul	4,960	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$6,894.40	8%	9%	$8,116	MII MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	4,960	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$28,817.60	8%	9%	$33,924	MII MII Assemblies	
A22A	Compaction - Small Areas	3,720	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.28	$6.28	$23,361.60	8%	9%	$27,501	MII MII Assemblies	
	Growth Media Placement																
A12A	Material Loading	1,650	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$2,656.50	8%	9%	$3,127	MII MII Assemblies	
A28A	Short Haul	1,650	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$2,293.50	8%	9%	$2,700	MII MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	1,650	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$9,586.50	8%	9%	$11,285	MII MII Assemblies	
A42B	Hydro-Seeding Crew	66,900	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$669.00	8%	9%	$788	MII MII Assemblies	
	Materials																
M3A	Subsoil, Delivered	4,960	CY	1.00	$0.00	$0.00	$0.00	$0.00	$21.25	$0.00	$21.25	$105,400.00	8%	9%	$124,077	V Vendor Quote	Includes purchase and delivery
M3B	Growth Media Delivered	1,650	CY	1.00	$0.00	$0.00	$0.00	$0.00	$27.50	$0.00	$27.50	$45,375.00	8%	9%	$53,415	V Vendor Quote	Includes purchase and delivery
M8A	Seed Mix	66,900	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$669.00	8%	9%	$788	P Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	210	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$157.50	8%	9%	$185	V Vendor Quote	
M10A	Hydromulching	4,500	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$1,575.00	8%	9%	$1,854	V Vendor Quote	
M43	Erosion Control Blankets	7,430	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$11,293.60	8%	9%	$13,295	CW RS Means	
												TOTAL UNIT COST:			$290,456		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:

	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-7

Alternative 2 **Cost Worksheet:** **CW2-7**
Capital Cost Sub-Element
Stormwater Control Measures for Upland Covers

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of stormwater control measures. It includes installation of run-on swales and vegetated or riprap/hardened swales within upland covers. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Upland Covers (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Installation of Run-On Swales																	
A9A	Excavation - Swales	220	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$488.40	8%	9%	$575	MII	MII Assemblies	
A49B	Rough Grading	6,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$420.00	8%	9%	$494	MII	MII Assemblies	
A12A	Material Loading	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$128.80	8%	9%	$152	MII	MII Assemblies	
A28A	Short Haul	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$111.20	8%	9%	$131	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$815.20	8%	9%	$960	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	4,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$42.00	8%	9%	$49	MII	MII Assemblies	
	Installation of Swales on Upland Cover																	
A9A	Excavation - Swales	110	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$244.20	8%	9%	$287	MII	MII Assemblies	
A49B	Rough Grading	3,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$210.00	8%	9%	$247	MII	MII Assemblies	
A12A	Material Loading	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$48.30	8%	9%	$57	MII	MII Assemblies	
A28A	Short Haul	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$41.70	8%	9%	$49	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$305.70	8%	9%	$360	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	2,100	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$21.00	8%	9%	$25	MII	MII Assemblies	
	Materials																	
M6A	Riprap/River-Rock, Delivered	160	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$5,840.00	8%	9%	$6,875	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	2,700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$405.00	8%	9%	$477	V	Vendor Quote	Delivered cost
M8A	Seed Mix	6,300	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$63.00	8%	9%	$74	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$15.00	8%	9%	$18	V	Vendor Quote	
M10A	Hydromulching	440	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$154.00	8%	9%	$181	V	Vendor Quote	
												TOTAL UNIT COST:			$11,011			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW2-6

Alternative 2 **Cost Worksheet:** **CW2-8**
Capital Cost Sub-Element
In-Place Containment using Creek Bed Cover

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of a Hardened Cover for in-place containment of sediments within the creek bed. The cover would contain a multi-layer cover system (including bedding layer, geotextile layer, and riprap layer) over the contaminated sediments within the Furnace Creek.

Cost Analysis:
Cost for Upland Covers (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Bedding Placement																	
A12A	Material Loading	190	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$305.90	8%	9%	$360	MII	MII Assemblies	
A28A	Short Haul	190	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$264.10	8%	9%	$311	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	190	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$1,103.90	8%	9%	$1,300	MII	MII Assemblies	
A22A	Compaction - Small Areas	160	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.28	$6.28	$1,004.80	8%	9%	$1,183	MII	MII Assemblies	
A19AA	Geotextile Installation	8,400	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	$0.16	$1,370.88	8%	9%	$1,614	MII	MII Assemblies	Installation only, no material cost
	Rirap Placement																	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$3,668.40	8%	9%	$4,318	MII	MII Assemblies	
	Materials																	
M6B	Rock/Gravel/Fill Material, Delivered	310	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$3,875.00	8%	9%	$4,562	V	Vendor Quote	Includes purchase and delivery to the Site.
M6A	Riprap/River-Rock, Delivered	530	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$19,345.00	8%	9%	$22,773	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	8,400	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$1,260.00	8%	9%	$1,483	V	Vendor Quote	Delivered cost
												TOTAL UNIT COST:			$39,175			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-9

Alternative 2 **Cost Worksheet:** **CW2-9**
Capital Cost Sub-Element
In-Place Containment using Creek Bank Cover

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of a Hardened Cover for in-place containment of sediments within the creek banks. The cover would contain a multi-layer cover system (including bedding layer, geotextile layer/cellular confinement system, and riprap layer) over the contaminated soils/sediments within the Furnace Creek banks.

Cost Analysis:
Cost for Upland Covers (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Installation of Hardened Cover - Riprap																	
A12A	Material Loading	620	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$998.20	8%	9%	$1,175	MII	MII Assemblies	
A28A	Short Haul	620	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$861.80	8%	9%	$1,015	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	210	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$1,220.10	8%	9%	$1,436	MII	MII Assemblies	
A22A	Compaction - Small Areas	180	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.28	$6.28	$1,130.40	8%	9%	$1,331	MII	MII Assemblies	
A19AA	Geotextile Installation	9,720	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	$0.16	$1,586.30	8%	9%	$1,867	MII	MII Assemblies	Installation only, no material cost
A16A	Riprap Placement	410	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$4,177.90	8%	9%	$4,918	MII	MII Assemblies	
	Installation of Hardened Cover - Cellular Confinement System with Riprap																	
S6A	Placement and Installation of Geoweb System	4,860	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.92	$0.92	$4,461.48	0%	0%	$4,461	P	Previous Work	
A12A	Material Loading	310	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$499.10	8%	9%	$588	MII	MII Assemblies	
A28A	Short Haul	310	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$430.90	8%	9%	$507	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	100	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$581.00	8%	9%	$684	MII	MII Assemblies	
A16A	Riprap Placement	210	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$2,139.90	8%	9%	$2,519	MII	MII Assemblies	
	Installation of Vegetated Cover - Cellular Confinement System																	
S6A	Placement and Installation of Geoweb System	1,620	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.92	$0.92	$1,487.16	0%	0%	$1,487	P	Previous Work	
A12A	Material Loading	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$128.80	8%	9%	$152	MII	MII Assemblies	
A28A	Short Haul	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$111.20	8%	9%	$131	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$464.80	8%	9%	$547	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	1,620	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$16.20	8%	9%	$19	MII	MII Assemblies	
	Materials																	
M89B	Geoweb System	6,480	SF	1.00	$0.00	$0.00	$0.00	$0.00	$1.73	$0.00	$1.73	$11,210.40	8%	9%	$13,197	V	Vendor Quote	Delivered cost
M6B	Rock/Gravel/Fill Material, Delivered	500	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$6,250.00	8%	9%	$7,358	V	Vendor Quote	Includes purchase and delivery to the Site.
M6A	Riprap/River-Rock, Delivered	910	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$33,215.00	8%	9%	$39,101	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	9,720	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$1,458.00	8%	9%	$1,716	V	Vendor Quote	Delivered cost
M8A	Seed Mix	1,620	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$16.20	8%	9%	$19	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	10	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$7.50	8%	9%	$9	V	Vendor Quote	
M10A	Hydromulching	120	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$42.00	8%	9%	$49	V	Vendor Quote	
M43	Erosion Control Blankets	180	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$273.60	8%	9%	$322	CW	RS Means	
												TOTAL UNIT COST:			$84,608			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-10

Alternative 2 **Cost Worksheet: CW2-10**
Capital Cost Sub-Element
Surveying for Construction Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves cost for site surveying before and after the removal action alternative is constructed.

Cost Analysis:
Cost for Site Surveying (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A63A	Survey	5	DAY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$497.54	$497.54	$2,487.71	100%	9%	$5,423	MII	MII Assemblies	
M133	Surveying Report Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A	Allowance	
												TOTAL UNIT COST:			$10,423			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-11

Alternative 2 **Cost Worksheet: CW2-11**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assume water for dust control can be obtained from Garoutte Creek at no cost under existing water rights.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A5A	Dust Control	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$115.45	$115.45	$18,472.00	8%	9%	$21,745	MII	MII Assemblies	Assume 2 hrs per day for 4 months
												TOTAL UNIT COST:			$21,745			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-12

Alternative 2 **Cost Worksheet: CW2-12**
Capital Cost Sub-Element
Dewatering during Removal Action

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the dewatering during the removal action.

Cost Analysis:
Cost for Dewatering (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A71A	Dewatering	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.93	$64.93	$10,388.00	8%	9%	$12,229	MII	MII Assemblies	
M89A	Geotubes	8	EA	1.00	$0.00	$0.00	$0.00	$0.00	$6,000.00	$0.00	$6,000.00	$48,000.00	8%	9%	$56,506	V	Vendor Quote	Delivered cost
A2A	General Site Work	20	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$1,484.40	8%	9%	$1,747	MII	MII Assemblies	
												TOTAL UNIT COST:			$70,482			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-13

Alternative 2
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW2-13**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the site respectively. It is assumed that mobilization and demobilization would be required only once.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A58A	Tractor Trailer- Heavy Equipment	40	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$117.25	$117.25	$4,689.86	8%	9%	$5,521	MII	MII Assemblies	
A59A	Tractor Trailer - Large Equipment	50	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$112.02	$112.02	$5,601.04	8%	9%	$6,594	MII	MII Assemblies	
A60A	Self-Propelled Equipment	40	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$2,173.85	8%	9%	$2,559	MII	MII Assemblies	
A61A	Pilot Car w/Driver	16	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$869.54	8%	9%	$1,024	MII	MII Assemblies	
												TOTAL UNIT COST:			$15,698			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-14

Alternative 2 **Cost Worksheet: CW2-14**
Capital Cost Sub-Element
Construction Erosion Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the installation of erosion control measures at the site during construction.

Cost Analysis:
Cost for Installation of Construction Erosion Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A2A	General Site Work	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$11,875.20	8%	9%	$13,979	MII	MII Assemblies	
M41	Silt Fence	1,000	LF	1.00	$0.79	$0.79	$0.13	$0.13	$0.25	$0.00	$1.17	$1,170.00	8%	9%	$1,377	CW	RS Means	
M42	Hay Bales	500	LF	1.00	$0.39	$0.39	$0.10	$0.10	$3.53	$0.00	$4.02	$2,010.00	8%	9%	$2,366	CW	RS Means	
M43	Erosion Control Blankets	4,000	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$6,080.00	8%	9%	$7,157	CW	RS Means	
												TOTAL UNIT COST:			$24,879			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-15

Alternative 2 **Cost Worksheet:** **CW2-15**
Capital Cost Sub-Element
Annual Post-Removal Site Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves inspection and maintenance pertaining to the upkeep of the removal action components during the post-removal site controls. It includes costs for cover maintenance, erosion control maintenance, and reseeding. Assume twice per year.

Cost Analysis:
Cost for Post-Removal Site Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A1A	Site Operations and Maintenance	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,480.53	$1,480.53	$5,922.12	8%	9%	$6,972	MII	MII Assemblies	
M119	Per Diem for 2 Person	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$1,320.00	0%	0%	$1,320	GSA	www.gsa.gov	
A44A	Site Inspection Crew	30	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.99	$100.99	$3,029.70	100%	9%	$6,605	MII	MII Assemblies	
M119	Per Diem for 2 Person	3	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$990.00	0%	0%	$990	GSA	www.gsa.gov	
M8A	Seed Mix	20,070	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$200.70	8%	9%	$236	P	Previous Work	Quantities adjusted for application twice per year. Materials only, 32 lb/acre.
M9A	Fertilizer (N2 and P2O5)	80	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$60.00	8%	9%	$71	V	Vendor Quote	Quantities adjusted for application twice per year.
M10A	Hydromulching	1,400	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$490.00	8%	9%	$577	V	Vendor Quote	Quantities adjusted for application twice per year.
M103	Erosion Repair Material Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A	Allowance	Includes costs for materials to repair diversion ditches and soil cover materials.
												TOTAL UNIT COST:			$21,771			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-18

Alternative 2
Capital Cost Sub-Element
Onsite Supervisory Staff and Equipment

Cost Worksheet: **CW2-18**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element onsite supervisory staff and equipment/vehicle.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A1C	Onsite Supervisory Staff - Crew of 2	80	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$644.93	$644.93	$51,594.40	100%	9%	$112,476	MII MII Assemblies	
M119	Per Diem for 2 Person	80	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$26,400.00	0%	0%	$26,400	GSA www.gsa.gov	
												TOTAL UNIT COST:			$138,876		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW2-19

Alternative 2 **Cost Worksheet: CW2-19**
Capital Cost Sub-Element
Installation of Temporary Retaining Wall

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element includes installation of temporary retaining wall using concrete blocks. These will be moved and re-installed as required to provide slope protection and prevent sluffing of mercury source material. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Temporary Retaining Wall (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A16C	Temporary Retaining Wall Placement	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,594.19	$2,594.19	$25,941.90	8%	9%	$30,539	MII	MII Assemblies	
M18A	Concrete Blocks	35	EA	1.00	$0.00	$0.00	$0.00	$0.00	$45.00	$0.00	$45.00	$1,575.00	8%	9%	$1,854	V	Vendor Quote	2' x 2' x 6' Concrete block
M18B	Concrete Blocks Delivery	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00	$1,000.00	$1,000.00	8%	9%	$1,177	A	Allowance	
												TOTAL UNIT COST:			$33,570			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

Cost Worksheets

Removal Alternative RA3

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TABLE CW3-2

Alternative 3 | **Cost Worksheet:** **CW3-2**
Capital Cost Sub-Element
Access Controls

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the cost associated with access controls on the site. Engineered controls include installation of warning signs along the perimeter of the Furnace Creek area and on-site disposal repository.

Cost Analysis:
Cost for Access Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A50B	Sign Installation Crew	14	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$32.00	$32.00	$448.00	8%	9%	$527	MII	MII Assemblies	
M37	Signs, Sign Post	14	EA	1.00	$0.00	$0.00	$0.00	$0.00	$32.50	$0.00	$32.50	$455.00	8%	9%	$536	CW	RS Means	Assume 250 FT apart
M37A	Signs	14	EA	1.00	$0.00	$0.00	$0.00	$0.00	$57.50	$0.00	$57.50	$805.00	8%	9%	$948	CW	RS Means	Assume 250 FT apart
													TOTAL UNIT COST:		$2,011			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-3

Alternative 3
Capital Cost Sub-Element
Clearing and Grubbing

Cost Worksheet: CW3-3

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves clearing and grubbing. It includes costs for labor, material, and equipment. It is assumed that trees and brush would be chipped in-place and would be spread within the OU1 boundary but outside the Furnace Creek catchment area.

Cost Analysis:
Cost for Clearing and Grubbing (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A51A	Clearing and Grubbing	2.1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$12,083.19	$12,083.19	$25,374.70	8%	9%	$29,871	MII MII Assemblies	
												TOTAL UNIT COST:			$29,871		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-4

Alternative 3 **Cost Worksheet:** **CW3-4**
Capital Cost Sub-Element
Construction Access Road

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of access road along the Furnace CreekThe following cost includes labor, material

Cost Analysis:
Cost for Access Road (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Grading of Access Road																	
A49C	Rough Grading - Access Road	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.14	$0.14	$2,310.00	8%	9%	$2,719	MII	MII Assemblies	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$2,091.60	8%	9%	$2,462	MII	MII Assemblies	
A19AA	Geotextile Installation	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	$0.16	$2,692.80	8%	9%	$3,170	MII	MII Assemblies	Installation only, no material cost
	Materials																	
M6B	Rock/Gravel/Fill Material, Delivered	590	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$7,375.00	8%	9%	$8,682	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	16,500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$2,475.00	8%	9%	$2,914	V	Vendor Quote	Delivered cost
												TOTAL UNIT COST:			$21,218			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-5

Alternative 3 **Cost Worksheet: CW3-5**
Capital Cost Sub-Element
Excavation and Hauling of Mercury Source Material

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the excavation, loading and hauling of mine materials. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Excavation of Mercury Source Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A9AA	Excavation	5,800	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.92	$5.92	$34,336.00	8%	9%	$40,420	MII	MII Assemblies	
A12A	Material Loading	7,000	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$11,270.00	8%	9%	$13,267	MII	MII Assemblies	
A29A	Short Haul - Onsite Disposal	7,000	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.84	$3.84	$26,880.00	8%	9%	$31,643	MII	MII Assemblies	To facility outside of PMDA
												TOTAL UNIT COST:			$85,330			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-6

Alternative 3 | **Cost Worksheet:** **CW3-6**
Capital Cost Sub-Element
Construction of Onsite Disposal Repository

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction onsite disposal repository and installation vegetated simple soil cover. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Onsite Disposal Repository (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Placement of Excavated of Mercury Source Material																	
A17B	Excavated Material Placement	7,000	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.55	$4.55	$31,850.00	8%	9%	$37,494	MII	MII Assemblies	Placement of excavated materials within the repository
A49B1	Rough Grading	0.5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3,125.17	$3,125.17	$1,562.59	8%	9%	$1,839	MII	MII Assemblies	
A21A	Compaction - Fill	5,300	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.51	$1.51	$8,003.00	8%	9%	$9,421	MII	MII Assemblies	Compacting embankment and subgrade
	Subsoil Placement																	
A12A	Material Loading	1,640	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$2,640.40	8%	9%	$3,108	MII	MII Assemblies	
A28A	Short Haul	1,640	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$2,279.60	8%	9%	$2,684	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	1,640	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$9,528.40	8%	9%	$11,217	MII	MII Assemblies	
A22A	Compaction - Small Areas	1,230	CCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.28	$6.28	$7,724.40	8%	9%	$9,093	MII	MII Assemblies	
	Growth Media Placement																	
A12A	Material Loading	550	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$885.50	8%	9%	$1,042	MII	MII Assemblies	
A28A	Short Haul	550	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$764.50	8%	9%	$900	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	550	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$3,195.50	8%	9%	$3,762	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	22,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$222.00	8%	9%	$261	MII	MII Assemblies	
	Material																	
M3A	Subsoil, Delivered	1,640	CY	1.00	$0.00	$0.00	$0.00	$0.00	$21.25	$0.00	$21.25	$34,850.00	8%	9%	$41,025	V	Vendor Quote	Includes purchase and delivery
M3B	Growth Media Delivered	550	CY	1.00	$0.00	$0.00	$0.00	$0.00	$27.50	$0.00	$27.50	$15,125.00	8%	9%	$17,805	V	Vendor Quote	Includes purchase and delivery
M8A	Seed Mix	22,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$222.00	8%	9%	$261	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	70	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$52.50	8%	9%	$62	V	Vendor Quote	
M10A	Hydromulching	1,500	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$525.00	8%	9%	$618	V	Vendor Quote	
M43	Erosion Control Blankets	2,500	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$3,800.00	8%	9%	$4,473	CW	RS Means	
												TOTAL UNIT COST:			$145,065			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW3-7

Alternative 3 **Cost Worksheet:** **CW3-7**
Capital Cost Sub-Element
Stormwater Control Measures for Onsite Disposal Repository

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction onsite disposal repository and installation vegetated simple soil cover. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Onsite Disposal Repository (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Installation of Run-On Swales																	
A9A	Excavation - Swales	40	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$88.80	8%	9%	$105	MII	MII Assemblies	
A49B	Rough Grading	1,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$84.00	8%	9%	$99	MII	MII Assemblies	
A12A	Material Loading	10	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$16.10	8%	9%	$19	MII	MII Assemblies	
A28A	Short Haul	10	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$13.90	8%	9%	$16	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	10	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$101.90	8%	9%	$120	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	840	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$8.40	8%	9%	$10	MII	MII Assemblies	
	Installation of Swales on Onsite Disposal Repository																	
A9A	Excavation - Swales	90	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$199.80	8%	9%	$235	MII	MII Assemblies	
A49B	Rough Grading	2,320	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$162.40	8%	9%	$191	MII	MII Assemblies	
A12A	Material Loading	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$48.30	8%	9%	$57	MII	MII Assemblies	
A28A	Short Haul	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$41.70	8%	9%	$49	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$305.70	8%	9%	$360	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	1,624	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$16.24	8%	9%	$19	MII	MII Assemblies	
	Materials																	
M6A	Riprap/River-Rock, Delivered	50	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$1,825.00	8%	9%	$2,148	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	1,056	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$158.40	8%	9%	$186	V	Vendor Quote	Delivered cost
M8A	Seed Mix	2,464	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$24.64	8%	9%	$29	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	10	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$7.50	8%	9%	$9	V	Vendor Quote	
M10A	Hydromulching	170	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$59.50	8%	9%	$70	V	Vendor Quote	
												TOTAL UNIT COST:			$3,722			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-8

Alternative 3 — **Cost Worksheet: CW3-8**
Capital Cost Sub-Element
Rehabilitation of Furnace Creek Bed

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves rehabilitation of the bed of Furnace Creek. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Rehabilitation of Furnace Creek Bed (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Bedding Placement																	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$2,091.60	8%	9%	$2,462	MII	MII Assemblies	
	River-Rock Placement																	
A12A	Material Loading	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$579.60	8%	9%	$682	MII	MII Assemblies	
A28A	Short Haul	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$500.40	8%	9%	$589	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	360	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$3,668.40	8%	9%	$4,318	MII	MII Assemblies	
	Materials																	
M6B	Rock/Gravel/Fill Material, Delivered	590	TON	1.00	$0.00	$0.00	$0.00	$0.00	$12.50	$0.00	$12.50	$7,375.00	8%	9%	$8,682	V	Vendor Quote	Includes purchase and delivery to the Site.
M6A	Riprap/River-Rock, Delivered	530	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$19,345.00	8%	9%	$22,773	V	Vendor Quote	Includes purchase and delivery to the Site.
M104	Installation of Woody Revetments, Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,500.00	$7,500.00	$7,500.00	0%	0%	$7,500	A	Allowance	
												TOTAL UNIT COST:			$48,277			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-9

Alternative 3
Capital Cost Sub-Element
Reclamation of Excavated Areas

Cost Worksheet: **CW3-9**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves reclamation of excavated areas (topsoil placement, revegetation, erosion control measures). It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Reclamation of Excavated Areas (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Growth Media Placement																	
A12A	Material Loading	1,840	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$2,962.40	8%	9%	$3,487	MII	MII Assemblies	
A28A	Short Haul	1,840	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$2,557.60	8%	9%	$3,011	MII	MII Assemblies	Assume 0.5 mile haul
A18A	Fill Placement - Constrained Areas	1,840	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.81	$5.81	$10,690.40	8%	9%	$12,585	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	74,700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$747.00	8%	9%	$879	MII	MII Assemblies	
	Material																	
M3B	Growth Media Delivered	1,840	CY	1.00	$0.00	$0.00	$0.00	$0.00	$27.50	$0.00	$27.50	$50,600.00	8%	9%	$59,566	V	Vendor Quote	Includes purchase and delivery
M8A	Seed Mix	74,700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$747.00	8%	9%	$879	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	230	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$172.50	8%	9%	$203	V	Vendor Quote	
M10A	Hydromulching	5,100	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$1,785.00	8%	9%	$2,101	V	Vendor Quote	
M43	Erosion Control Blankets	8,300	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$12,616.00	8%	9%	$14,852	CW	RS Means	
M104	Installation of Woody Revetments, Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,500.00	$7,500.00	$7,500.00	0%	0%	$7,500	A	Allowance	
												TOTAL UNIT COST:			$105,063			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-10

Alternative 3 **Cost Worksheet: CW3-10**
Capital Cost Sub-Element
Stormwater Control Measures within Reclamation Areas

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the construction of stormwater control measures. It includes installation of run-on swales and vegetated or riprap/hardened swales within upland covers. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Stormwater Control measures within Reclamation Areas (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
	Installation of Run-On Swales																	
A9A	Excavation - Swales	220	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$488.40	8%	9%	$575	MII	MII Assemblies	
A49B	Rough Grading	6,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$420.00	8%	9%	$494	MII	MII Assemblies	
A12A	Material Loading	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$128.80	8%	9%	$152	MII	MII Assemblies	
A28A	Short Haul	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$111.20	8%	9%	$131	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$815.20	8%	9%	$960	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	4,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$42.00	8%	9%	$49	MII	MII Assemblies	
	Installation of Swales within Reclamation Areas																	
A9A	Excavation - Swales	110	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.22	$2.22	$244.20	8%	9%	$287	MII	MII Assemblies	
A49B	Rough Grading	3,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	$0.07	$210.00	8%	9%	$247	MII	MII Assemblies	
A12A	Material Loading	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.61	$1.61	$48.30	8%	9%	$57	MII	MII Assemblies	
A28A	Short Haul	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.39	$1.39	$41.70	8%	9%	$49	MII	MII Assemblies	Assume 0.5 mile haul
A16A	Riprap Placement	30	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.19	$10.19	$305.70	8%	9%	$360	MII	MII Assemblies	
A42B	Hydro-Seeding Crew	2,100	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$21.00	8%	9%	$25	MII	MII Assemblies	
	Material																	
M6A	Riprap/River-Rock, Delivered	160	TON	1.00	$0.00	$0.00	$0.00	$0.00	$36.50	$0.00	$36.50	$5,840.00	8%	9%	$6,875	V	Vendor Quote	Includes purchase and delivery to the Site.
M89	Geotextile	2,700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.00	$0.15	$405.00	8%	9%	$477	V	Vendor Quote	Delivered cost
M8A	Seed Mix	6,300	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$63.00	8%	9%	$74	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$15.00	8%	9%	$18	V	Vendor Quote	
M10A	Hydromulching	440	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$154.00	8%	9%	$181	V	Vendor Quote	
												TOTAL UNIT COST:			$11,011			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-11

Alternative 3 **Cost Worksheet: CW3-11**
Capital Cost Sub-Element
Field Portable XRF Sampling

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves XRF Sampling during excavation. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for XRF Sampling (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A43AA	Sampling Crew - 1 Technician	80	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$316.32	$316.32	$25,305.60	100%	9%	$55,166	MII	MII Assemblies	
M126A	XRF, Rental	4	MO	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3,600.00	$3,600.00	$14,400.00	8%	9%	$16,952	V	Vendor Quote	
												TOTAL UNIT COST:			$72,118			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-12

Alternative 3
Capital Cost Sub-Element
Onsite Supervisory Staff and Equipment

Cost Worksheet: **CW3-12**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element includes field crew to oversee the removal action. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Supervisory Staff and Equipment (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
A1C	Onsite Supervisory Staff - Crew of 2	80	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$644.93	$644.93	$51,594.40	100%	9%	$112,476	MII MII Assemblies	
M119	Per Diem for 2 Person	80	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$26,400.00	0%	0%	$26,400	GSA www.gsa.gov	
												TOTAL UNIT COST:			$138,876		

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-13

Alternative 3 | **Cost Worksheet:** **CW3-13**
Capital Cost Sub-Element
Surveying for Construction Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves cost for site surveying before and after the remedial alternative is constructed.

Cost Analysis:
Cost for Site Surveying (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A63A	Survey	5	DAY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$497.54	$497.54	$2,487.71	100%	9%	$5,423	MII	MII Assemblies	
M133	Surveying Report Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A	Allowance	
												TOTAL UNIT COST:			$10,423			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-23

Alternative 3 **Cost Worksheet: CW3-14**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assume water for dust control can be obtained from Garoutte Creek at no cost under existing water rights.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A5A	Dust Control	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$115.45	$115.45	$18,472.00	8%	9%	$21,745	MII	MII Assemblies	Assume 2 hrs per day for 4 months
												TOTAL UNIT COST:			$21,745			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-15

Alternative 3
Capital Cost Sub-Element
Dewatering during Removal Action

Cost Worksheet: **CW3-15**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the dewatering during the removal action.

Cost Analysis:
Cost for Dewatering (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A71A	Dewatering	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.93	$64.93	$10,388.00	8%	9%	$12,229	MII	MII Assemblies	Assumed 3 Days
M89A	Geotubes	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$6,000.00	$0.00	$6,000.00	$60,000.00	8%	9%	$70,632	V	Vendor Quote	Delivered cost
A2A	General Site Work	20	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$1,484.40	8%	9%	$1,747	MII	MII Assemblies	
												TOTAL UNIT COST:			$84,608			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-16

Alternative 3
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW3-16**

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the site respectively. It is assumed that mobilization and demobilization would be required only once.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A58A	Tractor Trailer- Heavy Equipment	50	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$117.25	$117.25	$5,862.33	8%	9%	$6,901	MII	MII Assemblies	
A59A	Tractor Trailer - Large Equipment	60	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$112.02	$112.02	$6,721.25	8%	9%	$7,912	MII	MII Assemblies	
A60A	Self-Propelled Equipment	40	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$2,173.85	8%	9%	$2,559	MII	MII Assemblies	
A61A	Pilot Car w/Driver	16	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$54.35	$54.35	$869.54	8%	9%	$1,024	MII	MII Assemblies	
												TOTAL UNIT COST:			$18,396			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-17

Alternative 3
Capital Cost Sub-Element
Construction Erosion Control

Cost Worksheet: CW3-17

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves the installation of erosion control at the site during construction.

Cost Analysis:
Cost for Installation of Construction Erosion Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A2A	General Site Work	160	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$74.22	$74.22	$11,875.20	8%	9%	$13,979	MII	MII Assemblies	
M41	Silt Fence	1,000	LF	1.00	$0.79	$0.79	$0.13	$0.13	$0.25	$0.00	$1.17	$1,170.00	8%	9%	$1,377	CW	RS Means	
M42	Hay Bales	500	LF	1.00	$0.39	$0.39	$0.10	$0.10	$3.53	$0.00	$4.02	$2,010.00	8%	9%	$2,366	CW	RS Means	
M43	Erosion Control Blankets	4,000	SY	1.00	$0.39	$0.39	$0.13	$0.13	$1.00	$0.00	$1.52	$6,080.00	8%	9%	$7,157	CW	RS Means	
												TOTAL UNIT COST:			$24,879			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-18

Alternative 3 | **Cost Worksheet: CW3-18**
Annual O&M Cost Sub-Element
Annual Post-Removal Site Control

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element involves operations and maintenance pertaining to the upkeep of the removal action components during the post-removal site controls. It includes costs for sediment removal from detention basins, erosion control maintenance, and reseeding. Assume twice per year.

Cost Analysis:
Cost for Post-Removal Site Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A1A	Site Operations and Maintenance	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,480.53	$1,480.53	$5,922.12	8%	9%	$6,972	MII	MII Assemblies	
M119	Per Diem for 2 Person	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$1,320.00	0%	0%	$1,320	GSA	www.gsa.gov	
A44A	Site Inspection Crew	10	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.99	$100.99	$1,009.90	100%	9%	$2,202	MII	MII Assemblies	
M119	Per Diem for 2 Person	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$330.00	$330.00	$330.00	0%	0%	$330	GSA	www.gsa.gov	
M8A	Seed Mix	9,690	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00	$0.01	$96.90	8%	9%	$114	P	Previous Work	Quantities adjusted for application twice per year. Materials only, 32 lb/acre.
M9A	Fertilizer (N2 and P2O5)	40	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.75	$0.00	$0.75	$30.00	8%	9%	$35	V	Vendor Quote	Quantities adjusted for application twice per year
M10A	Hydromulching	680	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.00	$0.35	$238.00	8%	9%	$280	V	Vendor Quote	Quantities adjusted for application twice per year
M103	Erosion Repair Material Allowance	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A	Allowance	Includes costs for materials to repair diversion ditches and soil cover materials.
												TOTAL UNIT COST:			$16,253			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

TABLE CW3-21

Alternative 3 | **Cost Worksheet: CW3-21**
Annual O&M Cost Sub-Element
Installation of Temporary Retaining Wall

COST WORKSHEET

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: Final EE/CA for Furnace Creek NTCRA
Base Year: 2016

Prepared By: AIS **Date:** 3/18/2016
Checked By: EEW **Date:** 3/21/2016

Work Statement:
This sub-element includes installation of temporary retaining wall using concrete blocks. These will be moved and re-installed as required to provide slope protection and prevent sluffing of mercury source material. It includes costs for labor, material, and equipment.

Cost Analysis:
Cost for Temporary Retaining Wall (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION		COMMENTS
A16C	Temporary Retaining Wall Placement	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,594.19	$2,594.19	$25,941.90	8%	9%	$30,539	MII	MII Assemblies	
M18A	Concrete Blocks	35	EA	1.00	$0.00	$0.00	$0.00	$0.00	$45.00	$0.00	$45.00	$1,575.00	8%	9%	$1,854	V	Vendor Quote	2' x 2' x 6' Concrete block
M18B	Concrete Blocks Delivery	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00	$1,000.00	$1,000.00	8%	9%	$1,177	A	Allowance	
												TOTAL UNIT COST:			$33,570			

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), SE (www.salaryexpert.com), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2012), P (Previous Work), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2012 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, Mar 2012
Area Cost Factor	An AF of 1.05 is used for Oregon, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	ACR	Acres
EQUIP	Equipment	BCY	Bank Cubic Yard
MATL	Material	CLF	100 Linear Foot
HPF	HTRW Productivity Factor	DY	Days
ADJ LABOR	Adjusted Labor for HFP	EA	Each
ADJ EQUIP	Adjusted Equipment for HFP	LF	Linear Foot
UNMOD UC	Unmodified Unit Cost	HR	Hours
UNMOD LIC	Unmodified Line Item Cost	LB	Pounds
UNBUR LIC	Unburdened Line Item Cost	LCY	Loose Cubic Yard
PC OH	Prime Contractor Overhead	LS	Lump Sum
PC PF	Prime Contractor Profit	RL	Roll
BUR LIC	Burdened Line Item Cost	SY	Square Yard
		TN	Tons

Calculations

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PROJECT:	Black Butte Mine Superfund Site OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	3/21/2016
CLIENT:	USEPA			WRKSHT NO. :	QTO-01

Description: General assumptions that apply to all alternatives. Changes to these assumptions will impact the calculations for all alternatives. Assumptions are based on previous work of similar scope or values cited in literature.

GENERAL ASSUMPTIONS

Schedule Assumptions

Number of federal/state holidays per year, DY/YR:	10
Hours per Shift, HR/DY:	8

Material Property Assumptions

BCY - bank cubic yard - in place volume prior to excavation
LCY - loose cubic yards - volume after excavation
CCY - compacted cubic yards (aka embankment cubic yards) - volume after compaction
LB - pounds

Common Earth Bulking Factor:	1.20	*Conversion from BCY to LCY*
Common Earth Compaction Factor:	0.90	*Conversion from BCY to CCY*
Common Earth Compaction Factor:	0.75	*Conversion from LCY to CCY*
Unit weight of common earth, LB/BCY:	3000	*Based on EIS*
Unit weight of common earth, TON/BCY:	1.5	
Unit weight of common earth, LB/LCY:	2500	
Unit weight of common earth, TON/LCY:	1.3	
Sand Bulking Factor:	1.12	*Conversion from BCY to LCY*
Sand Compaction Factor:	0.95	*Conversion from BCY to CCY*
Sand Compaction Factor:	0.85	*Conversion from LCY to CCY*
Density of Sand (dry), LB/BCY:	2,673	*CAT Handbook*
Density of Sand (dry), LB/LCY:	2,387	*CAT Handbook*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to CCY*
Gravel Compaction Factor:	0.86	*Conversion from LCY to CCY*
Density of Gravel (pitrun), LB/BCY:	3,650	*CAT Handbook*
Density of Gravel (pitrun), LB/LCY:	3,259	*CAT Handbook*
Riprap Bulking Factor:	1.50	*Conversion from BCY to LCY*
Riprap Compaction Factor:	1.30	*Conversion from BCY to CCY*
Riprap Compaction Factor:	0.87	*Conversion from LCY to CCY*
Density of riprap, LB/BCY:	4,400	*CAT Handbook*
Density of riprap, LB/LCY:	2,933	*CAT Handbook*
Concrete Demolition Debris Bulking Factor:	1.30	*Conversion from BCY to LCY*
Density of Concrete Debris, LB/LCY:	1,855	
Density of Concrete Debris, TON/LCY:	0.93	
Density of Concrete Debris, TON/CY:	2.00	
Density of Asphalt, TON/CY:	2.05	

CDM Smith

PROJECT:	Black Butte Mine Superfund Site OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	3/21/2016
CLIENT:	USEPA			WRKSHT NO. :	QTO-ALT-1

Description: Alternative 1 cost estimate backup calculations

RA1: Retention of Mercury Source Material using Stormwater Detention Basins and Erosion Control Measures

Stormwater Detention Basins

Number of Detention Basins, EA:	4	
Top Width, FT:	4	*Assumed*
Height, FT:	10	*Assumed average*
Side Slope, H:V:	1	*:1*
Slope, %:	100%	
Bottom Width, FT:	24	
Length, FT:	100	*Assumed average*
Volume of Berm, CCY:	520	
Total Volume of Berm, CCY:	2,080	
Assumed Soil,%:	70%	
Assumed Fill Rock,%:	30%	
Volume of Soil, CCY:	1,460	
Volume of Soil, LCY:	1,950	
Volume of Fill Rock, CCY:	620	
Volume of Fill Rock, LCY:	720	
Volume of Fill Rock, TON:	1,170	

Riprap Armoring

Area of Riprap on Berm, SF:	11,310	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	420	
Volume of Riprap, LCY:	480	
Volume of Riprap, TON:	700	

Articulating Concrete Block

Area for Rough Grading, SF:	28,600	*Calculated from Plan View Figures*
Area of Articulating Concrete Block, SF:	20,000	*Calculated from Plan View Figures*

Stormwater Control Measures

Run-On Swales

Total Length of Run-On Swales, LF:	1,500	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	220	
Total Surface Area, SF:	6,000	
Assumed Area to be Vegetated,%:	70%	
	30%	
Total Surface Area to be Vegetated, SF:	4,200	
Total Surface Area to be Armored, SF:	1,800	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	70	
Volume of Riprap, LCY:	80	
Volume of Riprap, TON:	120	

PROJECT:	Black Butte Mine Superfund Site OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	3/21/2016
CLIENT:	USEPA			WRKSHT NO. :	QTO-ALT-1

Description: Alternative 1 cost estimate backup calculations

Runoff Swales within Upland and Creek Banks

Total Length of Swales, LF:	750	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	110	
Total Surface Area, SF:	3,000	
Assumed Area to be Vegetated,%:	70%	
Assumed to be Armored,%:	30%	
Total Surface Area to be Vegetated, SF:	2,100	
Total Surface Area to be Armored, SF:	900	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	30	
Volume of Riprap, LCY:	30	
Volume of Riprap, TON:	40	
Fertilizer Amendment for Topsoil, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Topsoil, LB:	20	
Hydromulching, LB:	440	

Chemical Surficial Treatment

Total Area of Action Boundary, ACR:	2.10
	10%
Assumed Area to be Treated, ACR:	0.21
Magnesium Chloride, LB/AC:	50
Tackifiers, LB/AC:	100
Magnesium Chloride, LB/AC:	20
Tackifiers, LB/AC:	30

Construction Access Road

Length of Access Road, LF:	1,100
Width of Access Road, LF:	15
Total Area, SF:	16,500
Depth of Gravel, FT:	0.5
Volume of Fill Rock, CCY:	310
Volume of Fill Rock, LCY:	360
Volume of Fill Rock, TON:	590

PROJECT: Furnace Creek, Black Butte Mine OU1	COMPUTED BY: AIS	CHECKED BY: EEW
JOB NO.: 106504.3126.004.13284.210.EEZ.01	DATE: 3/18/2016	DATE CHECKED: 3/21/2016
CLIENT: USEPA		WRKSHT NO.: QTO-ALT-2

Description: Alternative 2 cost estimate backup calculations

RA2: In-Place Containment of Mercury Source Material using Covers

Construction Access Road

Length of Access Road, LF:	1,100	
Width of Access Road, LF:	15	
Total Area, SF:	16,500	
Depth of Gravel, FT:	0.5	
Volume of Fill Rock, CCY:	310	
Volume of Fill Rock, LCY:	360	
Volume of Fill Rock, TON:	590	

Covers

Total Area of Action Boundary, ACR:	2.1	
Total Area of Action Boundary, SF:	**91,500**	

Creek Bed Cover

Length of Furnace Creek, LF:	1,050	
Width of Creek Bed Cover, LF:	8	*Assumed*
Total Surface Area, SF:	**8,400**	*Creek Bed Cover*
Thickness of Bedding Layer, FT:	0.5	*6" thick*
Thickness of Riprap Layer, FT:	1.0	*12" thick*
Volume of Bedding Layer, CCY:	160	
Volume of Bedding Layer, LCY:	190	
Volume of Bedding Layer, TON:	310	
Volume of Riprap Layer, CCY:	310	
Volume of Riprap Layer, LCY:	360	
Volume of Riprap Layer, TON:	530	

Creek Bank Cover

Total Area of Armored Cover, SF:	24,600	*Calculated from Plan View Figures*
Total Surface Area, SF:	**16,200**	*Creek Bank Cover*
Hardened Cover, %:	60%	*Riprap*
Hardened Cover, %:	30%	*Cellular Confinement System with Riprap*
Vegetated Cover, %:	10%	*Cellular Confinement System*
Hardened Cover - Riprap, SF:	**9,720**	
Thickness of Bedding Layer, FT:	0.5	*6" thick*
Thickness of Riprap Layer, FT:	1.0	*12" thick*
Volume of Bedding Layer, CCY:	180	
Volume of Bedding Layer, LCY:	210	
Volume of Bedding Layer, TON:	340	
Volume of Riprap Layer, CCY:	360	
Volume of Riprap Layer, LCY:	410	
Volume of Riprap Layer, TON:	600	
Hardened Cover - Cellular Confinement System with Riprap, SF:	**4,860**	
Thickness of Bedding Layer, FT:	0.5	*6" thick*
Thickness of Riprap Layer, FT:	1.0	*12" thick*

PROJECT:	Furnace Creek, Black Butte Mine OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	3/21/2016
CLIENT:	USEPA			WRKSHT NO. :	QTO-ALT-2

Description: Alternative 2 cost estimate backup calculations

Volume of Bedding Layer, CCY:	90	
Volume of Bedding Layer, LCY:	100	
Volume of Bedding Layer, TON:	160	
Volume of Riprap Layer, CCY:	180	
Volume of Riprap Layer, LCY:	210	
Volume of Riprap Layer, TON:	310	
Vegetated Cover - Cellular Confinement System, SF:	**1,620**	
Thickness of Subsoil Layer, FT:	0.5	*6" thick*
Thickness of Growth Media Layer, FT:	0.5	*6" thick*
Volume of Subsoil Layer, CCY:	30	
Volume of Subsoil Layer, LCY:	40	
Volume of Growth Media Layer, CCY:	30	
Volume of Growth Media Layer, LCY:	40	
Total Surface Area to be Vegetated, ACR:	0.04	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	10	
Hydromulching, LB:	120	

Upland Cover

Total Surface Area, SF:	**66,900**	*Upland Cover*
Thickness of Subsoil, FT:	1.5	*18" thick*
Thickness of Growth Media, FT:	0.5	*6" thick*
Volume of Subsoil, CCY:	3,720	
Volume of Subsoil, LCY:	4,960	
Volume of Growth Media, CCY:	1,240	
Volume of Growth Media, LCY:	1,650	
Total Surface Area to be Vegetated, ACR:	1.5	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	210	
Hydromulching, LB:	4,500	

Run-On Swales

Total Length of Run-On Swales, LF:	1,500	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	220	
Total Surface Area, SF:	6,000	
Assumed Area to be Vegetated,%:	70%	
Assumed to be Armored,%:	30%	

PROJECT:	Furnace Creek, Black Butte Mine OU1	**COMPUTED BY :**	AIS	**CHECKED BY:**	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	**DATE :**	3/18/2016	**DATE CHECKED:**	3/21/2016
CLIENT:	USEPA			**WRKSHT NO. :**	QTO-ALT-2

Description: Alternative 2 cost estimate backup calculations

Total Surface Area to be Vegetated, SF:	4,200	
Total Surface Area to be Armored, SF:	1,800	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	70	
Volume of Riprap, LCY:	80	
Volume of Riprap, TON:	120	

Runoff Swales within Upland Covers

Total Length of Swales, LF:	750	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	110	
Total Surface Area, SF:	3,000	
Assumed Area to be Vegetated,%:	70%	
Assumed to be Armored,%:	30%	
Total Surface Area to be Vegetated, SF:	2,100	
Total Surface Area to be Armored, SF:	900	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	30	
Volume of Riprap, LCY:	30	
Volume of Riprap, TON:	40	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	20	
Hydromulching, LB:	440	

Post-Removal Site Control

	15%
Assumed Area to be Treated, SF:	10,035
Assumed Area to be Treated, ACR:	0.23
Fertilizer Amendment for Growth Media, LB/AC:	135
Hydromulching, LB/AC:	3,000
Fertilizer Amendment for Growth Media, LB:	40
Hydromulching, LB:	700

Grading Steep Slopes

Assume Depth, FT:	3
Area to be Graded, SF:	16,200
Volume to be Graded, BCY:	**1,500**

PROJECT:	Furnace Creek, Black Butte Mine OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	6/3/2016
CLIENT:	USEPA			WRKSHT NO. :	QTO-ALT-3

Description: Alternative RA3 cost estimate backup calculations

RA3: Excavation and Onsite Disposal of Mercury Source Material with Reclamation/Rehabilitation of Excavated Surfaces

Construction Access Road

Length of Access Road, LF:	1,100	
Width of Access Road, LF:	15	
Total Area, SF:	16,500	
Depth of Gravel, FT:	0.5	
Volume of Fill Rock, CCY:	310	
Volume of Fill Rock, LCY:	360	
Volume of Fill Rock, TON:	590	

Excavation

Total Volume Excavated

Percentage of Excavation Area, %	*Depth, FT*
70%	1
20%	3
10%	4

Total Area of Action Boundary, ACR:	2.1	
Total Area of Action Boundary, SF:	**91,500**	
Total Excavation Volume, CF	155,550	
Total Excavation Volume, BCY:	5,800	
Total Excavation Volume, LCY:	7,000	
Disposed Excavated Soil, CCY:	5,300	
Number of truck roundtrips, EA:	663	*See PD-ALT-3 for productivity calculations.*
Number of days, DAY:	29	*See PD-ALT-3 for productivity calculations.*
Number of trucks per day, EA/DAY:	23	*See PD-ALT-3 for productivity calculations.*

Dimensions of On-Site Disposal Repository

Length, FT:	160	
Width, FT:	130	
Foot Print of the Repository, SF:	20,800	
Total Surface Area, SF:	**22,200**	

Vegetated Simple Soil Cover

Total Surface Area, SF:	**22,200**	
Thickness of Subsoil, FT:	1.5	*18" thick*
Thickness of Growth Media, FT:	0.5	*6" thick*
Volume of Subsoil, CCY:	1,230	
Volume of Subsoil, LCY:	1,640	
Volume of Growth Media, CCY:	410	
Volume of Growth Media, LCY:	550	
Total Surface Area to be Vegetated, ACR:	0.5	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	70	
Hydromulching, LB:	1,500	

PROJECT: Furnace Creek, Black Butte Mine OU1	COMPUTED BY: AIS	CHECKED BY: EEW
JOB NO.: 106504.3126.004.13284.210.EEZ.01	DATE: 3/18/2016	DATE CHECKED: 6/3/2016
CLIENT: USEPA		WRKSHT NO.: QTO-ALT-3

Description: Alternative RA3 cost estimate backup calculations

Run-On Swales

Total Length of Run-On Swales, LF:	300	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	40	
Total Surface Area, SF:	1,200	
Assumed Area to be Vegetated,%:	70%	
Assumed to be Armored,%:	30%	
Total Surface Area to be Vegetated, SF:	840	
Total Surface Area to be Armored, SF:	360	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	10	
Volume of Riprap, LCY:	10	
Volume of Riprap, TON:	10	

Runoff Swales on Onsite Disposal Repository

Total Length of Swales, LF:	580	*Measured from Plan View Figures*
Depth of Swale, FT:	2	
Width of Swale, FT:	4	
Volume of Grading for Swales, BCY:	90	
Total Surface Area, SF:	2,320	
Assumed Area to be Vegetated,%:	70%	
Assumed to be Armored,%:	30%	
Total Surface Area to be Vegetated, SF:	1,624	
Total Surface Area to be Armored, SF:	696	
Depth of Riprap, FT:	1	
Volume of Riprap, CCY:	30	
Volume of Riprap, LCY:	30	
Volume of Riprap, TON:	40	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	10	
Hydromulching, LB:	170	

Rehabilitation of Excavated Areas

Length of Furnace Creek, LF:	1,050	
Width of Rehabilitation FT:	16	*Assumed*
Total Surface Area, SF:	**16,800**	
Thickness of Bedding Layer, FT:	0.5	*6" thick*
Thickness of River-Rock Layer, FT:	0.5	*6" thick*

Description: Alternative RA3 cost estimate backup calculations

Volume of Bedding Layer, CCY:	310	
Volume of Bedding Layer, LCY:	360	
Volume of Bedding Layer, TON:	590	
Volume of River-Rock Layer, CCY:	310	
Volume of River-Rock Layer, LCY:	360	
Volume of River-Rock Layer, TON:	530	

Reclamation of Excavated Areas

Total Surface Area, SF:	**74,700**	
Thickness of Growth Media, FT:	0.5	*6" thick*
Volume of Growth Media, CCY:	1,380	
Volume of Growth Media, LCY:	1,840	
Total Surface Area to be Vegetated, ACR:	1.7	
Fertilizer Amendment for Growth Media, LB/AC:	135	
Hydromulching, LB/AC:	3,000	
Fertilizer Amendment for Growth Media, LB:	230	
Hydromulching, LB:	5,100	

Post-Removal Site Control

Assumed Percentage of Reclamation:	5%
Assumed Area to be Treated, SF:	4,845
Assumed Area to be Treated, ACR:	0.11
Fertilizer Amendment for Growth Media, LB/AC:	135
Hydromulching, LB/AC:	3,000
Fertilizer Amendment for Growth Media, LB:	20
Hydromulching, LB:	340

PROJECT:	Furnace Creek, Black Butte Mine OU1	COMPUTED BY :	AIS	CHECKED BY:	EEW
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	3/18/2016	DATE CHECKED:	3/21/2016
CLIENT:	USEPA			WRKSHT NO. :	PD-ALT-3

Description: Excavation and hauling productivity determinations for Alternative RA3.

Productivity Determinations - Excavation and Hauling for Onsite Disposal

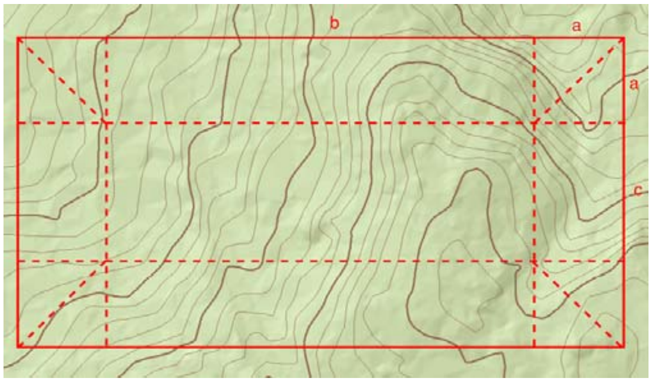
Excavator Productivity Determination		***Hauling Productivity Determination***	
Hours per Shift, HR/DY:	8	**Hours per Shift, HR/DY:**	8
Material bulking factor:	1.20	**Material Bulking Factor:**	1.20
Assumed Bucket Capacity, CY:	**2**	**Assumed Payload Capacity, LCY:**	**14**
Work Efficiency, %:	**50%**	**Work Efficiency, %:**	**50%**
Operator Ability Correction Factor:	**0.9**	**Estimated haul distance, MI:**	**1**
Bucket Fill Factor, %:	**75%**	**Payload Fill Factor:**	**75%**

Summary	**Number**	**Prod**	**Units**
Excavator	1	25.0	BCY/HR
Highway Haul Trucks	3	30.2	LCY/HR
Total number of roundtrip trucks	663	EA	
Estimated time to complete	29	DY	
Number of trucks per day	23	EA/DY	

Bucket Size	2	CY	Assumed Payload Capacity	8.75	BCY/truck
Bucket Fill Factor	75%	%		10.50	LCY/truck
Bucket Payload	1.5	CY			
Load Time	**7**	SEC	Adjusted Loader (1) Productivity	30.0	LCY/HR
Swing Time Loaded	**6**	SEC	Load Time per Truck	21.0	MIN
Dump Time	**3**	SEC	Assumed Average Haul Speed	**20**	MPH
Swing Time Unloaded	**5**	SEC	On Road Haul Time	3.0	MIN
Truck Exchange	**60**	SEC	Dump and Maneuver Time	**1.0**	MIN
Total	81	SEC/cycle	Assumed Average Return Speed	**20**	MPH
Cycle Time Per Excavator	1.350	MIN/cycle	On Road Return Time	3.0	MIN
	0.0225	HR/cycle	Cycle Time per Truck	28.0	MIN/cycle
Ideal Cycles Per Day	356	Cyc/Exc/DY		0.47	HR/cycle
Ideal Loader Productivity	66.7	LCY/HR	Ideal Cycles Per Day	17.0	Cyc/Truck/DY
	55.6	BCY/HR	Ideal Productivity per Truck	22.3	LCY/HR
Operator Ability Correction Factor	0.9				
Work Efficiency	50%	%	Work Efficiency	50%	%
Adjusted Loader Productivity	30.0	LCY/HR	Adjusted Productivity per Truck	11.1	LCY/HR
	25	BCY/HR			
Number of Excavators Anticipated	**1**		Number of Haul Trucks Anticipated	**3**	
Total Excavator Productivity	30.0	LCY/HR	Total Hauling Productivity	33.3	LCY/HR
	25	BCY/HR			
Volume to Excavate	5,800	BCY	Volume to Export	7,000	LCY
	7,000	LCY			
Excavation Time	232	HR	Hauling Time	210	HR
Haul Time	210	HR	Load Time	232	HR
Est total time to completion	232	HR	Est total time to completion	232	HR
	29	DY		29	DY
Imp. excavator productivity	**25.0**	**BCY/HR**	**Imp. hauling productivity**	**30.2**	**LCY/HR**

Consolidation Area 1:

1. Capacity of Onsite Repository:



Assume:

1. Maximum height of Waste Material:	12	ft
2. Slope	40%	
Total Length, FT:	160	(L)
Total Width, FT:	130	(W)
Total Foot Print, SF:	20,800	

Total Capacity

Calculations:

a=	30 FT
b=	100 FT
c=	70 FT
h=	12 FT

a. Pyramid

V= (2*a)^2*h/3

V= 14,400 ft^3

b. Large Wedge X2

V= 0.5*a*h*b*2

V= 36,000 ft^3

c. Small Wedge X2

V= 0.5*a*h*c*2

V= 25,200 ft^3

d. Rectangular Prism

V= b*c*h

V= 84,000 ft^3

$V_{CapacityCon1}$= 159,600 ft^3

V_{Con1} = 159,600 ft^3

Volume Check = **Good**

2. Onsite Repository:

Volume of Waste - Site

V_{waste} = 143,100 ft^3

$V_{capacity\ needed}$ = 143,100 ft^3

3. Surface Areas of Onsite Repository:

Slope Height, FT: 33

Surface Area Calculations:

a, Small Trapezoids

SA= 2*0.5*(c+(c+2a))*slope height

b. Large Trapezoids

SA= 2*0.5*(b+(b+2a))*slope height

c. Rectangle

SA= b*c

Small Trapezoids, SF:	6,600
Large Trapezoids, SF:	8,580
Top Rectangle, SF:	7,000
Total Surface Area=	**22,200**

Cost Estimate Backup

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TABLE PV-ADRFT

PRESENT VALUE ANALYSIS

Annual Discount Rate Factors Table

Site: Furnace Creek, Black Butte Mine OU1
Location: Lane County, Oregon
Phase: EE/CA
Base Year: 2016

Discount Rate (Percent):		7.0	
Year	**Discount Factor[1,2]**	**Year**	**Discount Factor[1,2]**
0	1.0000	26	0.1722
1	0.9346	27	0.1609
2	0.8734	28	0.1504
3	0.8163	29	0.1406
4	0.7629	30	0.1314
5	0.7130	31	0.1228
6	0.6663	32	0.1147
7	0.6227	33	0.1072
8	0.5820	34	0.1002
9	0.5439	35	0.0937
10	0.5083	36	0.0875
11	0.4751	37	0.0818
12	0.4440	38	0.0765
13	0.4150	39	0.0715
14	0.3878	40	0.0668
15	0.3624	41	0.0624
16	0.3387	42	0.0583
17	0.3166	43	0.0545
18	0.2959	44	0.0509
19	0.2765	45	0.0476
20	0.2584	46	0.0445
21	0.2415	47	0.0416
22	0.2257	48	0.0389
23	0.2109	49	0.0363
24	0.1971		
25	0.1842		

Notes:

1 Annual discount factors were calculated using the formulas and guidance presented in Section 4.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

2 The real discount rate of 7.0% was obtained from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, Page 4-5.

COST INDICES FOR ESCALATION

Base Year for Work: **2016**

Year	Cost Index[1]
1990	398.34
1991	406.78
1992	415.22
1993	427.83
1994	439.45
1995	452.31
1996	462.16
1997	472.17
1998	478.10
1999	486.21
2000	497.07
2001	503.52
2002	517.46
2003	529.95
2004	571.29
2005	608.36
2006	641.91
2007	673.52
2008	716.54
2009	703.00
2010	724.17
2011	756.48
2012	773.75
2013	787.64
2014	804.05
2015	804.78
2016	815.68
2017	830.36
2018	846.14
2019	863.06
2020	880.32
2021	897.93
2022	915.88
2023	934.20
2024	952.89
2025	971.94

1 Yearly composite cost index (weighted average) from the U.S. Army Corps of Engineers Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304 31 March 2012. Revised 30 September 2015.

SalaryExpert Cost Sources

Base Year: 2016

COST CODES FOR LABOR AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
L1	Blast Foreman	HR	(b) (6)	$0.00	$0.00	$0.00	2016	1.00	1	#VALUE!	$0.00	$0.00	$0.00	100%	9%	-	-	
L2	Project Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$42.32	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-2081.00 L3	
L3	Civil Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$40.38	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-2051.00 L3	
L4	Clerks, Typist, Bookkeeper & Receptionist	HR		$0.00	$0.00	$0.00	2016	1.00	1	$16.41	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 43-9061.00 L4	
L5	Safety Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$47.40	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-2111.00 L4	
L6	Environmental Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$42.32	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-2081.00 L3	
L7	Environmental Lawyer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$42.00	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 23-1011.00 L3	
L8	Environmental Scientist	HR		$0.00	$0.00	$0.00	2016	1.00	1	$31.16	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 19-2041.00 L3	
L9	Field Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$29.96	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-3022.00 L4	
L10	Field Draftsmen	HR		$0.00	$0.00	$0.00	2016	1.00	1	$22.90	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-3011.00 L3	
L11	Field Technician	HR		$0.00	$0.00	$0.00	2016	1.00	1	$32.49	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-3025.00 L3	
L12	Geologist	HR		$0.00	$0.00	$0.00	2016	1.00	1	$34.34	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 19-2042.00 L3	
L13	General Superintendent (P.M.)	HR		$0.00	$0.00	$0.00	2016	1.00	1	$36.98	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 11-9021.00 L3	
L14	Hydrogeologist	HR		$0.00	$0.00	$0.00	2016	1.00	1	$34.34	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 19-2042.00 L3	
L15	Mechanical Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	--	$0.00	$0.00	$0.00	100%	9%	-	-	
L16	Project Manager	HR		$0.00	$0.00	$0.00	2016	1.00	1	$48.69	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 11-9041.00 L3	
L17	Quality Control Engineer	HR		$0.00	$0.00	$0.00	2016	1.00	1	$41.18	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 11-3051.01 L3	
L18	Surveyors	HR		$0.00	$0.00	$0.00	2016	1.00	1	$32.87	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 17-1022.00 L2	
L19	Paralegal	HR		$0.00	$0.00	$0.00	2016	1.00	2	$52.52	$0.00	$0.00	$0.00	100%	9%	FLC Wage	FLC 23-2011.00 L3	
L20	Electrician	HR		$0.00	$0.00	$0.00	2016	1.00	1	--	$0.00	$0.00	$0.00	100%	9%	-	-	
L21	Plumber	HR		$0.00	$0.00	$0.00	2016	1.00	1	$42.11	$0.00	$0.00	$0.00	100%	9%	Davis-Bacon	NJ160027 (Residential) - PLUM0290-008	
L22	Site Manager/Operator	HR		$0.00	$0.00	$0.00	2016	1.00	1	--	$0.00	$0.00	$0.00	0%	0%	-	-	
L23	General Operator/Technician	HR		$0.00	$0.00	$0.00	2016	1.00	1	--	$0.00	$0.00	$0.00	0%	0%	-	-	

Base Year: 2016

COST CODES FOR MATERIAL AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
M2A	Standbox with Sediment Filter and Piping	EA	$0.00	$0.00	$7,500.00	$0.00	2016	1	1	$0.00	$0.00	$7,500.00	$0.00	8%	9%	P	Previous Work	
M3A	Subsoil, Delivered	CY	$0.00	$0.00	$21.25	$0.00	2016	1	1	$0.00	$0.00	$21.25	$0.00	8%	9%	V	Vendor Quote	Includes purchase and delivery
M3B	Growth Media Delivered	CY	$0.00	$0.00	$27.50	$0.00	2016	1	1	$0.00	$0.00	$27.50	$0.00	8%	9%	V	Vendor Quote	Includes purchase and delivery
M6A	Riprap/River-Rock, Delivered	TON	$0.00	$0.00	**$36.50**	$0.00	2016	1	1	$0.00	$0.00	$36.50	$0.00	8%	9%	V	Vendor Quote	Includes purchase and delivery to the Site.
M6B	Rock/Gravel/Fill Material, Delivered	TON	$0.00	$0.00	**$12.50**	$0.00	2016	1	1	$0.00	$0.00	$12.50	$0.00	8%	9%	V	Vendor Quote	Includes purchase and delivery to the Site.
M8	Seed Mix	ACR	$0.00	$0.00	**$210.00**	$0.00	2016	1	1	$0.00	$0.00	$210.00	$0.00	8%	9%	P	Previous Work	Materials only, 32 lbs/acre
M8A	Seed Mix	SF	$0.00	$0.00	**$0.01**	$0.00	2016	1	1	$0.00	$0.00	$0.01	$0.00	8%	9%	P	Previous Work	Materials only, 32 lbs/acre
M9A	Fertilizer (N2 and P2O5)	LB	$0.00	$0.00	**$0.75**	$0.00	2016	1	1	$0.00	$0.00	$0.75	$0.00	8%	9%	V	Vendor Quote	
M10A	Hydromulching	LB	$0.00	$0.00	**$0.35**	$0.00	2016	1	1	$0.00	$0.00	$0.35	$0.00	8%	9%	V	Vendor Quote	
M10B	Magnesium Chloride	LB	$0.00	$0.00	**$0.50**	$0.00	2016	1	1	$0.00	$0.00	$0.50	$0.00	8%	9%	V	Vendor Quote	
M10C	Tackifier	LB	$0.00	$0.00	**$0.35**	$0.00	2016	1	1	$0.00	$0.00	$0.35	$0.00	8%	9%	V	Vendor Quote	
M13	Community Awareness Activities Allowance	EA	$0.00	$0.00	$0.00	**$5,000.00**	2016	1	1	$0.00	$0.00	$0.00	$5,000.00	0%	0%	A	Allowance	1 meeting per 5-yr review.
M18	Articulating Concrete Blocks	SF	$0.00	$0.00	$5.62	$0.00	2015	1.02	1	$0.00	$0.00	$5.73	$0.00	8%	9%	V	Vendor Quote	Includes geotextile fabric
M18A	Concrete Blocks	EA	$0.00	$0.00	$45.00	$0.00	2016	1	1	$0.00	$0.00	$45.00	$0.00	8%	9%	V	Vendor Quote	2' x 2' x 6' Concrete block
M18B	Concrete Blocks Delivery	LS	$0.00	$0.00	$0.00	$1,000.00	2016	1	1	$0.00	$0.00	$0.00	$1,000.00	8%	9%	A	Allowance	
M27	Copy and Shipping Allowance	LS	$0.00	$0.00	$0.00	**$2,000**	2016	1	1	$0.00	$0.00	$0.00	$2,000.00	0%	0%	A	Allowance	
M27A	Copy and Shipping Allowance	LS	$0.00	$0.00	$0.00	**$1,000**	2016	1	1	$0.00	$0.00	$0.00	$1,000.00	0%	0%	A	Allowance	
M33A	Organic Material, Delivered	LCY	$0.00	$0.00	**$23.00**	$0.00	2016	1	1	$0.00	$0.00	$23.00	$0.00	8%	9%	V	Vendor Quote	
M36	Supplies, Copying and Shipping Allowance	LS	$0.00	$0.00	$0.00	**$7,500.00**	2016	1	1	$0.00	$0.00	$0.00	$7,500.00	0%	0%	A	Allowance	
M37	Signs, Sign Post	EA	$0.00	$0.00	**$32.50**	$0.00	2016	1	1	$0.00	$0.00	$32.50	$0.00	8%	9%	CW	RS Means	Assume 250 FT apart
M37A	Signs	EA	$0.00	$0.00	**$57.50**	$0.00	2016	1	1	$0.00	$0.00	$57.50	$0.00	8%	9%	CW	RS Means	Assume 250 FT apart
M41	Silt Fence	LF	$0.79	$0.13	$0.25	$0.00	2016	1	1	$0.79	$0.13	$0.25	$0.00	8%	9%	CW	RS Means	
M42	Hay Bales	LF	$0.39	$0.10	$3.53	$0.00	2016	1	1	$0.39	$0.10	$3.53	$0.00	8%	9%	CW	RS Means	
M43	Erosion Control Blankets	SY	$0.39	$0.13	$1.00	$0.00	2016	1	1	$0.39	$0.13	$1.00	$0.00	8%	9%	CW	RS Means	
M89	Geotextile	SF	$0.00	$0.00	**$0.15**	$0.00	2014	1.02	1	$0.00	$0.00	$0.15	$0.00	8%	9%	V	Vendor Quote	Delivered cost
M89A	Geotubes	EA	$0.00	$0.00	**$6,000.00**	$0.00	2016	1	1	$0.00	$0.00	$6,000.00	$0.00	8%	9%	V	Vendor Quote	Delivered cost
M89B	Geoweb System	SF	$0.00	$0.00	**$1.60**	$0.00	2011	1.08	1	$0.00	$0.00	$1.73	$0.00	8%	9%	V	Vendor Quote	Delivered cost
M102	Erosion Repair Material Allowance	LS	$0.00	$0.00	$0.00	**$2,500.00**	2016	1	1	$0.00	$0.00	$0.00	$2,500.00	0%	0%	A	Allowance	Includes costs for materials to repair diversion ditches and soil cover materials.
M103	Erosion Repair Material Allowance	LS	$0.00	$0.00	$0.00	**$5,000.00**	2016	1	1	$0.00	$0.00	$0.00	$5,000.00	0%	0%	A	Allowance	Includes costs for materials to repair diversion ditches and soil cover materials.
M104	Installation of Woody Revetments, Allowance	LS	$0.00	$0.00	$0.00	**$7,500.00**	2016	1	1	$0.00	$0.00	$0.00	$7,500.00	0%	0%	A	Allowance	
M118	Per Diem for 3 Person	DY	$0.00	$0.00	$0.00	**$495.00**	2016	1	1	$0.00	$0.00	$0.00	$495.00	0%	0%	GSA	www.gsa.gov	
M119	Per Diem for 2 Person	DY	$0.00	$0.00	$0.00	**$330.00**	2016	1	1	$0.00	$0.00	$0.00	$330.00	0%	0%	GSA	www.gsa.gov	
M120	Per Diem for 1 Person	DY	$0.00	$0.00	$0.00	**$165.00**	2016	1	1	$0.00	$0.00	$0.00	$165.00	0%	0%	GSA	www.gsa.gov	
M126A	XRF, Rental	MO	$0.00	$0.00	$0.00	**$3,600.00**	2016	1	1	$0.00	$0.00	$0.00	$3,600.00	8%	9%	V	Vendor Quote	
M131	Document Submission and Recording Allowance	EA	$0.00	$0.00	$0.00	**$250**	2016	1	1	$0.00	$0.00	$0.00	$250.00	0%	0%	A	Allowance	
M132	Surveying Report Allowance	LS	$0.00	$0.00	$0.00	**$15,000.00**	2016	1	1	$0.00	$0.00	$0.00	$15,000.00	0%	0%	A	Allowance	
M133	Surveying Report Allowance	LS	$0.00	$0.00	$0.00	**$5,000.00**	2016	1	1	$0.00	$0.00	$0.00	$5,000.00	0%	0%	A	Allowance	

Base Year: 2016

COST CODES FOR SUBCONTRACTORS AND UNIT COSTS

Cost Code	Work or Material Description	Description for Cost Worksheets	Units	Unit Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Unit Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
S1A	Blasting Rock	Blasting Rock- Deadwood Formation	BCY	**$9.00**	2007	1.22	1	$10.98	8%	9%	P	Previous Work	Includes blasting equipment, material and labor
S1B	Blasting Rock	Blasting Rock- Rock Borrow Area	BCY	**$13.00**	2007	1.22	1	$15.86	8%	9%	P	Previous Work	Includes blasting equipment, material and labor
S2A	ARD Collection - Vault and Manhole Installation	ARD Collection - Vault and Manhole Installation	LS	**$526,500.00**	2006	1.28	1	$673,920.00	0%	0%	P	Previous Work	Includes all material and installation costs
S3A	ARD Pump House Construction	ARD Pump House Construction	LS	**$469,200.00**	2006	1.28	1	$600,576.00	0%	0%	P	Previous Work	Includes all material and installation costs for building, pump control, monitoring, electrical system, foundation, HVAC, lightning protection and pipes and fittings.
S4A	Installation of Power Line	Power Line Installation	LF	**$26.95**	2005	1.35	1	$36.38	0%	0%	P	Previous Work	Power line; 3-phase 7200/12470 Volts. Includes costs for material, equipment and labor.
S5A	Mobilization and Preparatory Work	Mobilization/Demobilization and Preparatory Work	EA	**$623,727.34**	2002	1.58	1	$985,489.20	0%	0%	P	Previous Work	Assumes remobilization for each construction season
S6A	Placement and Installation of Geoweb System	Placement and Installation of Geoweb System	SF	**$0.85**	2011	1.08	1	$0.92	0%	0%	P	Previous Work	

Base Year: 2016

COST CODES FOR MII ASSEMBLIES AND UNIT COSTS

Cost Code	Work or Material Description	Description for Cost Worksheets	Units	MII Unit Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted MII Unit Cost	PC OH	PC PF	Cost Source Source	 Source ID	Comments
A1A	Site Operations and Maintenance	Site Operations and Maintenance	DY	$1,480.53	2016	1.00	1	$1,480.53	8%	9%	MII	MII Assemblies	
A1B	Onsite Supervisory Staff - Crew of 1	Onsite Supervisory Staff - Crew of 1	DY	$353.25	2016	1.00	1	$353.25	100%	9%	MII	MII Assemblies	
A1C	Onsite Supervisory Staff - Crew of 2	Onsite Supervisory Staff - Crew of 2	DY	$644.93	2016	1.00	1	$644.93	100%	9%	MII	MII Assemblies	
A2A	General Site Work	General Site Work	HR	$74.22	2016	1.00	1	$74.22	8%	9%	MII	MII Assemblies	
A5A	Dust Control	Dust Control	HR	$115.45	2016	1.00	1	$115.45	8%	9%	MII	MII Assemblies	
A9A	Excavation - Swales	Excavation - Swales	BCY	**$2.22**	2016	1.00	1	$2.22	8%	9%	MII	MII Assemblies	
A9AA	Excavation	Excavation	BCY	**$5.92**	2016	1.00	1	$5.92	8%	9%	MII	MII Assemblies	
A12A	Material Loading	Material Loading	LCY	**$1.61**	2016	1.00	1	$1.61	8%	9%	MII	MII Assemblies	
A16A	Riprap Placement	Riprap Placement	LCY	**$10.19**	2016	1.00	1	$10.19	8%	9%	MII	MII Assemblies	
A16B	Articulating Concrete Blocks Placement	Articulating Concrete Blocks Placement	SF	**$1.76**	2016	1.00	1	$1.76	8%	9%	MII	MII Assemblies	Includes geotextile fabric
A16C	Temporary Retaining Wall Placement	Temporary Retaining Wall Placement	EA	**$2,594.19**	2016	1.00	1	$2,594.19	8%	9%	MII	MII Assemblies	
A17A	Fill Placement - Mass Fill Areas	Fill Placement - Mass Fill Areas	LCY	**$4.55**	2016	1.00	1	$4.55	8%	9%	MII	MII Assemblies	
A17AA	Fill Placement - Mass Fill Areas	Fill Placement - Top Soil	LCY	**$4.55**	2016	1.00	1	$4.55	8%	9%	MII	MII Assemblies	
A17B	Excavated Material Placement - Mass Fill Areas	Excavated Material Placement	LCY	**$4.55**	2016	1.00	1	$4.55	8%	9%	MII	MII Assemblies	Placement of excavated materials within the repository
A18A	Fill Placement - Constrained Areas	Fill Placement - Constrained Areas	LCY	**$5.81**	2016	1.00	1	$5.81	8%	9%	MII	MII Assemblies	
A19AA	Geotextile Installation	Geotextile Installation	SF	**$0.16**	2014	1.02	1	$0.16	8%	9%	MII	MII Assemblies	Installation only, no material cost
A21A	Compaction - Fill	Compaction - Fill	CCY	**$1.51**	2016	1.00	1	$1.51	8%	9%	MII	MII Assemblies	Compacting embankment and subgrade
A22A	Compaction - Small Areas	Compaction - Small Areas	CCY	**$6.28**	2016	1.00	1	$6.28	8%	9%	MII	MII Assemblies	
A28A	Short Haul	Short Haul	LCY	**$1.39**	2016	1.00	1	$1.39	8%	9%	MII	MII Assemblies	Assume 0.5 mile haul
A29A	Short Haul - Onsite Disposal	Short Haul - Onsite Disposal	LCY	**$3.84**	2016	1.00	1	$3.84	8%	9%	MII	MII Assemblies	To facility outside of PMDA
A42A	Hydro-Seeding	Hydro-Seeding Crew	ACR	**$349.36**	2016	1.00	1	$349.36	8%	9%	MII	MII Assemblies	
A42AA	Surficial Treatment	Surficial Treatment	ACR	**$349.36**	2016	1.00	1	$349.36	8%	9%	MII	MII Assemblies	
A42B	Hydro-Seeding	Hydro-Seeding Crew	SF	**$0.01**	2016	1.00	1	$0.01	8%	9%	MII	MII Assemblies	
A43A	Sampling Crew w/ 2 Technicians	Sampling Crew - 2 Technicians	DY	**$632.64**	2016	1.00	1	$632.64	100%	9%	MII	MII Assemblies	
A43AA	Sampling Crew w/ 1 Technician	Sampling Crew - 1 Technician	DY	**$316.32**	2016	1.00	1	$316.32	100%	9%	MII	MII Assemblies	
A44A	Site Inspection Crew	Site Inspection Crew	HR	**$100.99**	2016	1.00	1	$100.99	100%	9%	MII	MII Assemblies	
A49B	Rough Grading	Rough Grading	SF	**$0.07**	2016	1.00	1	$0.07	8%	9%	MII	MII Assemblies	
A49B1	Rough Grading	Rough Grading	ACR	**$3,125.17**	2016	1.00	1	$3,125.17	8%	9%	MII	MII Assemblies	
A49B2	Grading Steep Slopes	Grading Steep Slopes	BCY	**$9.13**	2016	1.00	1	$9.13	8%	9%	MII	MII Assemblies	
A49C	Rough Grading - Access Road	Rough Grading - Access Road	SF	**$0.14**	2016	1.00	1	$0.14	8%	9%	MII	MII Assemblies	
A50B	Sign Installation	Sign Installation Crew	EA	**$32.00**	2016	1.00	1	$32.00	8%	9%	MII	MII Assemblies	
A51A	Clearing and Grubbing	Clearing and Grubbing	ACR	**$12,083.19**	2016	1.00	1	$12,083.19	8%	9%	MII	MII Assemblies	
A54B	Standbox with Sediment Filter	Standbox with Sediment Filter	EA	**$633.45**	2016	1.00	1	$633.45	8%	9%	MII	MII Assemblies	
A55AA	Silt Fence Installation	Silt Fence Installation	LF	**$1.06**	2012	1.06	1	$1.12	8%	9%	MII	MII Assemblies	
A56A	Hay Bale	Hay Bale	HR	**$166.38**	2012	1.06	1	$176.36	8%	9%	MII	MII Assemblies	
A56AA	Hay Bale	Hay Bale	LF	**$0.53**	2012	1.06	1	$0.56	8%	9%	MII	MII Assemblies	
A57A	Rolled Erosion Control	Rolled Erosion Control	HR	**$125.33**	2012	1.06	1	$132.85	8%	9%	MII	MII Assemblies	
A57AA	Rolled Erosion Control	Rolled Erosion Control	SY	**$1.95**	2012	1.06	1	$2.07	8%	9%	MII	MII Assemblies	
A58A	Tractor w/Low Bed Trailer	Tractor Trailer- Heavy Equipment	HR	**$110.61**	2012	1.06	1	$117.25	8%	9%	MII	MII Assemblies	
A59A	Tractor w/Low Bed Trailer	Tractor Trailer - Large Equipment	HR	**$105.68**	2012	1.06	1	$112.02	8%	9%	MII	MII Assemblies	
A60A	Self-Propelled Equipment	Self-Propelled Equipment	HR	**$51.27**	2012	1.06	1	$54.35	8%	9%	MII	MII Assemblies	
A61A	Pilot Car w/Driver	Pilot Car w/Driver	HR	**$51.27**	2012	1.06	1	$54.35	8%	9%	MII	MII Assemblies	
A62A	Cap O&M	Cap O&M	DAY	**$478.12**	2012	1.06	1	$506.81	8%	9%	MII	MII Assemblies	
A63A	Survey	Survey	DAY	**$469.38**	2012	1.06	1	$497.54	100%	9%	MII	MII Assemblies	
A64A	Water Truck Operation	Water Truck Operation	DAY	**$1,152.86**	2012	1.06	1	$1,222.03	8%	9%	MII	MII Assemblies	

CDM Smith

PROJECT:	Black Butte Mine	COMPUTED BY :	EW	CHECKED BY:	AIS
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	2/24/2016	DATE CHECKED:	2/24/2016
CLIENT:	USEPA			WRKSHT NO. :	EQ-01

Description: Determination of backup for equipment rate updates. Information presented should represent the information that is used to update the project's MII equipment library. Region specific factors and shipping rates can be found in the region specific *Construction Equipment Ownership and Operating Expense Schedule* (EP 1110-1-8 - http://www.nww.usace.army.mil/Missions/CostEngineering.aspx).

Library Detail

Area Location: 08 NORTHWEST
Title: EP14R08
Note: 2014 Region 8 equipment library updated with current COM and area specific sales tax, electricity, gas, and diesel fuel costs for Lane County, Oregon.

Factors

Sales Tax, %:	**0.00**	*State and local sales tax rate - search internet*
Working Hours/Year (WHPY), HR/YR:	**1,540**	*See region specific Construction Equipment Ownership and Operating Expense Schedule (EP 1110-1-8)*
Labor Adjustment Factor:	**1.06**	*See region specific Construction Equipment Ownership and Operating Expense Schedule (EP 1110-1-8)*
COM, %:	**2.5**	*https://www.fiscal.treasury.gov/fsservices/gov/pmt/promptPayment/promptPayment_home.htm*
COM Disc., %:	**25**	*See region specific Construction Equipment Ownership and Operating Expense Schedule (EP 1110-1-8)*

Fuels

Electricity, $/KWH:	**$0.088**	*http://www.eia.gov/electricity/monthly/*	*See Table 5.6.A - End-Use Sector, by State - commercial rate*
Gas, $/GAL:	**$1.876**	*http://fuelgaugereport.aaa.com/todays-gas-prices/*	
Federal Diesel Tax, $/GAL:	$0.244		
State Diesel Tax, $/GAL:	$0.303	*http://www.api.org/Oil-and-Natural-Gas-Overview/Industry-Economics/Fuel-Taxes*	
Diesel (Off-Road), $/GAL:	**$1.421**	*On-Road diesel minus fuel taxes*	
Diesel (On-Road), $/GAL:	**$1.968**	*http://fuelgaugereport.aaa.com/todays-gas-prices/*	

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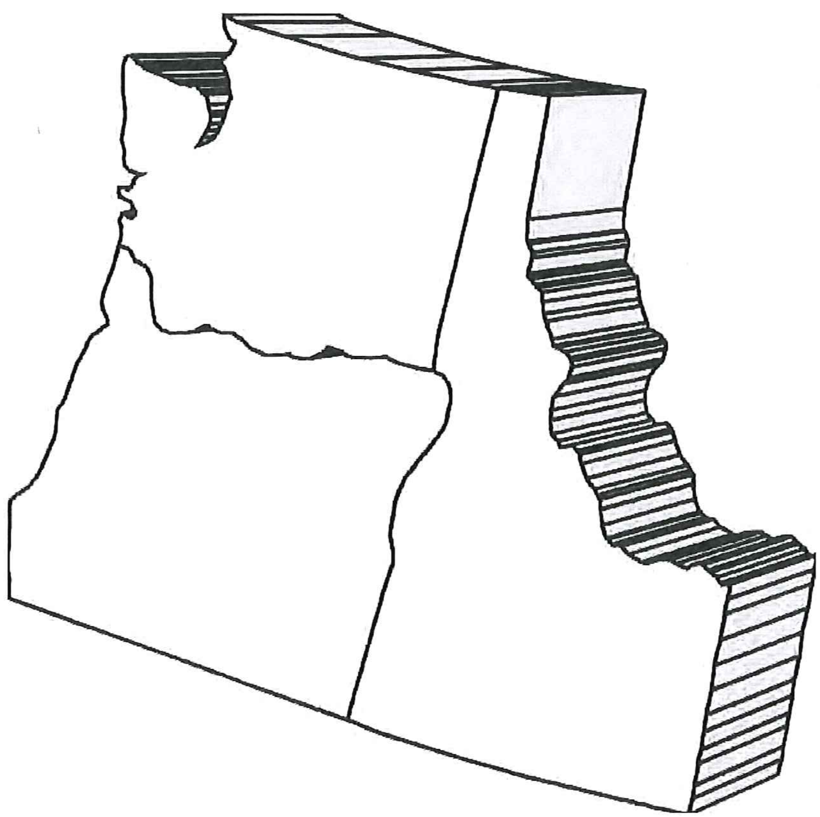
US Army Corps
of Engineers®

EP 1110-1-8
Volume 8
April 2014

Construction Equipment Ownership and Operating Expense Schedule

Region VIII



APPENDIX B

AREA FACTORS

NORTHWEST

Region: 8

Total State Sales or Import Tax Rate:	6.05%	
Working Hours Per Year (WHPY):	1,540	hrs/yr
Labor Adjustment Factor (LAF):	1.06	
Electricity Cost Per Kilowatt-Hour:	$0.078	/kW-Hr
Gasoline Cost Per Gallon:	$3.85	/gal
Diesel Cost Per Gallon (Off-Road Use):	$3.54	/gal
Diesel Cost Per Gallon (On-Road Use):	$4.07	/gal
Cost-of-Money Rate (Full Rate):	2.125%	
Cost-of-Money Rate (Adjusted):	1.700%	

Freight Rates

over	0	cwt	thru	240	$30.86
over	240	cwt	thru	300	$29.05
over	300	cwt	thru	400	$26.59
over	400	cwt	thru	500	$24.30
over	500	cwt	thru	700	$11.26
over	700	cwt	thru	800	$9.51
over	800	cwt	thru	99,999	$6.48

U.S. Energy Information Administration

Electric Power Monthly

Data for November 2015 | **Release Date:** January 26, 2016 | **Next Release:** February 26, 2016
|

Previous Issues

Issue: December 2015 Format: pdf Go

Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector,

by State, November 2015 and 2014 (Cents per Kilowatthour)

	Residential		Commercial		Industrial		Transportation		All Sectors	
Census Division and State	**November 2015**	**November 2014**	**November 2015**	**November 2014**	**November 2015**	**November 2014**	**November 2015**	**November 2014**	**November 2015**	**November 2014**
New England	**18.43**	**18.02**	**14.59**	**14.00**	**11.94**	**11.02**	**8.78**	**10.66**	**15.53**	**14.97**
Connecticut	20.01	20.02	15.23	15.18	13.01	12.40	11.43	14.07	16.86	16.84
Maine	15.55	15.75	13.18	12.57	8.78	8.19	--	--	12.81	12.43
Massachusetts	18.32	17.61	14.52	13.68	12.96	11.70	6.68	8.96	15.54	14.69
New Hampshire	18.15	18.18	14.39	14.20	12.66	11.33	--	--	15.49	15.24
Rhode Island	18.63	16.68	14.54	13.19	13.25	11.96	18.33	15.00	15.97	14.32
Vermont	17.66	17.09	14.59	14.70	9.99	10.03	--	--	14.45	14.40
Middle Atlantic	**16.17**	**16.07**	**13.16**	**12.96**	**7.44**	**7.07**	**11.33**	**11.53**	**12.91**	**12.76**
New Jersey	15.64	15.59	13.01	12.17	10.45	10.16	10.42	10.44	13.60	13.22
New York	18.30	19.45	15.33	15.29	7.20	6.24	12.21	12.55	15.11	15.34
Pennsylvania	14.40	13.20	9.53	9.54	7.05	6.97	8.35	7.76	10.30	9.94
East North Central	**13.30**	**12.95**	**9.88**	**10.08**	**6.81**	**6.93**	**7.63**	**8.35**	**9.83**	**9.87**
Illinois	13.19	12.62	8.83	9.15	6.15	6.56	7.18	7.95	9.32	9.41
Indiana	11.65	11.63	9.60	10.24	6.67	6.92	10.30	11.65	8.79	9.09
Michigan	14.68	14.38	10.55	10.87	6.92	7.43	11.64	11.66	10.72	10.86
Ohio	13.00	12.89	10.19	10.07	7.14	6.72	11.92	12.39	10.03	9.88
Wisconsin	14.19	13.59	10.60	10.62	7.44	7.43	--	--	10.58	10.50
West North Central	**11.38**	**10.66**	**8.83**	**8.78**	**6.45**	**6.24**	**8.61**	**8.37**	**8.85**	**8.58**
Iowa	11.42	10.34	8.21	7.83	5.18	4.73	--	--	7.48	7.05
Kansas	12.79	12.25	9.85	10.11	7.29	7.64	--	--	9.92	10.01
Minnesota	12.05	11.72	9.14	9.51	7.14	6.47	9.54	9.24	9.42	9.17
Missouri	11.04	10.09	8.56	8.21	5.77	5.67	7.38	7.08	8.88	8.43
Nebraska	10.53	10.09	8.44	8.22	6.86	6.98	--	--	8.46	8.35
North Dakota	9.31	8.65	8.42	8.43	8.00	7.78	--	--	8.49	8.24
South Dakota	10.97	10.42	8.81	8.88	6.91	6.82	--	--	9.12	8.97
South Atlantic	**11.76**	**11.59**	**9.32**	**9.68**	**6.15**	**6.51**	**7.91**	**8.48**	**9.66**	**9.84**
Delaware	14.51	13.97	10.70	10.19	8.07	7.49	--	--	11.59	10.97
District of Columbia	13.71	12.72	12.03	11.88	9.18	7.02	9.23	9.56	12.13	11.79
Florida	11.69	12.11	9.57	10.17	8.10	7.81	9.19	9.67	10.51	10.90
Georgia	10.44	10.72	9.05	10.45	5.12	6.26	4.37	5.73	8.51	9.50
Maryland	14.99	13.19	10.63	10.30	8.27	8.69	7.88	8.39	12.04	11.44
North Carolina	11.41	10.63	8.37	8.41	5.77	6.00	8.15	7.80	8.82	8.72
South Carolina	12.65	12.53	10.05	10.47	5.61	6.14	--	--	8.92	9.42

Virginia	11.48	11.46	8.16	8.42	6.84	7.05	7.60	8.55	9.18	9.39
West Virginia	10.73	9.33	9.12	8.17	6.25	5.88	--	--	8.42	7.67
East South Central	**11.07**	**10.65**	**10.18**	**10.27**	**5.72**	**5.61**	**7.58**	**7.45**	**8.84**	**8.70**
Alabama	11.46	11.09	10.63	10.95	5.52	5.94	--	--	8.74	9.01
Kentucky	10.69	10.17	9.45	9.38	5.39	5.28	--	--	8.08	7.84
Mississippi	11.55	11.66	10.29	10.93	6.38	6.17	--	--	9.22	9.41
Tennessee	10.78	10.18	10.23	10.03	5.96	5.23	7.58	7.45	9.32	8.80
West South Central	**10.87**	**11.07**	**7.73**	**8.20**	**5.23**	**5.79**	**5.57**	**5.59**	**7.86**	**8.29**
Arkansas	10.15	9.72	8.20	8.08	6.00	5.86	8.90	11.94	7.96	7.74
Louisiana	9.05	8.91	8.44	8.49	5.22	5.15	7.56	8.60	7.30	7.21
Oklahoma	10.26	9.70	7.09	7.43	4.73	5.43	--	--	7.25	7.55
Texas	11.48	11.98	7.64	8.28	5.20	6.04	5.43	5.37	8.08	8.75
Mountain	**11.22**	**11.20**	**9.29**	**9.30**	**5.88**	**5.97**	**9.80**	**10.55**	**8.75**	**8.81**
Arizona	11.29	11.08	9.54	9.39	5.53	5.97	7.96	--	9.23	9.24
Colorado	11.58	11.64	9.78	9.74	6.81	7.03	9.96	10.86	9.49	9.58
Idaho	9.39	9.79	7.59	7.78	5.76	5.64	--	--	7.81	8.01
Montana	10.85	10.25	10.10	9.83	4.93	5.53	--	--	8.75	8.70
Nevada	12.71	13.61	8.98	9.56	5.20	4.63	8.51	8.95	8.10	8.21
New Mexico	11.83	11.55	9.88	9.77	5.77	6.22	--	--	8.97	8.98
Utah	10.71	10.63	8.20	8.38	5.73	5.73	9.95	10.40	8.07	8.15
Wyoming	10.99	10.63	9.22	8.99	6.55	6.56	--	--	7.82	7.77
Pacific Contiguous	**14.25**	**13.79**	**13.03**	**13.25**	**9.16**	**9.08**	**8.18**	**8.37**	**12.59**	**12.42**
California	17.36	17.00	14.81	15.16	12.24	12.52	8.14	8.33	15.11	15.16
Oregon	10.68	10.56	8.84	8.85	6.18	6.01	9.25	9.31	8.95	8.81
Washington	9.37	8.61	8.47	8.20	4.51	4.49	9.58	9.09	7.75	7.18
Pacific Noncontiguous	**24.09**	**27.84**	**21.42**	**25.54**	**19.50**	**25.03**	**--**	**--**	**21.63**	**26.08**
Alaska	20.28	19.70	17.72	17.82	15.78	15.62	--	--	18.21	18.01
Hawaii	27.16	34.84	24.64	32.49	20.76	28.50	--	--	23.83	31.58
U.S. Total	**12.73**	**12.48**	**10.36**	**10.52**	**6.62**	**6.75**	**9.69**	**10.20**	**10.11**	**10.13**

See Technical notes for additional information on the Commercial, Industrial, and Transportation sectors.
Notes: - See Glossary for definitions. - Values for 2014 are final. Values for 2015 are preliminary estimates based on a cutoff model sample.
See Technical Notes for a discussion of the sample design for the Form EIA-826.
Utilities and energy service providers may classify commercial and industrial customers based on either NAICS codes or demands or usage falling within specified limits by rate schedule.
Changes from year to year in consumer counts, sales and revenues, particularly involving the commercial and industrial consumer sectors, may result from respondent implementation of changes in the definitions of consumers, and reclassifications.
Totals may not equal sum of components because of independent rounding.
Source: U.S. Energy Information Administration, Form EIA-826, Monthly Electric Sales and Revenue Report with State Distributions Report.

TEXT SIZE: A+ A- A • TEXT ONLY TRANSLATE Find

Fuels Tax Group

Oregon Department of Transportation

Department

About Us
Contact Us
Email Fuels Tax Group
Fuel Tax Programs
Current Fuel Tax Rates
Forms & Applications
Payment Methods & Due Dates
Online Filing
Official Notices
Reports
Frequently Asked FAQ's
Oregon Revised Statutes
Administrative Rules
Other Links
Financial Services

Current Oregon Fuel Tax Rates

General Information

The Fuels Tax Group administers the following tax programs for the state of Oregon:

Oregon State Taxes
County Gasoline Taxes
City Gasoline and Diesel Taxes

NOTE: There are additional city taxes applicable in Tillamook, The Dalles, Stanfield, Sandy, Oakridge, and Dundee; however, these taxes are not administered by ODOT. Please inquire at your local government offices about applicable taxes in your area.

Required Gasoline Tax Disclosures

Oregon State Taxes

The State of Oregon fuel tax rates are as follows:

GASOLINE	$.30 per gallon
USE FUEL: all fuel other than gasoline used in a motor vehicle (see conversion information below for propane & CNG)	$.30 per gallon
AVIATION GASOLINE	$.11 per gallon
JET FUEL	$.03 per gallon

Use fuel includes premium diesel, biodiesel, and any fuel other than gasoline used to propel a motor vehicle on public roads.

Biodiesel dispensed into motor vehicles is taxed at $.30 per gallon.

For propane and CNG dispensed into motor vehicles, it is necessary to convert the amount of Propane and CNG to a figure that is equal to a gallon of liquid fuel as follows: (NOTE: these converted gallons can now be multiplied by the tax rate of $.30 per gallon)

- Propane: Divide taxable gallons by 1.3
- CNG: Divide taxable gallons by 1.2

The current tax rates for Gasoline and Use Fuel are effective January 1, 2011.

The tax rate for Aviation gasoline prior to October 23, 1999 was $.03 per gallon. Effective October 23, 1999 the rate was increased to $.06 per gallon and effective July 1, 2000 the rate was increased to its present rate of $.09 per gallon.

The tax rate for Jet Fuel prior to October 23, 1999 was $.005 per gallon. Effective October 23, 1999 the rate was increased to its present rate of $.01 per gallon.

County Gasoline Taxes

For county jurisdictions motor vehicle fuel (gasoline) is taxed at the following rates:

MULTNOMAH COUNTY	$.03 per gallon
WASHINGTON COUNTY	$.01 per gallon

City Gasoline & Diesel Taxes

For local city jurisdictions motor vehicle fuel includes gasoline and diesel fuel, except Coburg which does not include diesel, and is taxed at the following rates:

CITY OF WOODBURN	$.01 per gallon
CITY OF EUGENE	$.05 per gallon
CITY OF SPRINGFIELD	$.03 per gallon
CITY OF COTTAGE GROVE	$.03 per gallon
CITY OF VENETA	$.03 per gallon
CITY OF TIGARD	$.03 per gallon
CITY OF MILWAUKIE	$.02 per gallon
CITY OF COQUILLE	$.03 per gallon
CITY OF COBURG	$.03 per gallon
CITY OF ASTORIA	$.03 per gallon
CITY OF WARRENTON	$.03 per gallon

Sales tax

Oregon doesn't have a general sales tax or a use/transaction tax.

Oregon uses the **Oregon Business Registry Resale Certificate (/DOR/forms/FormsPubs/or-business-registry-resale-cert_800-002.pdf)** for Oregon buyers who buy goods outside of the state and then resell them in Oregon.

Don't file this form with us. Give the completed form to the out-of-state seller at the time of purchase. The out-of-state seller may accept this certificate as a substitute "resale certificate" and exempt the transaction from the state's sales/use/transaction tax, but they are **not** required to accept it.

Oregon does not have a sales tax exempt certificate.

If you're an Oregon resident working or shopping in a state with a sales tax and want information about that state's sales tax policy regarding nonresidents, consult that state's taxation agency.

Oregon law doesn't allow you to reduce your Oregon taxes because you paid sales taxes in another state.

Oregon Metro Averages

Select Market

**Prices Are In US Dollars Per Gallon*
Prices updated as of 2/24/2016 3:45am

Eugene-Springfield

	Regular	Mid	Premium	Diesel
Current	$1.876	$1.992	$2.104	$1.968
Yesterday	$1.867	$2.000	$2.107	$1.963
Week Ago	$1.859	$1.989	$2.100	$1.963
Month Ago	$2.029	$2.208	$2.330	$2.051
Year Ago	$2.553	$2.667	$2.764	$2.861

Highest Recorded Average Price

	Price	Date
Regular Unl.	$4.330	6/28/2008
DSL.	$4.896	7/11/2008

Medford-Ashland

	Regular	Mid	Premium	Diesel
Current	$1.871	$2.006	$2.138	$1.931
Yesterday	$1.863	$2.006	$2.135	$1.938
Week Ago	$1.862	$1.988	$2.112	$1.905
Month Ago	$2.079	$2.208	$2.356	$2.077
Year Ago	$2.564	$2.685	$2.770	$2.925

Highest Recorded Average Price

	Price	Date
Regular Unl.	$4.379	7/11/2008
DSL.	$4.994	7/21/2008

Portland-Vancouver (OR only)

	Regular	Mid	Premium	Diesel
Current	$1.896	$2.060	$2.183	$2.006
Yesterday	$1.900	$2.064	$2.186	$2.009
Week Ago	$1.928	$2.089	$2.213	$2.016
Month Ago	$2.129	$2.314	$2.438	$2.242
Year Ago	$2.485	$2.594	$2.700	$2.906

Highest Recorded Average Price

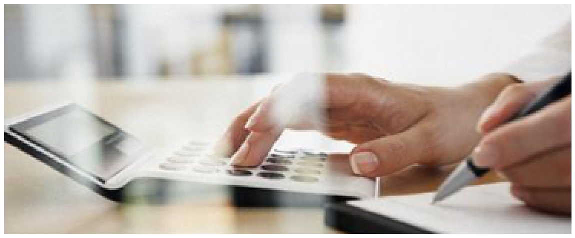
	Price	Date
Regular Unl.	$4.278	6/21/2008
DSL.	$4.920	7/18/2008

Salem

	Regular	Mid	Premium	Diesel
Current	$1.849	$2.017	$2.153	$2.099
Yesterday	$1.858	$2.023	$2.156	$2.107
Week Ago	$1.875	$2.028	$2.167	$2.115
Month Ago	$2.086	$2.275	$2.399	$2.285
Year Ago	$2.461	$2.568	$2.667	$2.851

Highest Recorded Average Price

	Price	Date
Regular Unl.	$4.262	7/8/2008
DSL.	$4.867	7/19/2008



Prompt Payment

The Prompt Payment rule makes sure that valid and proper invoices submitted by vendors are paid on time by federal agencies.

On-time and Late payments

If a vendor submits a proper and valid invoice, the agency must pay it on time. If not, the payment is late.

In most cases when an agency pays a vendor late, it must pay interest. Prompt Payment determines those interest penalties.

- More about on-time and late payments
- Calculators and formulas for paying interest
- Current and historical rates for paying interest

Early (accelerated) payments – no discount

In some cases where it is in the best interest of the government, an agency may pay more quickly than the standard time for payment (without a discount).

More about accelerated payments

Discounts for early payments

In some cases, a vendor may offer the agency discount for early payment.

- More about discounts on payments
- Calculator and formula for discounts

Quick Links

- Prompt Payment final rule (5 CFR Part 1315)
  Text version
  PDF version
- Federal Acquisition Regulation 52.232-25
  (clauses related to prompt payments)
- FAR EFT Final Rule: (3/4/99); published by DoD, GSA, and NASA
  The Federal Acquisition Regulation (FAR) Electronic Funds Transfer (EFT) final rule addresses the use of electronic funds transfer for federal contract payments and provides for the collection of banking information from vendors.
- Federal Travel Regulation final rule
  This final rule provides for late payment interest penalties for Federal government employee travel reimbursements. See §301–71.210 How do we calculate late payment fees?

Updates

- OMB guidance on application of PPA requirements for invoices received during shutdown
- Becoming a CARS Reporter Training
- Prompt Payment Interest Rate
  January 1, 2016 - June 30, 2016 = 2.500 percent

Receive E-Mail Updates

- Subscribe to Updates
- Revise Subscriptions

Related Resources

- Current Value of Funds Rate
- Electronic Funds Transfer (EFT)
- Federal Acquisition Regulation (FAR)

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AMERICAN PETROLEUM INSTITUTE

STATE MOTOR FUEL TAXES
RATES EFFECTIVE 1/1/2016

OREGON

Oregon Gasoline

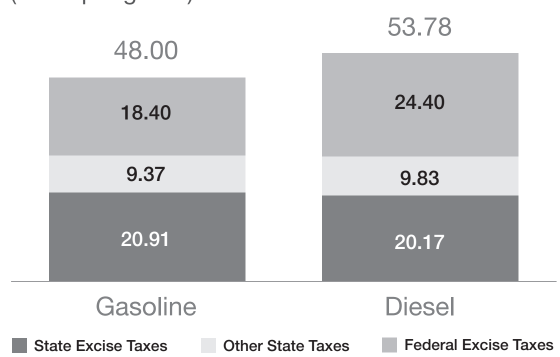
30.00	State Excise Tax
1.10	Other State Taxes/Fees
31.10	Total State Taxes/Fees
49.50	Total State plus Federal Excise Taxes (@ 18.4 cpg)

Oregon Diesel

30.00	State Excise Tax
0.35	Other State Taxes/Fees
30.35	Total State Taxes/Fees
54.75	Total State plus Federal Excise Taxes (@ 24.4 cpg)

National Average

(cents per gallon)

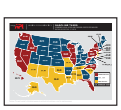


Notes

"Other Taxes" decreased from 1.09 cpg to 1.07 cpg for gasoline and decreased from 0.35 to 0.34 cpg for diesel in Q32015. "Other Taxes" columns include additional optional county gasoline (ranging from 1 to 3 cpg) and city gasoline and diesel taxes (ranging from 1 to 5 cpg).

-- Click here for Oregon Fuel Tax Information

The "other taxes" include in the local diesel taxes. Cottage Grove is the closest city to Black Butte Mine Superfund Site. The local rate for diesel tax in Cottage Grove is $.03 per gallon. Therefore, this local tax was added to determine the total state diesel tax (30.30 cents per gallon).



To find out more, visit www.api.org/tax

PROJECT:	Black Butte Mine	COMPUTED BY :	EW	CHECKED BY:	AIS
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	2/24/2016	DATE CHECKED:	2/24/2016
CLIENT:	USEPA			WRKSHT NO. :	LB-01

Description: Determination of base wage rates for management and engineering personnel and general construction personnel.

Library Detail

Title: LC_OR_2016 LCOR_022416

Note: Labor costs updated with local labor costs (Davis-Bacon or FLCdatacenter.com), February 2016.

Professional Labor Work Hours Per Year

Number of weeks per year:	52	
Number of hours per week:	40	
Number of work hours per year:	2,080	*Based on 52 weeks x 40 hours per week*

Escalation

Previous salary cost index (2Q16):	813.65
Cost estimate prep cost index (2Q16):	813.65

Escalation indices (composite index) obtained from the U.S. Army Corps of Engineers Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304, March 2012, revised as of 30 September 2014 for feature code 06 - Fish & Wildlife Facilities.

PROJECT:	Black Butte Mine	COMPUTED BY :	EW	CHECKED BY:	AIS
JOB NO.:	106504.3126.004.13284.210.EEZ.01	DATE :	2/24/2016	DATE CHECKED:	2/24/2016
CLIENT:	USEPA			WRKSHT NO. :	LB-02

Description:	Determination of base wage rates for management and engineering personnel (i.e., project manager, civil engineer, etc.). Wage rates based on Foreign Labor Certification Data Center Online Wage Library (FLCdatacenter.com) salary estimates for Lane County, Oregon obtained February 2016. Salary rates were used for hourly labor rate determination for the MII estimate. Payroll taxes and insurance are included in the MII estimate calculations.

Professional Labor Rates

Source Tag	Labor Category	Salary	Hourly	Benefits	Bonus	Year	Source
FA-AGENS	General Superintendents (P.M.)	(b) (6)		15%	7%	2016	FLC 11-9021.00 Level 3
FA-PROJM	Project Managers			15%	7%	2016	FLC 11-9041.00 Level 3
FB-CLTYP	Clerks, Typists, etc.			15%	7%	2016	FLC 43-9061.00 Level 4
FB-PURAG	Purchasing Agents			15%	7%	2016	FLC 13-1023.00 Level 3
FC-ENCGF	Hydrogeologist/Geologist			15%	7%	2016	FLC 19-2042.00 Level 3
FC-ENGCI	Engineers, Civil			15%	7%	2016	FLC 17-2051.00 Level 3
FA-PROJM	Engineers, Project			15%	7%	2016	FLC 17-2081.00 Level 3
FC-ENGQC	Quality Control Engineer			15%	7%	2016	FLC 11-3051.01 Level 3
FC-FLDER	Field Engineer			15%	7%	2016	FLC 17-3022.00 Level 4
FC-FLDRT	Field Draftsmen			15%	7%	2016	FLC 17-3011.00 Level 3
FC-SURYC	Surveyors, Chief			15%	7%	2016	FLC 17-1022.00 Level 4
FC-SURYR	Surveyors			15%	7%	2016	FLC 17-1022.00 Level 2
FD-SAENG	Safety Engineers			15%	7%	2016	FLC 17-2111.00 Level 4
HO-STFENG	Environmental Engineer			15%	7%	2016	FLC 17-2081.00 Level 3
HO-FLDTCH	Field Technician (HTW Projects)			15%	7%	2016	FLC 17-3025.00 Level 3
HO-STFSCI	Environmental Scientist			15%	7%	2016	FLC 19-2041.00 Level 3
L-ASP	Environmental Lawyer			15%	7%	2016	FLC 23-1011.00 Level 3
L-LARE	Paralegal			15%	7%	2016	FLC 23-2011.00 Level 3

	Labor Category	Salary	Hourly	Taxable Fringe	Non-Tax Fringe[1]	Total
FA-AGENS	General Superintendents (P.M.)	(b) (6)			$0.00	(b) (6)
FA-PROJM	Project Managers				$0.00	
FB-CLTYP	Clerks, Typists, etc.				$0.00	
FB-PURAG	Purchasing Agents				$0.00	
FC-ENCGF	Hydrogeologist/Geologist				$0.00	
FC-ENGCI	Engineers, Civil				$0.00	
FA-PROJM	Engineers, Project				$0.00	
FC-ENGQC	Quality Control Engineer				$0.00	
FC-FLDER	Field Engineer				$0.00	
FC-FLDRT	Field Draftsmen				$0.00	
FC-SURYC	Surveyors, Chief				$0.00	
FC-SURYR	Surveyors				$0.00	
FD-SAENG	Safety Engineers				$0.00	
HO-STFENG	Environmental Engineer				$0.00	
HO-FLDTCH	Field Technician (HTW Projects)				$0.00	
HO-STFSCI	Environmental Scientist				$0.00	
L-ASP	Environmental Lawyer				$0.00	
L-LARE	Paralegal				$0.00	

Notes

1 - Non-taxable fringe is taken out of Taxable Fringe but is set at $0.00 in MII per the U.S. Army Corps of Engineers.

CDM Smith	PROJECT: Black Butte Mine	COMPUTED BY : EW		CHECKED BY: AIS	
	JOB NO.: 106504.3126.004.13284.210.EEZ.01	DATE : 2/24/2016		DATE CHECKED: 2/24/2016	
	CLIENT: USEPA			WRKSHT NO. : LB-03	

Description: Determination of base wage rates for general construction personnel (i.e., labor, equipment operators, etc.). Wage rates based on Foreign Labor Certification (FLC) Data Center Online Wage Library (flcdatacenter.com) or base wage rates from Davis-Bacon determinations for Lane County, Oregon obtained February 2016. Fringe rates were assumed where Davis-Bacon determination did not set fringe rates. Payroll taxes and insurance are included in the MII estimate calculations.

Craft Labor Rates

Source Tag	Labor Category	Hourly	Fringe	Year	Source
B-SKILLWKR	Skilled Workers	-	-	-	Average of all labor rates
B-PLUMBER	Plumbers	(b) (6)		2016	NJ160027 (Residential) - PLUM0290-008
B-STM/PIPE	Steam/Pipefitters			2016	NJ160052 (Heavy) - PLUM0475-021
B-CARPNTER	Carpenters			2016	OR160057 (Heavy) - CARP0001-024
B-CEMTFINR	Cement Finishers			2016	OR160057 (Heavy) - SUOR2009-055
B-RODMAN	Rodmen, (Reinforcing)			2016	OR160057 (Heavy) - IRON0029-011
B-LABORER	Laborers, (Semi-Skilled)			2016	OR160001 (Highway) - LABO0003-003 - Group 3
X-EQOPRHVY	Equip. Operators, Heavy			2016	OR160057 (Heavy) - ENGI0701-030 - Group 2
X-EQOPRMED	Equip. Operators, Medium			2016	OR160057 (Heavy) - ENGI0701-030 - Group 4
B-EQOPRLT	Equip. Operators, Light			2016	OR160057 (Heavy) - ENGI0825-030 Group 5
X-EQOPROIL	Equip. Oilers / Grade Checker			2016	OR160057 (Heavy) - ENGI0701-030 - Group 6
B-TRKDVRHV	Truck Drivers, Heavy			2016	OR160001 (Highway) - TEAM0037-004 - Group 7
B-TRKDVRLT	Truck Drivers, Light			2016	OR160001 (Highway) - TEAM0037-004 - Group 1

	Labor Category	Hourly	Taxable Fringe	Non-Tax Fringe[1]	Total
B-SKILLWKR	Skilled Workers	(b) (6)		$0.00	(b) (6)
B-PLUMBER	Plumbers			$0.00	
B-STM/PIPE	Steam/Pipefitters			$0.00	
B-CEMTFINR	Carpenters			$0.00	
B-RODMAN	Cement Finishers			$0.00	
B-RODMAN	Rodmen, (Reinforcing)			$0.00	
B-LABORER	Laborers, (Semi-Skilled)			$0.00	
X-EQOPRHVY	Equip. Operators, Heavy			$0.00	
X-EQOPRMED	Equip. Operators, Medium			$0.00	
B-EQOPRLT	Equip. Operators, Light			$0.00	
X-EQOPROIL	Equip. Oilers / Grade Checker			$0.00	
B-TRKDVRHV	Truck Drivers, Heavy			$0.00	
B-TRKDVRLT	Truck Drivers, Light			$0.00	

Notes

1 - Non-taxable fringe is taken out of Taxable Fringe but is set at $0.00 in MII per the U.S. Army Corps of Engineers.