FINAL

Non-Time-Critical Removal Action Implementation Plan

Furnace Creek Area
Black Butte Mine

Black Butte Mine Superfund Site
Operable Unit 1
Cottage Grove, OR

Prepared for:

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Acronyms

ASA	American Society of Agronomy
BBM	Black Butte Mine
BMPs	best management practices
CDM Smith	CDM Federal Programs Corporation
cfs	cubic feet per second
D50	average rock diameter
EA	EA Engineering, Science, and Technology, Inc., PBC
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
FPXRF	field-portable x-ray fluorescence
>	greater than
≥	greater than or equal to
H	horizontal
HgS	cinnabar
lbs	pounds
<	less than
≤	less than or equal to
LiDAR	light detection and ranging
mg/kg	milligrams per kilogram
MW	monitoring well
NAVD88	North American Vertical Datum of 1988
NTCRA	non-time-critical removal action
oz/sy	ounce per square yard
%	percent
PLS	pure live seed
ppm	parts per million
PRAOs	preliminary removal action objectives
RA	Removal Action
Site	Black Butte Mine Superfund Site
USDA	U.S. Department of Agriculture
V	vertical

Section 1

Introduction

This implementation plan for the Furnace Creek area in 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., PBC (EA) and CDM Federal Programs Corporation (CDM Smith) under Task Order 0103-RICO-10EK, Remedial Action Contract Number EP-W-06-004.

This implementation plan was prepared to support the non-time-critical removal action (NTCRA) at the Furnace Creek area of OU1. An engineering evaluation/cost analysis (EE/CA) report for the Furnace Creek area was developed in 2016 to document the environmental review and removal action selection process and provide a framework for evaluating and selecting alternative technologies (CDM Smith 2016). The EE/CA identified preliminary removal action objectives (PRAOs) of the NTCRA and analyzed the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the PRAOs. This NTCRA was approved in the first amendment to the action memorandum for BBM on September 13, 2017 (EPA 2017).

1.1 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.

1.1.1 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 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.

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 south of the main dirt road that runs adjacent to Furnace Creek through the tailings impoundment. The overgrown dirt road on the east side of Garoutte Creek and the main road adjacent to Furnace Creek have been identified as potential access routes on the implementation plan figures in Appendix A.

1.1.2 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.

1.1.2.1 General Site Features

Currently, much of the Site is undeveloped forest. A single-family residence (private residence), occupied year-round, is within the Site and present near the Federal Emergency Management Agency 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.

1.1.2.2 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 the implementation plan figures in Appendix A. The foundation of the furnace and a group of sub-vertical pipes 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.

1.1.2.3 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 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). For the purposes of this implementation plan, 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. Test pit observations conducted in 2007 in the Furnace Creek area indicated that the thickness of tailings ranged from less than 1 foot to greater than 9 feet in at least one test pit location. Unfortunately, the exact 2007 test pit locations are unknown.

During the previous removal action, tailings with relatively lower mercury concentrations, produced from processing of ore through the "New Furnace" located outside of the Furnace Creek Watershed, were used to cover the relatively higher mercury concentration tailings in the Old Furnace Area.

1.1.3 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 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, and is designated as station F-1 on Sheet C1 of the implementation plan figures (Appendix A).

1.1.3.1 Furnace Creek Characteristics

As mentioned previously, Furnace Creek is approximately 2,100 feet in length, with the last (downgradient) 900 linear feet of the creek partially filled with historic mine tailings. In addition to the headwall scarp, four other headcuts have been created as a likely result of the high-flow event and from flows downcutting through deposited tailings and debris flow deposits. These headcut locations have been identified on Sheets C2 through C4 of the implementation plan figures (Appendix A). Within these identified headcuts, the average vertical drop ranges from 6 to 12 feet. Apart from the headcut locations, Furnace Creek is a small entrenched channel with an approximate depth and width of 1 foot. The average existing longitudinal gradient of the channel (not including the headcut areas) is approximately 25 percent (%).

Spent tailings that were discharged into the Furnace Creek catchment have been remobilized downstream because of the high-flow event and from downcutting through the headcut locations, and have covered the channel in places. Due to the steep topography and slopes within the Furnace Creek catchment area, there is potential for erosion of tailings and soil into the Furnace Creek channel throughout the area.

1.2 Removal Action Alternatives

This section describes the removal action alternatives identified 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 previously identified in the EE/CA for evaluation (CDM Smith 2016):

- Alternative Removal Action (RA) 1: 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

1.2.1 Removal Action Scope and Purpose

The purpose 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 concentrations of mercury in sediment that are discharging from Furnace Creek to the Coast Fork Willamette River watershed. Tailings and co-mingled contaminated soils/sediment within the Furnace Creek are the dominant sources of mercury loading 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.

No components to directly address dissolved mercury in surface water and shallow alluvial groundwater underlying Furnace Creek are 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

1.2.2 Selected Removal Action Alternative

As identified in the first amendment to the action memorandum (EPA 2017), the selected removal action alternative for Furnace Creek is Alternative RA3. Alternative RA3 consists of the 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 approach will remove mercury source material from the Furnace Creek catchment area, reduce mobilization of particulate-bound mercury into Furnace Creek, reduce the potential for mercury leaching into groundwater, and reduce surface water and shallow groundwater interaction with contaminated sediment within the Furnace Creek bed.

Under Alternative RA3, tailings and co-mingled contaminated soils/sediment will be removed (excavated) and the existing tailings repository location will be expanded for onsite disposal of excavated mercury source material. The new onsite disposal repository will be contained using a suitable cover specifically designed for the repository conditions, with erosion control measures installed. The excavated upland and creek bank areas within the Furnace Creek catchment area will be graded and backfilled to provide positive drainage and support vegetation. The creek corridor of the Furnace Creek will be rehabilitated to stabilize the bank slopes and reduce future erosion of remaining mercury-contaminated soil and sediment.

There may be some locations within the Furnace Creek area where the excavation approach, as defined in the selected removal alternative, is not suitable. In these locations, an in-place containment approach, as described under Alternative RA2, would be more feasible. Alternative RA2 involves an in-place containment for areas of tailings and co-mingled contaminated soils/sediment using covers as the strategy for managing particulate-bound mercury. Existing surface tailing and contaminated soils/sediment would be regraded to the extent practicable and covered with geotextile and a simple cover soil system (cobble within the creek channel and soil within the floodplain).

1.2.3 Removal Action Boundary

The Furnace Creek removal action boundary is shown on Sheet C9 of the implementation plan figures (Appendix A). The boundary was selected to include all areas of the Furnace Creek Tailings that are inside the Furnace Creek catchment as defined by the light detection and ranging (LiDAR) dataset, excluding the portion of the Old Furnace area that was capped during 2007.

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 the 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 screening data collected from the channel and banks of Furnace Creek indicate consistently high mercury concentrations in sediment and bank soil extending all the way to the confluence with Garoutte Creek.

Tailings or affected soil located outside of the Furnace Creek catchment were excluded from the removal action boundary because these tailings are outside the drainage pathway to Furnace Creek and do not contribute to mercury loading of Furnace Creek. The Old Furnace area that has been previously capped was also excluded based on the assumption that the capping soil has limited migration of mercury from residual furnace wastes to Furnace Creek. However, some minor disturbance may be required in this area to install a new access route near the Old Furnace Area and monitoring well (MW) 10 for access to Furnace Creek. Protective measures, such as the stormwater best management practices (BMPs) shown in Appendix A, should be installed to prevent migration of capped Old Furnace Area soils from entering Furnace Creek.

The area within the removal action boundary was further investigated in October 2017. Based on results from the investigation, the anticipated extent of excavation and restoration of the Furnace Creek area was further refined as described in Section 2.2.2.

Section 2

Removal Action Activities

Removal action activities associated with the Furnace Creek project include excavation and restoration of Furnace Creek and expansion of an existing repository. Information detailing these actions is further described below.

2.1 Removal Action Performance

Alternative RA3, along with Alternative RA2 in some locations, has been selected as the removal action alternative to meet the PRAOs identified in Section 1.2.1. The performance of the removal actions will be measured by:

- Visual confirmation: No visual evidence of tailings after removal or covering for RA alternatives involving excavation or containment. Tailings have relatively coarse texture (sandy gravel to gravel) and a characteristic pink-to-red color compared to the underlying native material. Native material will have no visual evidence of tailings co-mingled with soils and sediments.

- Analytical confirmation: Confirmation of tailings removal to the recommended field screening decision criteria Table 2-1 using a field-portable x-ray fluorescence (FPXRF) analyzer or other reliable tool (hereafter only discussed as FPXRF for simplicity), and comparison of pre- and post-removal action Furnace Creek mercury loading at the confluence with Garoutte Creek.

Table 2-1 Recommended Field Screening Decision Criteria

Mercury (mg/kg)	Recommended Action
greater than or equal to (≥) 20	Remove material.
less than (<) 20 and greater than (>) 7	Remove material based on field decision, accounting for location of materials, potential for future erosion, and other supplemental factors. Consider resampling if arsenic is >100 mg/kg.
less than or equal to (≤) 7	Leave material in place. Consider resampling if arsenic is >100 mg/kg.

Visual identification, with backup analytical FPXRF confirmation, should be the primary tool for determining when the full extent of tailings has been removed. Additional information regarding the recommendations for the field screening decision criteria is presented in Appendix B.

It is anticipated that a sampling and analysis plan will be prepared to support this project. That plan will provide guidance on the details associated with confirmation sampling. Typical minimum sampling frequencies that may be considered are one sample per 1,000 square feet of excavation floor. This frequency may be set more strictly in the sampling and analysis plan.

2.2 Restoration Components

The following subsections present the design components for implementation of the Furnace Creek restoration and cleanup.

2.2.1 Access Road Development

Potential access routes, described previously in Section 1.1.1, have been identified on the implementation plan figures in Appendix A. Because the potential access routes are currently overgrown with dense vegetation in certain locations, clearing and grubbing (and potential limb trimming) should be performed as detailed in Section 2.2.5 to create improved access for construction equipment. Sheet C8 of the implementation plan figures (Appendix A) identify these clearing and grubbing limits along the potential access routes. Additional temporary access routes may be constructed at the discretion of the removal contractor to allow direct access for equipment to the active working area of Furnace Creek. These temporary routes shall be coordinated with the field engineer prior to construction.

2.2.2 Limits of Excavation

As mentioned in Section 1.2.3, the area within the removal action boundary was further investigated in October 2017. Based on the FPXRF results from that additional investigation, the anticipated extent of excavation and restoration was further refined. Excavation and restoration of the Furnace Creek area should primarily occur within the proposed limits of the excavation and restoration boundary identified on Sheets C9 and C10 (Appendix A). However, it should be noted that removal may occur outside this proposed boundary, if necessary, to achieve stable channel configurations.

2.2.3 Hydrology and Hydraulics

Evaluations of various methods to determine flow rates for the Furnace Creek were discussed and identified in the EE/CA (CDM Smith 2016). Furnace Creek stream flow ranges from no flow during the dry season to approximately 3 cubic feet per second (cfs) during large precipitation events. Flow discharge estimates are based on continuous stream discharge monitoring data collected from December 2012 through October 2014. For the purposes of this implementation plan, the design flow events selected are approximately 1 cfs, equating to a 2-year, 24-hour storm event, (CDM Smith 2016) and approximately 3 cfs, equating to a 100-year, 6-hour storm event.

2.2.4 Borrow Material Requirements

Borrow source material will include soil for the covering of tailings in Furnace Creek under the Alternative RA2 approach where applicable, soil for the cover of the expanded repository, and cobble, cobble bedding, and riprap for construction of the stream channel and rock cross vanes (where applicable).

Uncontaminated soil and rock shall be identified and provided by the removal contractor. Soil material shall be used for the construction of the repository cover and for capping of tailings within Furnace Creek (described further in Section 2.3.1.2), and cobble/riprap shall be used for channel lining and construction of rock cross-vane structures (see Section 2.3.1.).

It is preferred that borrow material be obtained from the Site. Locations for borrow source areas near Furnace Creek are unknown at this time; however, it is the removal contractor's responsibility to identify and locate areas, with approval from the field engineer, for use as borrow source material. Note that the field engineer will be an independent party identified by and/or approved by EPA prior to the start of work. Should no practical locations be identified within the Site area, it may be necessary to import clean rock or soil.

Due to some remaining uncertainty regarding the extent and depth of tailings throughout the Furnace Creek drainage, initial volume estimates for borrow source material are unknown. As mentioned above, it is the removal contractor's responsibility to work with the field engineer to identify onsite borrow source locations. It is preferred that onsite borrow source locations are used before importing material from an offsite location. The removal contractor should submit the potential borrow source location to EPA for approval prior to sourcing borrow material (both soil and rock).

2.2.4.1 Borrow Material Suitability

Soil material to be used for the covering of tailings and the expanded repository should meet the gradation and growth media requirements specified in Table 2-2. Soil material should be free of boulders, timbers, tree trunks and branches, building debris, or other deleterious material that will prevent proper placement of material.

Table 2-2 Soil Cover Suitability Criteria and Sampling Methods

Property	Acceptance Criteria	Standard Procedure
Coarse Fragments	20 – 30%	American Society of Agronomy (ASA) Monograph No. 9, Part 1, Method 15-5
Maximum Rock Size (inches)	0 – 3	Measured verification in the field
Soil Reactivity (pH)	pH 5.5 – 8.5	ASA Monograph No. 9, Part 2, Method 10-3.2
Electrical Conductivity (EC) (mmhos/cm)	0 – 8	ASA Monograph No. 9, Part 2, Method 10-3.3
Sodium Adsorption Ratio (SAR)	0 – 10	ASA Monograph No. 9, Part 2, Method 10-3.4.45
Organic Matter (OM) Content	3 – 20%	ASA Monograph No. 9, Part 1, Method 29-3
Saturation Percent	25 – 85%	U.S. Department of Agriculture (USDA) Handbook 60, Method 27a
Available Water Holding Capacity	>0.1	Soil Science Society of America, Part 4

Additionally, borrow materials, both rock and soil, should meet the recommended decision criteria identified in Appendix B (for onsite and offsite borrow source locations) and be clean and free of metals or other potentially hazardous substances that exceed applicable standards or are otherwise identified as tailings/waste.

Decision criteria for borrow soil and rock (for onsite and offsite borrow source locations) are summarized in Table 2-3, with a description of criteria development provided in Appendix B. It is the removal contractor's responsibility to verify that these requirements are met prior to placement at the Site. As mentioned previously, each borrow source is subject to EPA approval prior to sourcing of material, and EPA may require additional testing for borrow source material to verify it is not contaminated. Specific testing and requirements will depend on the borrow source material type (i.e., soil or rock) and the identified borrow source location.

Material that exceeds the maximum concentrations will be rejected. However, because the preference is to use onsite borrow material, should material be encountered that does not fully satisfy the criteria listed within this implementation plan but would meet the intent of this implementation plan, the material may be used with approval from the field engineer and EPA.

Table 2-3 Borrow Material Recommended Decision Criteria

Analyte	Onsite	Offsite
Mercury (mg/kg)	<7	<2
Arsenic (mg/kg)	<30	<20

It is anticipated that a sampling and analysis plan will be prepared to support this project. That plan will provide guidance on the details associated with borrow material sampling. Typical minimum sampling frequencies that may be considered are one sample per 200 cubic yards of onsite borrow material and one sample per 500 cubic yards of offsite borrow material. These frequencies may be set more strictly in the sampling and analysis plan.

2.2.5 Clearing and Grubbing

The Site consists of mixed forest dominated by Douglas-Fir, Western Red Cedar, Western Hemlock, and bigleaf maple. Understory vegetation within forested areas consists of vine maple, Oregon grape, and thimbleberry, with Himalayan blackberry 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, particularly the existing repository.

This work consists of clearing, grubbing, removing, and otherwise disposing of vegetation and debris within the clearing limits identified on the implementation plan figures (Appendix A). The area has not been logged recently and significant brush and trees will need to be cleared and grubbed throughout the Site. Clearing and grubbing should be done at times and in a manner such that the surrounding vegetation, adjacent property, and anything designated to remain should not be damaged. Care should be taken not to damage or injure trees, shrubbery, vines, plants, and other vegetation growing outside the clearing limits. Unless specifically designated to be saved for use as log cross vanes or woody debris, all trees, stumps, brush, logs, and other matter occurring within clearing limits shall be cut and chipped for use as mulch. However, invasive species that have been cleared, such as the Scotch Broom mentioned above, should not be saved and instead stockpiled separately from other cleared and grubbed material. Log structure materials designated for future stream reconstruction activities should be salvaged and stockpiled as needed.

2.2.5.1 Woody Material Management

Logs will be utilized for construction of the drop-structure grade controls for reconstruction of Furnace Creek. This section pertains to harvesting and stockpiling of wood materials for future stream reconstruction.

The cut logs to be stockpiled for use as a log structure for stream reconstruction should be harvested Douglas-Fir, Western Red Cedar, or Red Alder, and have a minimum diameter at breast height (DBH) of 8 inches throughout the length of the log. Minimum length for log structures to be installed should be approximately 4 feet and coordinated in the field between the removal contractor and the field engineer. Logs should be cut perpendicular to the length of the log. One end of the log should be cut at an angle to install the log cross-vane structure as shown on Sheet CD3 of the implementation plan figures (Appendix A). Logs should be stockpiled separately at the Site and so that the wood products do not deteriorate over time. Initial estimates indicate that approximately 10 to 20 logs should be saved for stream reconstruction use in grade control structures.

2.2.5.2 Mulch

Mulch will be manufactured onsite by chipping logs and woody debris generated and salvaged during clearing and grubbing activities. Mulch will be used to create a stormwater runon berm approximately 12-inches wide by 12-inches high (minimum dimensions) on the upland banks to limit recontamination of Furnace Creek from areas outside the removal action.

Remaining woody debris that has not been chipped for use as mulch should be scattered on the upland areas to provide microsites for revegetation operations.

2.3 Furnace Creek Restoration

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. To achieve this, a couple of different typical sections may be installed throughout the channel length, as well as placement of stream channel grade control structures.

2.3.1 Stream Restoration Details

Restoration of the stream bank, floodplain, and upland bank areas include excavation of contaminated tailings material, regrading, and installation of cover soil and construction of rock or log cross vanes where applicable. The following subsections detail the various restoration methods and typical sections.

2.3.1.1 Typical Section A – Excavation to Native Ground

The selected removal action alternative (RA3) encompasses removal of contaminated material to native ground or clean material. Typical Section A reflects removal of contaminated materials to native ground and is the preferred method for implementation. The performance metrics for the excavation of contaminated material are to remove tailings so that the remaining concentrations in the native soils are less than the recommended field screening decision criteria in Table 2-1, and to restore the removal action areas to native ground. Visual confirmation should be conducted during excavation as the primary method for identifying remaining tailings and/or soils with elevated mercury concentrations. Residual mercury concentrations in the native ground surface should be verified using a FPXRF device. Material should be removed until the recommended field screening decision criteria in Table 2-1 are satisfied.

Following removal of contaminated material, the floodplain and overbanks should be regraded to stable slopes (i.e., less than 3-feet horizontal to 1-foot vertical [3H:1V]). During construction, temporary slopes of 1.5H:1V (maximum) may be used in order to chase and remove tailings. If there is insufficient material present to regrade the slopes to the 3H:1V final configuration, additional backfill may be needed. Following regrading, a 12-inch layer of cobble layer (composed of cobble with a maximum rock diameter of 6 inches) should be installed within the stream channel as shown in Typical Section A on Sheet C14 in the implementation plan figures (Appendix A).

As shown on Sheet C9 of the implementation plan figures (Appendix A), excavation and restoration of Furnace Creek shall primarily occur within the proposed boundary. Excavation and restoration may occur outside this boundary, if necessary, to remove tailings and achieve stable slopes. To limit recontamination of Furnace Creek from stormwater runon outside of this excavation and restoration boundary, a stormwater runon berm constructed of chipped mulch from the cleared trees should be installed at this interface as detailed on Sheet CD1. If any additional areas outside of the excavation and restoration boundary shown on Sheet C9 become disturbed, the area shall be revegetated with the upland seed mix provided in Table 2-6.

2.3.1.2 Typical Section B – Tailings Covered in Place

While excavation of the contaminated material to native ground is the preferred method, this option may not be feasible in certain locations where the depth of tailings is significant. As mentioned previously, some uncertainty remains regarding the extent and depth of tailings material throughout the Furnace Creek drainage. As such, excavations of tailings material to native ground may not be possible when deep tailings are encountered and the overbank areas require regrading to stable slopes.

For the portions of Furnace Creek where final maximum stable slopes of 3H:1V cannot be achieved if tailings are excavated to full depth as described in Typical Section A, stream restoration activities shall proceed under Typical Section B – Tailings Covered in Place. Typical Section B reflects the covering of the channel and floodplain area with clean borrow source material (i.e., cobble in the stream channel and soil in the floodplain and overbank areas) and graded to stable slopes. An 8 ounce per square yard non-woven geotextile filter fabric should be placed within the stream channel and floodplain area where tailings remain and anchored into the upland banks and upstream of the placement area, to a minimum depth of 12 inches. The geotextile filter fabric will serve as a visual barrier between the contaminated material/tailings and the borrow material, as well as a means to prevent sediment migration. Within the stream channel, a 12-inch cobble layer (composed of cobble with a maximum rock diameter of 6 inches) should be installed atop the geotextile filter fabric. Cobble should be installed so as to not damage the geotextile during placement or backfill.

As with Typical Section A, a stormwater runon berm constructed of chipped mulch from the cleared trees should be installed to limit recontamination of Furnace Creek from stormwater runon outside the excavation and restoration boundary. The mulch berm should be installed as shown on Sheet CD1 in Appendix A.

2.3.1.3 Headcut Areas

The reconstruction of Furnace Creek includes the installation of stream channel grade controls (i.e., rock cross vanes and log cross vanes) to control steep channel grades in the pre-identified headcut areas of the stream (see Sheets C11-C13 in Appendix A) and in areas where grade breaks occur along the channel reach. A combination of rock cross vanes shall be used in the pre-identified headcut areas (and at additional locations should they be identified in the field) and log cross vanes shall be used as grade-control structures at grade break locations in Furnace Creek. These structures will be constructed as shown on Sheets CD2 and CD3 of the implementation plan figures in Appendix A. Headcut locations and incised areas within the channel should no longer exist following removal of contaminated material and restoration of Furnace Creek.

2.3.2 Furnace Creek Revegetation and Stabilization

The creek corridor of Furnace Creek should be rehabilitated to stabilize the bank slopes and reduce future erosion of remaining mercury-contaminated soil and sediment. Stabilization measures include the placement of straw wattles along the edge of the Furnace Creek channel banks and mulch berms along the edge of the upland banks as described in Section 2.2.5. Revegetation of the Furnace Creek disturbed areas including the floodplain and upland banks shall be performed as shown in the schematic in Figure 2-1. It is recommended that revegetation of the Furnace Creek area be performed via a hydroseeder (using the specified seed mixes) with ProMatrix™ engineered fiber matrix (or other engineer-approved alternative) applied at 2,500 pounds per acre. Planting of trees and shrubs is not required for this work. Given the uncertainty over the exact disturbance footprint, quantity estimates for the floodplain, riparian, and upland seed mixes have not been provided.

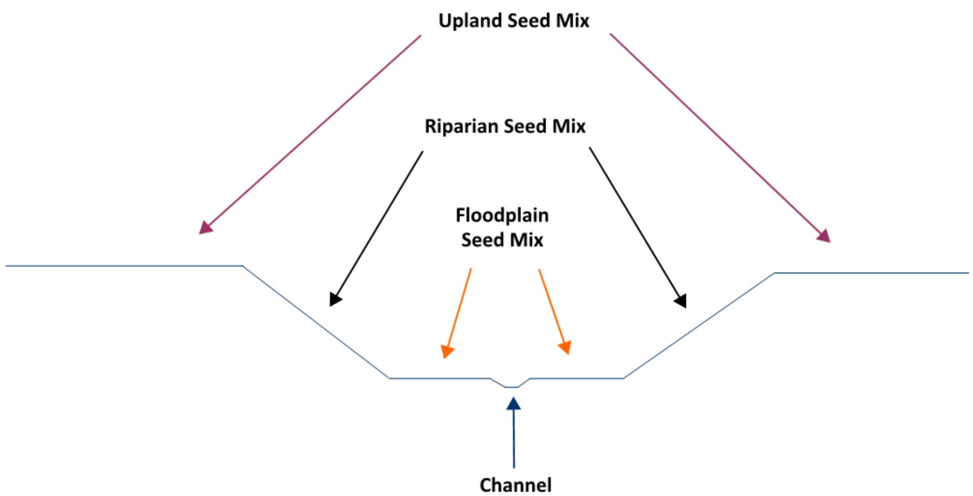

Figure 2-1 Furnace Creek Revegetation Schematic

The removal contractor shall use the floodplain seed mix specified in Table 2-4 for stabilization of the disturbed floodplain areas within the Furnace Creek restored area. Seed mix shall have the specified composition per acre. Minimum seeding rate shall be 50 pure live seed (PLS) per square foot and maximum seeding rate shall be 150 PLS per square foot.

Table 2-4 Furnace Creek Floodplain Seed Mix

Common Name	Scientific Name	PLS %*
California Brome	*Bromus carinatus*	20
Slender Wheatgrass	*Elymus trachycaulus*	20
California Poppy	*Eschscholzia californica*	10
Annual Gaillardia (Indian Blanket)	*Gaillardia aristata*	5
Common Yarrow	*Achillea millefolium*	5
Tufted Hairgrass	*Deschampsia cespitosa*	15
Broadleaf Lupine	*Lupinus latifolius*	5
Prairie Junegrass	*Koeleria macrantha*	5
Goatsbeard	*Aruncus dioicus*	5
Showy Milkweed	*Asclepias speciosa*	10
Total		**100**

* Seed supplier to determine PLS per square foot to meet the requested percentages of each species in the restored habitat

The removal contractor shall use the riparian seed mix specified in Table 2-5 for stabilization of the disturbed areas upland of the floodplain and Furnace Creek channel as shown in Figure 2-1. Seed mix shall have the specified composition per acre. Minimum seeding rate shall be 50 PLS per square foot and maximum seeding rate shall be 150 PLS per square foot.

Table 2-5 Furnace Creek Riparian Seed Mix

Common Name	Scientific Name	PLS %*
Meadow Barley	*Hordeum brachyantherum*	15
California Brome	*Bromus carinatus*	15
Native Red Fescue	*Festuca rubra*	10
Northwestern Mannagrass	*Glyceria occidentallis*	10
Tufted Hairgrass	*Deschampsia cespitosa*	15
Spike Bentgrass	*Agrostis exarata*	10
Nootka Rose	*Rosa nutkana*	5
Common Snowberry	*Symphoricarpos alba*	5
Douglas Spirea	*Spiraea dougalsii*	5
Red osier dogwood	*Cornus sericea*	5
Vine maple	*Acer circinatum*	2.5
Red alder	*Alnus rubra*	2.5
Total		**100**

* Seed supplier to determine PLS per square foot to meet the requested percentages of each species in the restored habitat

The removal contractor shall use the upland seed mix specified in Table 2-6 for revegetating any disturbed areas upland of the Furnace Creek channel or for those disturbed areas outside the Furnace Creek restoration boundary. Seed mix shall have the specified composition per acre. Minimum seeding rate shall be 50 PLS per square foot and maximum seeding rate shall be 150 PLS per square foot.

Table 2-6 Furnace Creek Upland Seed Mix

Common Name	Scientific Name	PLS %*
California Brome	*Bromus carinatus*	20
Meadow Barley	*Hordeum brachyantherum*	10
Douglas-Fir	*Pseudotsuga menziesii*	10
Bigleaf Maple	*Acer macrophyllum*	10
Indian Plum	*Oemleria cerasiformis*	10
Nootka Rose	*Rosa nutkana*	10
Black Elderberry	*Sambucus nigra*	5
Western Red Cedar	*Thuja plicata*	10
Oceanspray	*Holodiscus discolor*	10
Salal	*Gaultheria shallon*	10
Total		**100**

* Seed supplier to determine PLS per square foot to meet the requested percentages of each species in the restored habitat

2.4 Repository Improvement and Expansion

Excavated tailings and co-mingled contaminated soils/sediment from the Furnace Creek restoration activities should be transported for onsite disposal at the existing repository. The existing tailings repository will be expanded to allow for the placement of excavated tailings and contaminated soil as shown on Sheet C15 of the implementation plan figures (Appendix A). Elemental mercury is not anticipated but should it be encountered, it should be segregated and disposed of appropriately offsite. Contaminated soil or tailings material with discrete point concentrations exceeding 2,000 mg/kg of mercury shall not be placed in the repository. Should material be encountered that exceeds these criteria, the material shall be placed in a separate stockpile and the field engineer shall be notified.

The existing repository and surrounding area should first be cleared and grubbed as shown on Sheet C8 of the implementation plan figures (Appendix A). Due to the range in volume of anticipated waste material, tailings and contaminated soil should first be placed and consolidated within the maximum horizontal footprint of the proposed repository. Once contaminated material has been placed within the maximum perimeter boundary, vertical expansion may be performed as needed to achieve the repository configuration shown on Sheet C15 (Appendix A). Vertical expansion can be performed, up to a maximum repository height of 20 feet, as more tailings and contaminated material becomes available. Repository slopes shall be graded to promote positive drainage off the repository and graded to stable slopes (i.e., 3H:1V maximum).

The repository shall be graded at all times to maintain a minimum 5% slope in order to promote positive stormwater drainage.

A simple cover using clean borrow soil material should be installed across the repository including the existing portion following consolidation of the contaminated material. Orange construction fencing, or other engineer-approved alternative, shall be placed underneath the borrow soil cover to delineate between the consolidated contaminated material and the clean borrow soil cover. Following soil placement, the repository cover should be revegetated with the upland seed mix specified in Table 2-6. The repository cover will be the primary means used to limit exposure to humans by incidental ingestion and to minimize potential for erosion of contaminated tailings and soil.

2.4.1 Drainage Details

A perimeter stormwater channel should be installed around the base of the expanded repository footprint to capture runoff from the surface of the repository and to direct runon around the repository to the stormwater basin. The stormwater channel has been conservatively designed to allow the channel to remain in place permanently, and should be a trapezoidal channel with a 2-foot bottom width, 3H:1V side slopes at each side, and a depth of 1 foot. The stormwater channel should also be revegetated with the upland seed mix specified in Table 2-6 to create a grass-lined channel. Stormwater BMPs such as rock check dams may need to be installed prior to establishment of vegetation, and cleaned out following large storm events.

The stormwater basin has been designed as a permanent feature to hold repository stormwater runoff generated from the 2-year, 24-hour storm event. The stormwater basin will hold approximately 2,500 cubic feet of stormwater from the repository and should have an approximate bottom width of 35–40 feet and an approximate depth of 4 feet, with 3H:1V side slopes.

Currently, an additional natural drainage exists to the south of the repository. Field observations indicate this drainage infiltrates at the southern boundary of the existing repository. This drainage will be rerouted around the expanded repository to limit the amount of drainage entering the expanded repository footprint. An addendum to this implementation plan addressing the routing of this natural drainage will be issued at a later date; however, in the meantime, the permanent repository perimeter stormwater channel and basin may be used together with temporary BMPs to manage any flows from this drainage area during construction.

Section 3

Construction Monitoring

In general, construction monitoring will include quality assurance during construction to verify that the removal action is being constructed as indicated in this implementation plan and according to the implementation plan figures (Appendix A), and that performance metrics are being met.

3.1 Quality Assurance Procedures

Quality assurance refers to the means and actions employed to assure conformity of construction with this implementation plan and figures. Quality assurance during construction will be performed by the field engineer and/or construction management team, to verify that specified construction techniques and procedures are used and that specified performance metrics are met.

3.1.1 Furnace Creek Restoration and Repository Construction

The following subsections identify quality assurance procedures for the restoration of Furnace Creek and expansion of the onsite repository.

3.1.1.1 Furnace Creek Restoration

The restoration of Furnace Creek involves the excavation of contaminated material, reconstruction of the channel run, and installation of grade-control structures (i.e., rock cross vanes and log cross vanes). Construction quality assurance for the restoration of Furnace Creek involves monitoring grade control and verifying material requirements.

The excavation of upland, riparian, and Furnace Creek channel materials should occur as indicated in the implementation plan figures or as designated in the field by the field engineer. No excavation should occur at the Site without notifying the field engineer. Once the removal contractor has completed the Furnace Creek excavation activities in the active work zone, the field engineer will verify the lines and grades of the restored areas of the channel and confirm that maximum side slopes are not exceeded.

The placement of borrow material (e.g., soil, cobble) will be monitored during construction. The field engineer will supervise the placement of borrow source material and verify construction in accordance with the typical sections shown in the implementation plan figures (Appendix A). The field engineer will continuously monitor the restored portions of Furnace Creek to verify that no erosion has occurred within the stream channel or along the banks, the rock cross vanes and log cross vanes are performing as intended, and no scouring has occurred in these areas. In the event that the field engineer finds evidence of scour along the rock cross vanes and log cross vanes, additional actions may be implemented to limit future scouring in these areas.

3.1.1.2 Repository Construction

The existing repository will be expanded to provide additional capacity for excavated materials generated during Furnace Creek restoration. Contaminated tailings and/or soil and sediment material will be placed and consolidated in the onsite repository as shown in the implementation plan figures (Appendix A). The field engineer will supervise the placement and consolidation of the contaminated material and verify the repository has been constructed as detailed in the implementation plan figures (Appendix A). The repository will be graded to promote drainage of stormwater runoff and to minimize erosion potential and ponding of water. The removal contractor will be responsible for monitoring and verifying that contouring of the repository is performed to the appropriate lines and grades and materials are placed in accordance with the implementation plan figures (Appendix A).

3.1.1.3 Stormwater Control Channels

The field engineer will confirm that the removal contractor has verified, using appropriate instruments, the repository stormwater control channels meet the channel side slopes and bottom width as shown on the implementation plan figures (Appendix A).

3.1.1.4 Stormwater Basin

The field engineer will visually monitor the excavation of material during the construction of the stormwater basin to confirm conformance with the lines and grades shown on the implementation plan figures (Appendix A). Furthermore, the field engineer will verify that material excavated during the construction of the stormwater basin is designated as contaminated material and placed within the repository footprint.

3.1.2 Environmental Protection Methods

The removal contractor should implement dust control countermeasures, water quality monitoring, and an erosion and sediment control plan in an effort to protect human health and the environment.

3.1.2.1 Temporary Erosion and Sediment Control BMPs

The primary BMP to be employed for this project is scheduling construction during the dry season when most or all of the stream channel is anticipated to be dry. Additionally, the work should be sequenced from upstream to downstream to minimize potential for recontamination of restored creek sections.

BMPs should be installed and maintained throughout the duration of the project. Anticipated temporary erosion control BMPs include silt fence, straw wattles, straw bales, and check dams, and mulching, fertilizing, and seeding for slope stabilization. Silt fence should be installed downstream of the active working area of Furnace Creek to prevent sediment discharge generated during construction activities from migrating downstream.

The removal contractor should inspect and maintain erosion-control BMPs throughout construction to verify they are properly installed and are functioning adequately. The field engineer will visually verify that temporary BMPs are in place and will monitor the erosion-control maintenance efforts. If the field engineer determines that installed BMPs are not adequately controlling erosion, the field engineer will direct the removal contractor to stop work until necessary protections are in place.

3.1.2.2 Dust Monitoring and Control

The removal contractor should water or otherwise treat dust-generating surfaces as often as necessary to prevent visible dust during construction. Methods for treating dust-generating surfaces should be verified and checked with the field engineer prior to implementation. The field engineer will visually monitor fugitive dust throughout the construction process and will notify the removal contractor upon observing visible dust.

3.1.2.3 Water Quality Monitoring

The field engineer will perform ongoing visual monitoring for oil sheen and sediment discharge during construction and will notify the removal contractor of any visible discharge. If discharge is observed, the removal contractor should immediately take appropriate steps to modify construction BMPs, engineering controls, and other measures, as appropriate, to preserve water quality. If there is significant sheen or sediment observed migrating outside the engineering control at any time, construction activities should be suspended until a remedy is executed, as confirmed by the field engineer.

3.1.3 Suitability of Imported and Borrow Material

Prior to use of imported or borrow material at the Site, samples of material intended for use at the Site shall be submitted by the removal contractor for analysis (see Section 2.2.4). The field engineer will review and confirm the samples were collected and analyzed appropriately, and the results meet the acceptance criteria listed in Tables 2-1, 2-2, and 2-3 (as appropriate for the material type). If the results do not meet the acceptance criteria, the material will be rejected. The field engineer will verify that a clean material certificate has been received for each source used for the following material types:

- Cover soil (i.e., topsoil)
- Crushed aggregates/granular fill (i.e., cobble bedding, cobble, riprap)

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Section 4

References

CDM Smith. 2016. *Final Engineering Evaluation Cost Analysis (EE/CA), Furnace Creek Area of Operable Unit 1, Black Butte Mine Superfund Site, Cottage Grove, Oregon*.

EPA. 2017. *First Amendment to Action Memorandum for a Non-Time-Critical Removal Action for the Furnace Creek Area at Operable Unit 1 of the Black Butte Mine Superfund Site, Lane County, Oregon*.

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Appendix A

Implementation Plan Figures

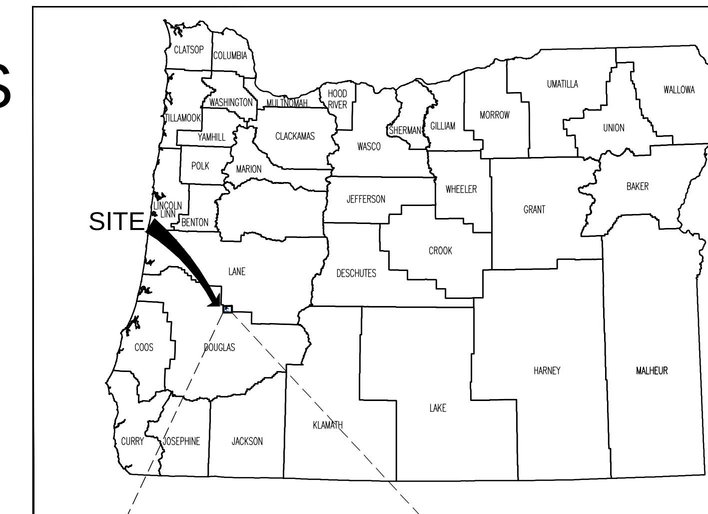
US EPA
Region 10
Seattle, Washington

BLACK BUTTE MINE SUPERFUND SITE

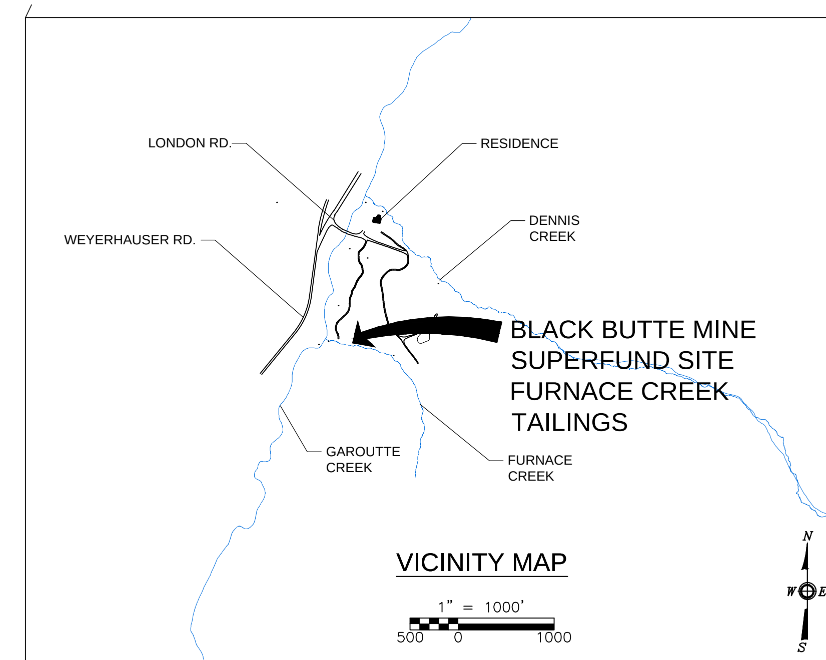
FURNACE CREEK TAILINGS NTCRA IMPLEMENTATION PLAN FIGURES

LANE COUNTY, OREGON

DRAWING INDEX



OREGON
LOCATION MAP
(NTS)



VICINITY MAP
1" = 1000'
500 0 1000

EXCAVATION PLAN NOTES:

1. CONDUCT CLEARING AND GRUBBING WITHIN THE LIMITS OF EXCAVATION. TREE AND PLANT PROTECTION DURING CLEARING AND GRUBBING SHALL BE CONDUCTED AS DIRECTED BY ENGINEER.
2. INITIAL EXCAVATION LIMITS ARE APPROXIMATE BASED ON EXISTING DATA. LATERAL AND VERTICAL EXTENTS OF EXCAVATION ARE SUBJECT TO CHANGE BASED ON VISUAL OBSERVATION AND CONFIRMATION SAMPLING.
3. DISPOSE OF ALL EXCAVATED MATERIALS IN ACCORDANCE WITH THE IMPLEMENTATION PLAN AND FIGURES. EXCAVATED MATERIALS SHALL BE DISPOSED AT THE REPOSITORY UNLESS OTHERWISE SPECIFIED BY ENGINEER.
4. CONFIRMATION SAMPLING WILL BE CONDUCTED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) AND/OR ENGINEER.
5. RESTORATION ACTIVITIES, INCLUDING BACKFILLING, SHALL NOT COMMENCE WITHOUT ENGINEER APPROVAL BASED ON CONFIRMATION SAMPLE RESULTS.
6. EXCAVATE AROUND TREES AND BUSHES TO BE LEFT IN PLACE AS DIRECTED BY THE ENGINEER.
7. DURING CONSTRUCTION, THE ENGINEER MAY DESIGNATE ADDITIONAL TREES AND BUSHES TO BE LEFT IN PLACE OR REMOVED THAT ARE NOT SHOWN ON THE CONTRACT DRAWINGS.
8. CONTRACTOR TO PROTECT AND LEAVE ALL ABOVEGROUND AND UNDERGROUND UTILITIES (E.G., WATER, GAS, AND ELECTRICAL LINES). THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING ALL DAMAGED UTILITIES AT NO EXPENSE TO THE OWNER OR THE US EPA.
9. ASSUME 2' DEEP EXCAVATION INTO NATIVE GROUND BELOW SURFACE REMOVALS.
10. AS NECESSARY AND APPLICABLE, PRIOR TO CONSTRUCTION, CONTRACTOR SHALL ESTABLISH EXCLUSION ZONES, CONTAMINATION REDUCTION ZONES AND SUPPORT ZONES.
11. CONTRACTOR SHALL CONSTRUCT TEMPORARY PROJECT SAFETY FENCING AROUND WORK AREA(S).

SOIL EROSION AND SEDIMENT CONTROL NOTES (CONTRACTOR RESPONSIBILITY):

1. INSTALL THE APPROPRIATE EROSION AND SEDIMENT CONTROLS PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES. THE EROSION CONTROL PRACTICES AND STRUCTURES SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPLEMENTATION. MAINTAIN EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION.
2. PROVIDE A MAXIMUM OF 3 OPENINGS IN SILT FENCE FOR CONSTRUCTION ACCESS, UNLESS AN ALTERNATIVE NUMBER OF OPENINGS ARE APPROVED BY ENGINEER. LOCATION AND SIZE (2 – MAXIMUM 16 FEET WIDE, 1 – MAXIMUM 4 FEET WIDE) ARE TO BE ACCEPTABLE TO THE ENGINEER PRIOR TO CONSTRUCTION. CLOSE OFF EACH OPENING WITH STRAW BALES AT THE END OF EACH DAY.
3. INSTALL TEMPORARY SOIL EROSION AND SEDIMENT CONTROL MEASURES SHOWN ON DRAWINGS AND/OR DEEMED NECESSARY BY THE ENGINEER DURING THE COURSE OF CONSTRUCTION.
4. REMOVE EROSION AND SEDIMENT CONTROLS UPON COMPLETION OF RESTORATION ONLY WITH APPROVAL FROM THE ENGINEER.
5. MAINTAIN ALL EROSION CONTROLS FOR DURATION OF CONSTRUCTION ACTIVITIES AS REQUIRED BY ENGINEER.

RESTORATION PLAN NOTES (CONTRACTOR RESPONSIBILITY):

1. BEGIN BACKFILL AND RESTORATION ONLY AFTER EXCAVATION ACTIVITIES ARE COMPLETED AND APPROVED BY THE ENGINEER.
2. MAINTAIN ALL EROSION AND SEDIMENTATION CONTROLS PREVIOUSLY INSTALLED DURING EXCAVATION ACTIVITIES.
3. GRADE ALL BACKFILL MATERIALS TO ALLOW POSITIVE DRAINAGE. DO NOT LEAVE LOW SPOTS OR AREAS WHERE WATER WILL COLLECT WITHIN THE RESTORATION AREAS.
4. RECLAIM ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITIES INCLUDING THOSE AREAS OUTSIDE OF EXCAVATION LIMITS.
5. CLEAN UP AND RESTORE AREAS ADJACENT TO THE WORK AREA ONCE RESTORATION ACTIVITIES ARE COMPLETED AS DIRECTED BY THE ENGINEER.
6. PROTECT AND LEAVE UTILITY POLES IN PLACE DURING RESTORATION.
7. RESTORATION AROUND TREES AND BUSHES TO BE LEFT IN PLACE SHALL BE SUBJECT TO THE EXCLUSION RADIUS, AS DIRECTED BY THE ENGINEER. THE EXCLUSION RADIUS IS TYPICALLY DEFINED AS THE DRIPLINE OF THE BRANCHES OF THE TREE OR BUSH.

GENERAL NOTES:

1. LOCATION OF ALL EXISTING UTILITIES, STRUCTURES, AND SUBSURFACE SOIL OR ROCK CONDITIONS ARE BASED ON THE BEST AVAILABLE INFORMATION AND NOT WARRANTED TO BE EXACT, NOR IS IT WARRANTED THAT ALL ARE SHOWN. ALL OVERHEAD ELECTRICAL AND TELEPHONE CABLES AND POLES, AND UNDERGROUND WATER AND SEWER ARE NOT WARRANTED TO BE SHOWN.
2. THE CONTRACTOR SHALL BECOME SATISFIED AS TO THE CONDITIONS WITHIN THE SITES, THE TYPE OF EQUIPMENT REQUIRED TO PERFORM THE WORK, AND THE CHARACTER, QUALITY, AND QUANTITY OF THE SUBSURFACE MATERIALS TO BE ENCOUNTERED INSOFAR AS THIS INFORMATION IS REASONABLY ASCERTAINABLE FROM AN INSPECTION OF WORK AREAS, AS WELL AS INFORMATION PRESENTED BY THE IMPLEMENTATION PLAN AND THESE CONSTRUCTION FIGURES.
3. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL EXISTING ITEMS, UTILITIES, OR STRUCTURES. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO SATISFY ITSELF THAT ALL THE EXISTING UTILITIES AND OTHER ITEMS, WHETHER SHOWN ON THESE DRAWINGS OR NOT, HAVE BEEN PROPERLY LOCATED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING UTILITY CLEARANCES AND REPORT FINDINGS TO THE ENGINEER ON UTILITY CLEARANCE FORMS PRIOR TO CONSTRUCTION ACTIVITIES. PROTECTION OF UTILITIES IN-PLACE IS PREFERABLE TO UTILITY RELOCATION. IF ANY UTILITY REQUIRES RELOCATION, THE CONTRACTOR SHALL NOTIFY THE OWNER OF THE UTILITY WELL IN ADVANCE OF APPROACH TO THE UTILITY AND SHALL BE RESPONSIBLE FOR MAKING ALL ARRANGEMENTS WITH THE UTILITY'S OWNER FOR RELOCATION OF THE UTILITY.
4. THE CONTRACTOR IS RESPONSIBLE FOR ALL PROJECT SAFETY AS DETAILED IN THE CONTRACTOR'S SITE SAFETY AND HEALTH PLAN.
5. THE CONTRACTOR SHALL PROVIDE CONSTRUCTION FENCING AND SIGNS TO IDENTIFY ACTIVE WORK ZONES TO PREVENT UNAUTHORIZED ACCESS TO THE SITE.
6. EPA WILL OBTAIN ALL ACCESS AGREEMENTS NECESSARY TO ACCESS THE PROPERTIES THAT REQUIRE REMOVAL. THE CONTRACTOR IS NOT TO PERFORM WORK ON ANY PROPERTIES WITHOUT A SIGNED ACCESS AGREEMENT.
7. THE CONTRACTOR SHALL LIMIT ITS ACTIVITIES TO WITHIN THE DESIGNATED WORK AREAS AND COORDINATE WORK REQUIRED OUTSIDE THESE WORK AREAS WITH THE ENGINEER.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE MINIMUM SECURITY TO SECURE THE CONTRACTOR'S FACILITIES AND EQUIPMENT.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SIGNAGE.
10. THE CONTRACTOR SHALL USE CAUTION WHEN WORKING AROUND MINE SHAFTS, ADITS, AND SUBSIDENCES.
11. EXISTING CONTOUR DATA FROM AERIAL LIDAR DATA, COLLECTED APRIL OF 2013.
12. CLEARED VEGETATIVE MATERIAL INCLUDING TREES, SHRUBS, AND BUSHES, SHALL BE SALVAGED AND STOCKPILED BY THE CONTRACTOR FOR REUSE AS MULCH AND LOG CROSS VANE STRUCTURES FOR RESTORATION ACTIVITIES. INVASIVE SPECIES SUCH AS SCOTCH BROOM AND BLACKBERRY BUSHES SHALL BE DISPOSED OF IN SEPARATE SLASH PILES AND NOT USED FOR RESTORATION ACTIVITIES. NON-INVASIVE CLEARED MATERIAL NOT USED FOR RESTORATION ACTIVITIES SHALL BE DISPOSED OF IN SEPARATE SLASH PILES.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SIZING OF EQUIPMENT USED DURING THE PROJECT FOR WEIGHT RESTRICTION ON EXISTING BRIDGES AND ROADS. CONTRACTOR SHALL COORDINATE WITH LANE COUNTY REGARDING LOAD LIMITS ON ACCESS ROUTE BRIDGE NEAR THE RESIDENCE. CONTRACTOR SHALL COORDINATE WITH APPROPRIATE COUNTY, STATE, AND FEDERAL AGENCIES FOR USE OF PUBLIC ROADS.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ASSESSING THE POTENTIAL FOR FIRE HAZARDS ONSITE AND MITIGATE FIRE HAZARDS DURING CONSTRUCTION, PARTICULARLY DURING CLEARING AND GRUBBING ACTIVITIES AND STOCKPILING OF WOODY DEBRIS.

LEGEND

NOTE: IN GENERAL, EXISTING FEATURES ARE GREY AND NEW OR IMPORTANT FEATURES ARE BLACK.

- 7750 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 7750 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- W — POTABLE WATER LINE
- FURNACE CREEK TAILINGS
- REMOVAL ACTION BOUNDARY
- CLEARING AND GRUBBING LIMITS
- ACCESS ROUTE LIMB TRIMMING LIMITS
- PROPOSED LIMITS OF EXCAVATION AND RESTORATION
- EDGE OF EXISTING ROAD
- STREAM FLOWLINE
- PROPOSED STORMWATER CHANNEL FLOWLINE
- MONITORING WELL
- SURFACE WATER SAMPLING LOCATION
- OLD FURNACE AREA DEBRIS
- SILT FENCE PATTERN IN DETAIL
- STRAW WATTLE IN DETAIL
- NATIVE SOIL IN DETAIL
- TAILINGS CAPPED IN PLACE
- COBBLE LAYER
- NATIVE SOIL
- BORROW SOIL COVER
- MULCH BERM
- 8oz. NON-WOVEN GEOTEXTILE FILTER FABRIC

DETAIL NAME

DETAIL — SCALE

TOP — DETAIL NUMBER

BOT — SHEET WHERE DETAIL IS SHOWN

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: MILLER, TAUSHA
DRAWN BY: THOMAS, T.J.
SHEET CHK'D BY: MILLER, TAUSHA
CROSS CHK'D BY: MILLER, TAUSHA
APPROVED BY: BEAUDOIN, KARA
DATE: APRIL 2018

CDM Smith
CDM Federal Programs Corporation
1220 Big Creek Rd.
Kellogg, ID 83837
Tel: (208) 417-2250

U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

GENERAL NOTES AND LEGEND

PROJECT NO. 106504

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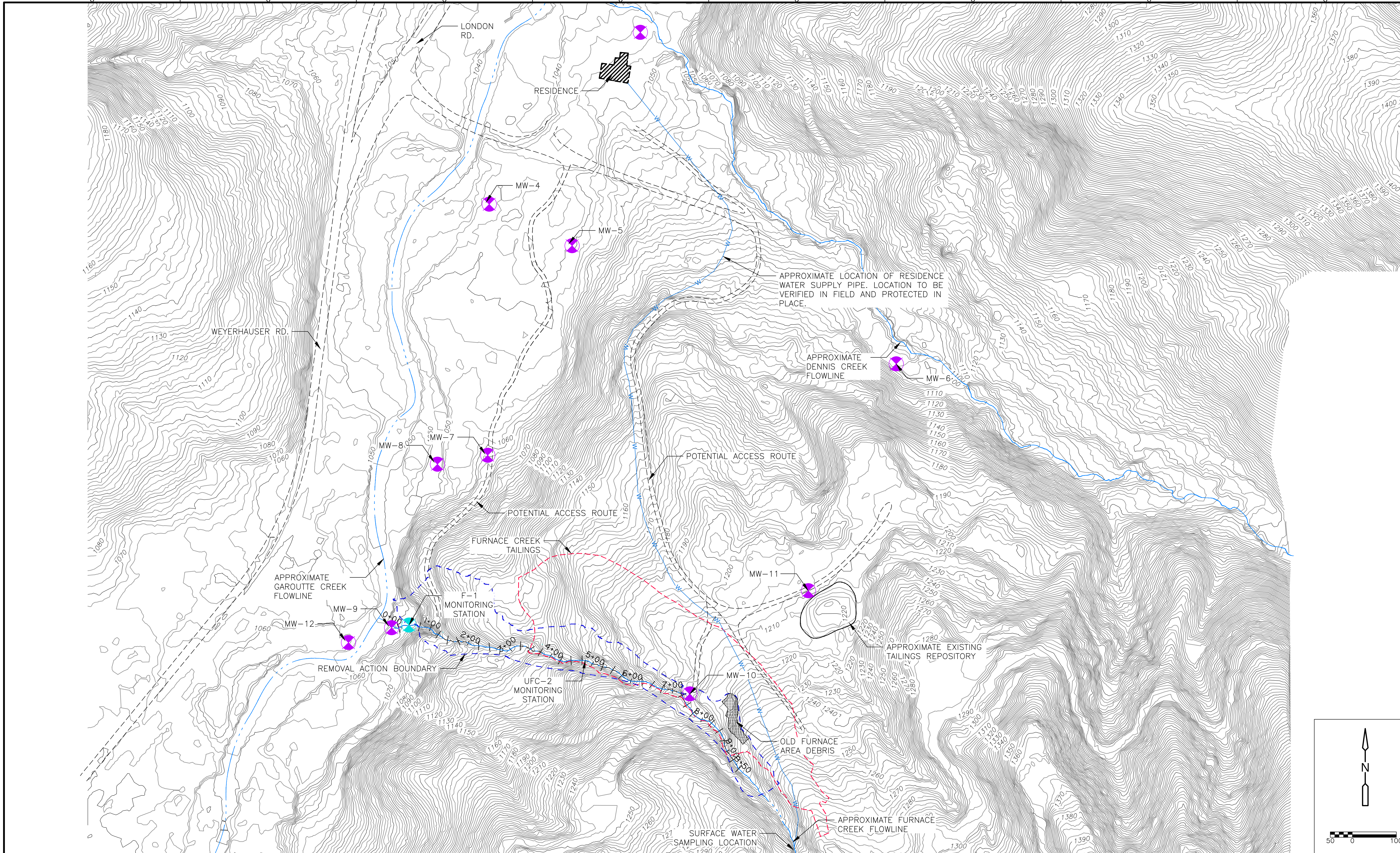

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U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

SITE OVERVIEW

PROJECT NO. 106504

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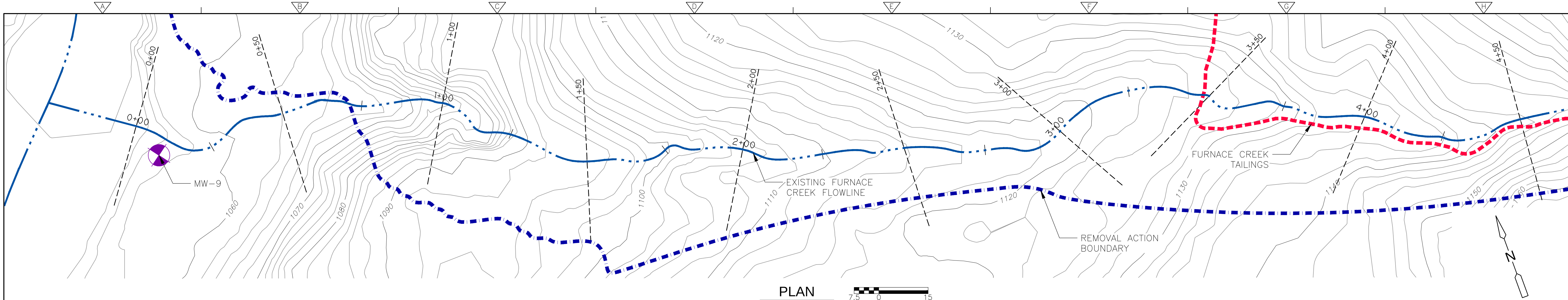

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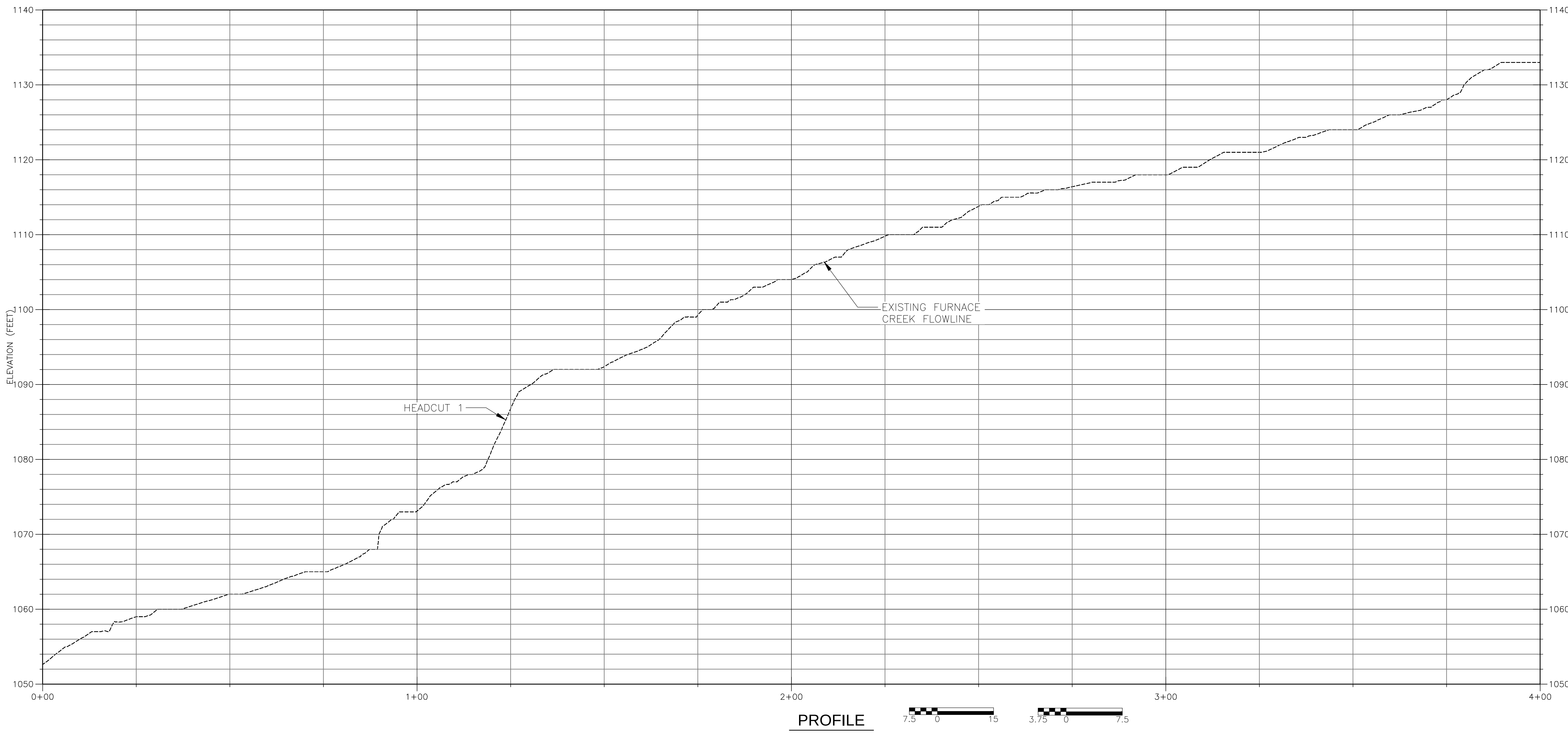

PROFILE

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Tel: (208) 417-2250

U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

EXISTING CONDITIONS PLAN AND PROFILE
STA. 0+00 TO STA. 4+00

PROJECT NO. 106504
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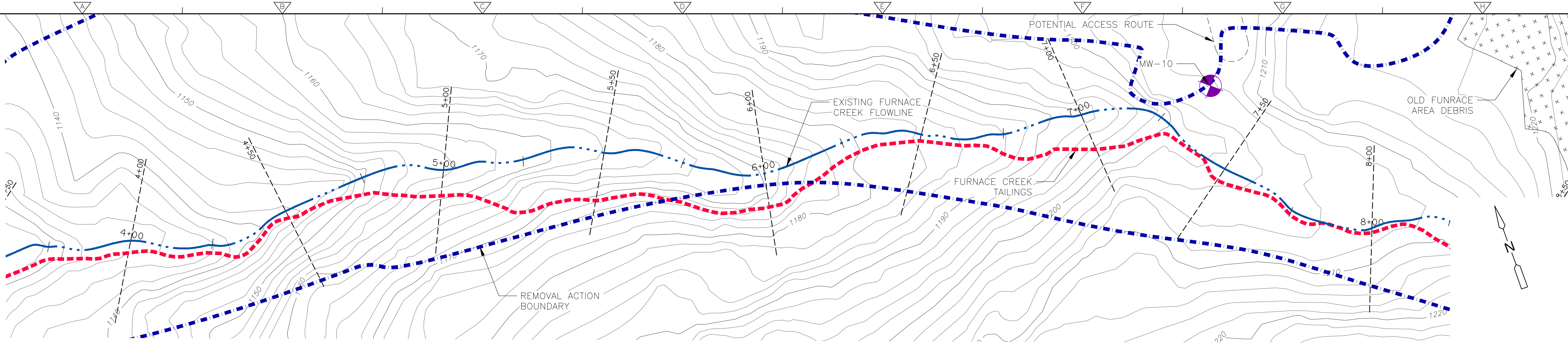
C2



PLAN

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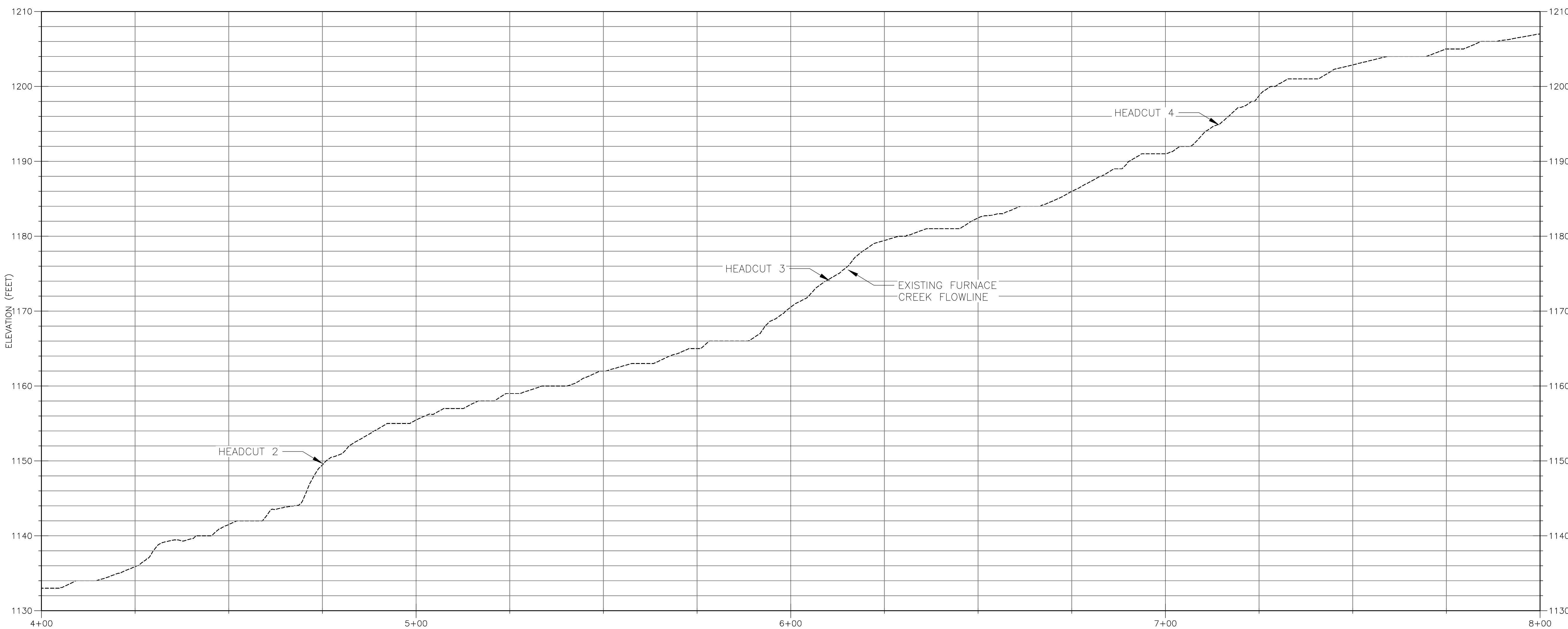

PROFILE

7.5 0 15
HORIZONTAL SCALE

3.75 0 7.5
VERTICAL SCALE

REV. NO.	DATE	DRWN	CHKD	REMARKS

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DRAWN BY: THOMAS, T.J.
SHEET CHK'D BY: MILLER, TAUSHA
CROSS CHK'D BY: MILLER, TAUSHA
APPROVED BY: BEAUDOIN, KARA
DATE: APRIL 2018

CDM Smith
CDM Federal Programs Corporation
1220 Big Creek Rd.
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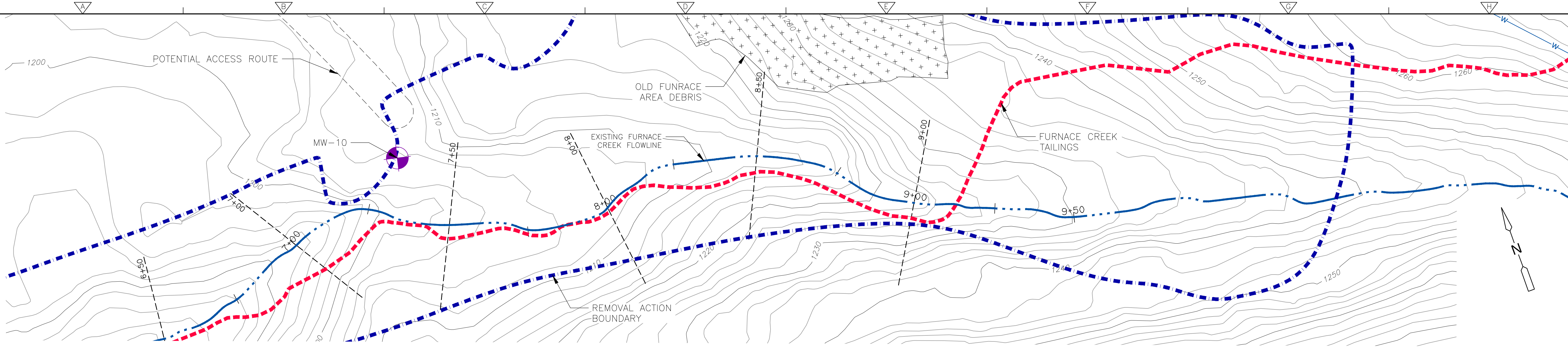
Tel: (208) 417-2250

U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

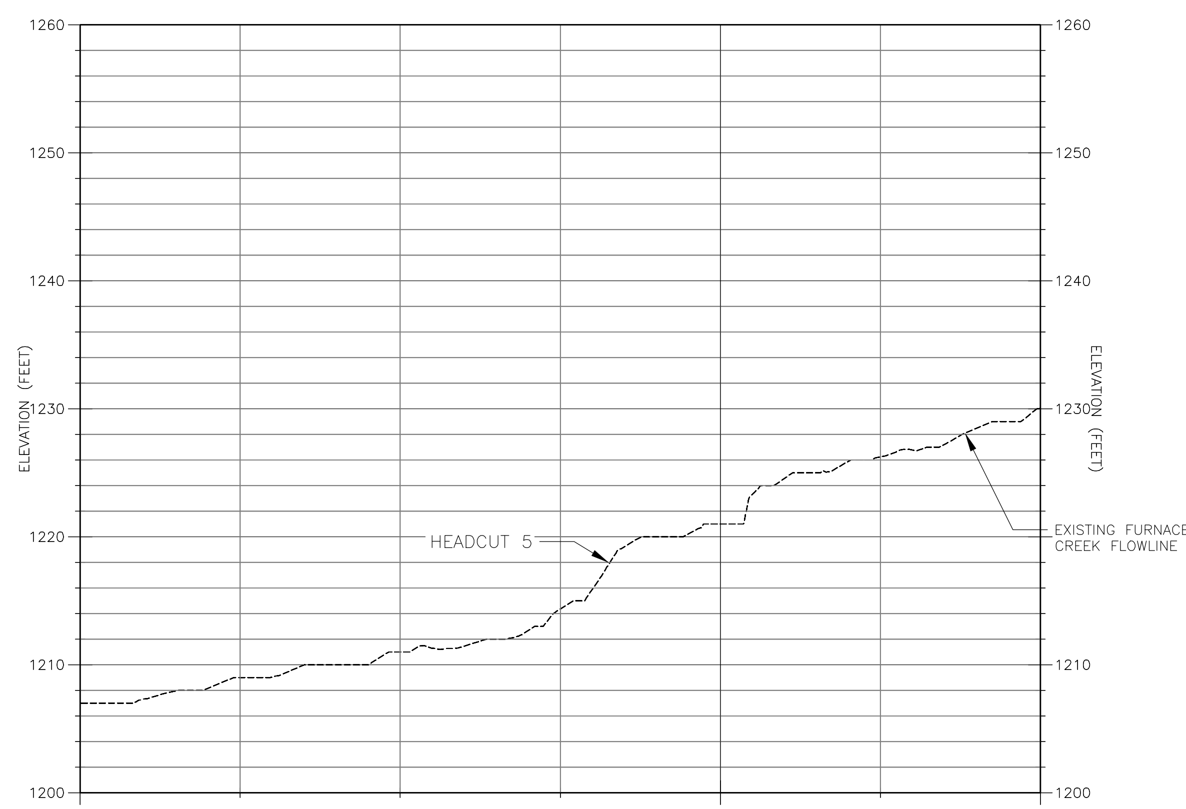
EXISTING CONDITIONS PLAN AND PROFILE
STA. 4+00 TO STA. 8+00

PROJECT NO. 106504

SHEET NO.
C3



PLAN



PROFILE

HORIZONTAL SCALE

VERTICAL SCALE

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: MILLER, TAUSHA
DRAWN BY: THOMAS, T.J.
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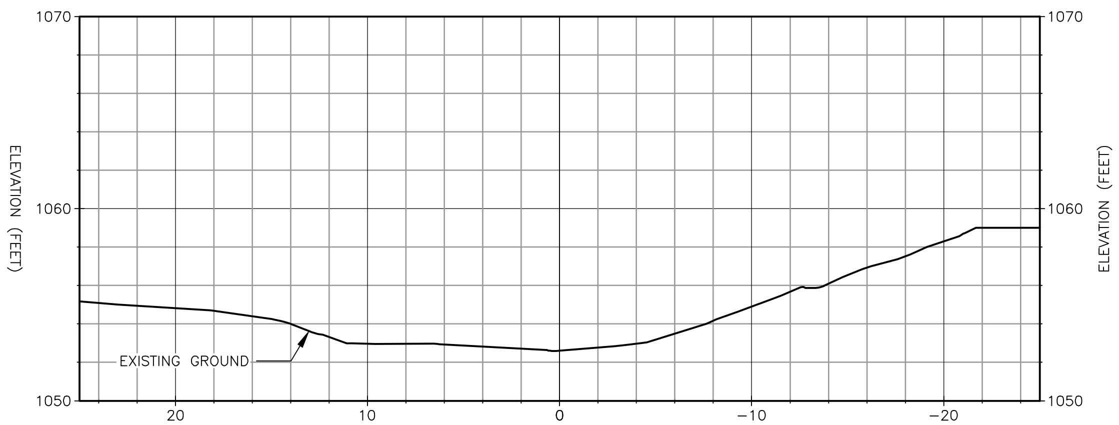
COTTAGE GROVE, OR

EXISTING CONDITIONS PLAN AND PROFILE
STA. 8+00 TO STA. 9+50

PROJECT NO. 106504

SHEET NO. C4



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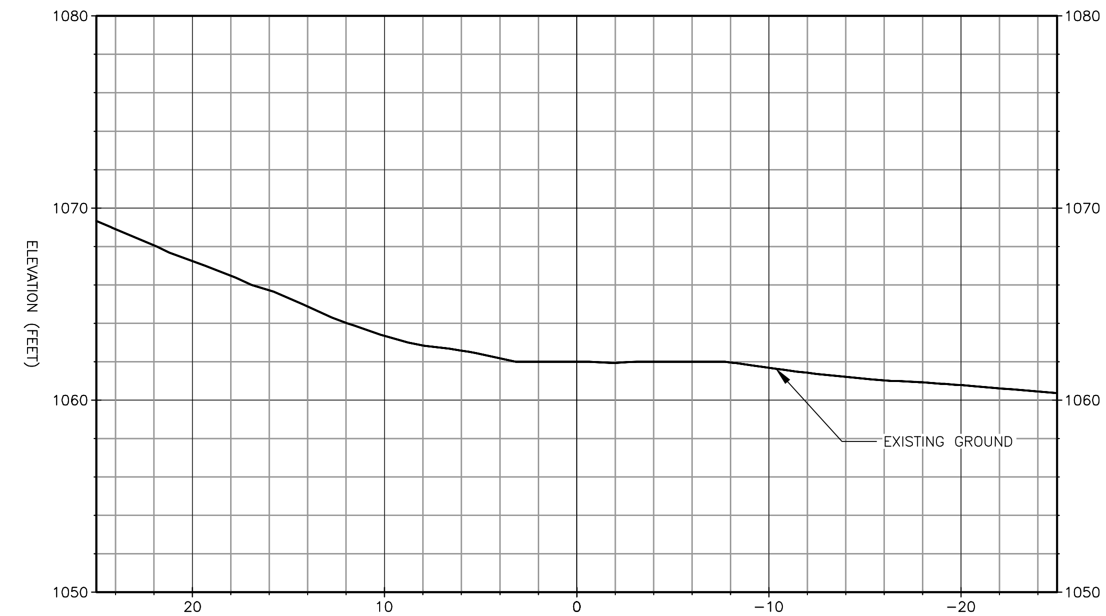

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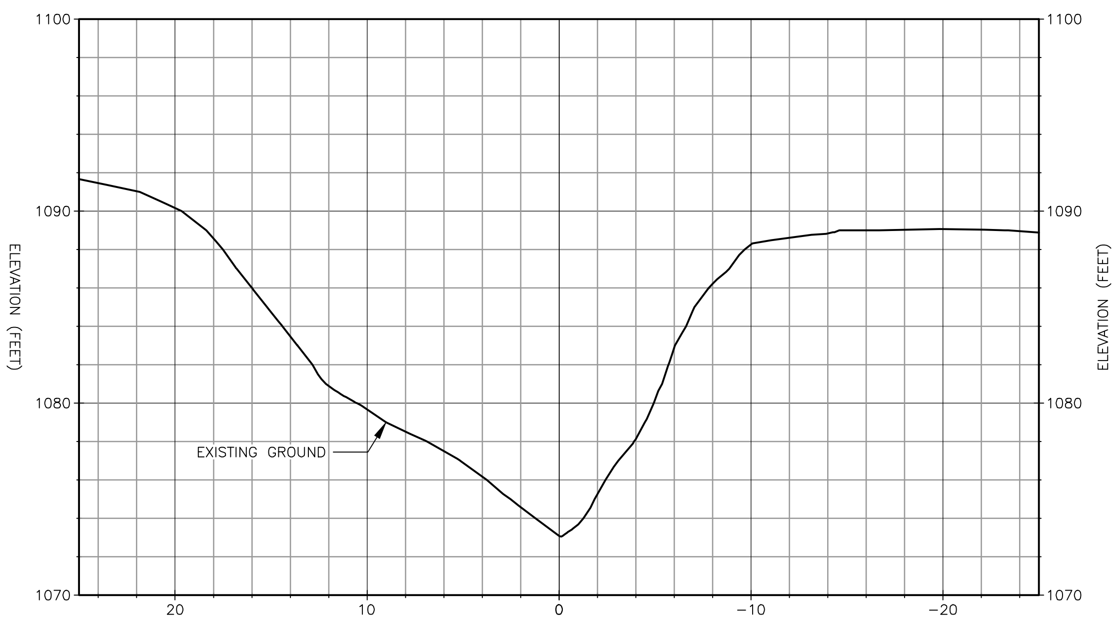

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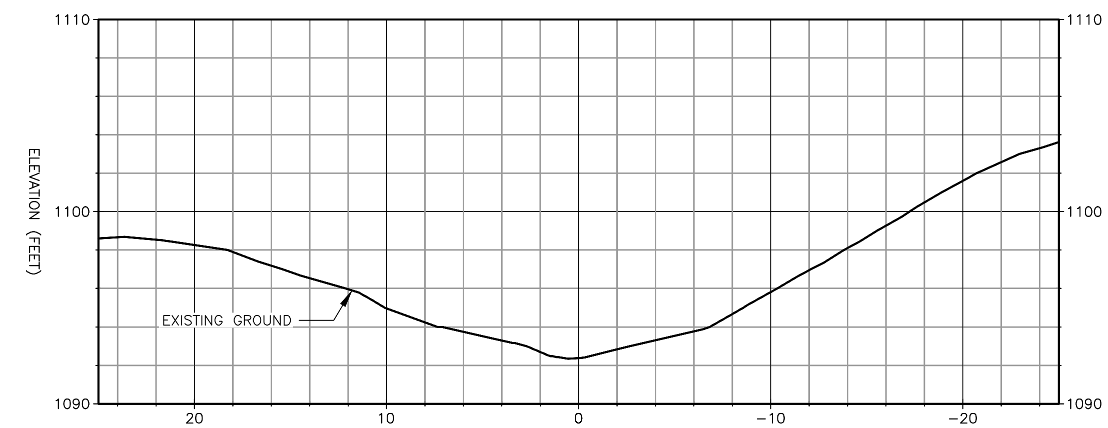

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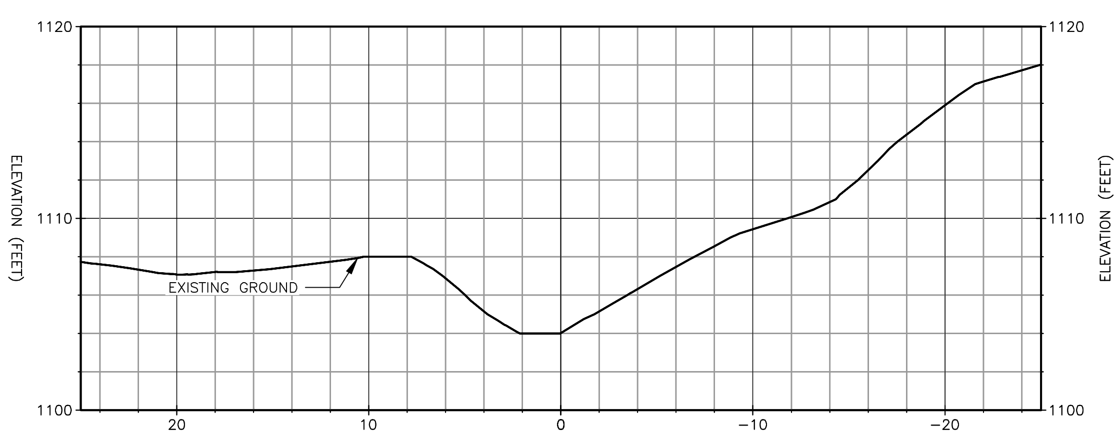

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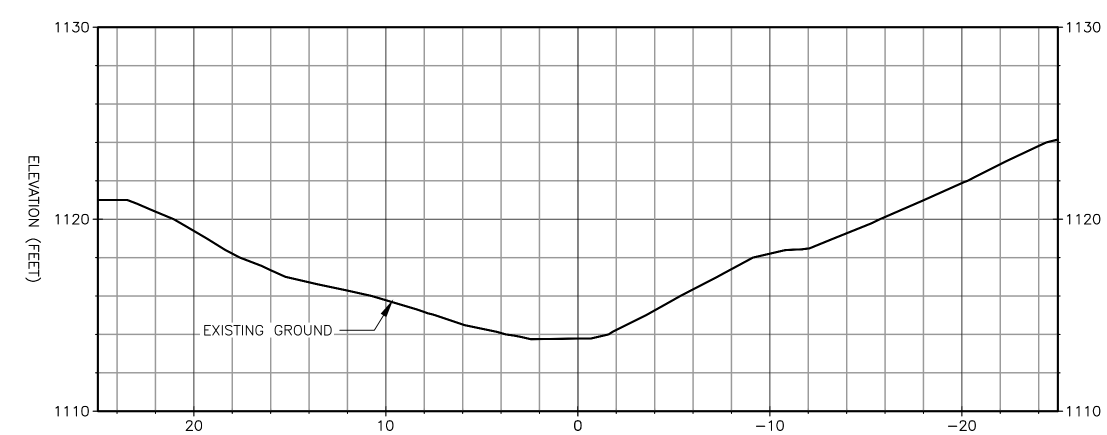

STREAM STATION 2+50

*ALL SECTION VIEWS LOOKING DOWNSTREAM

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: MILLER, TAUSHA
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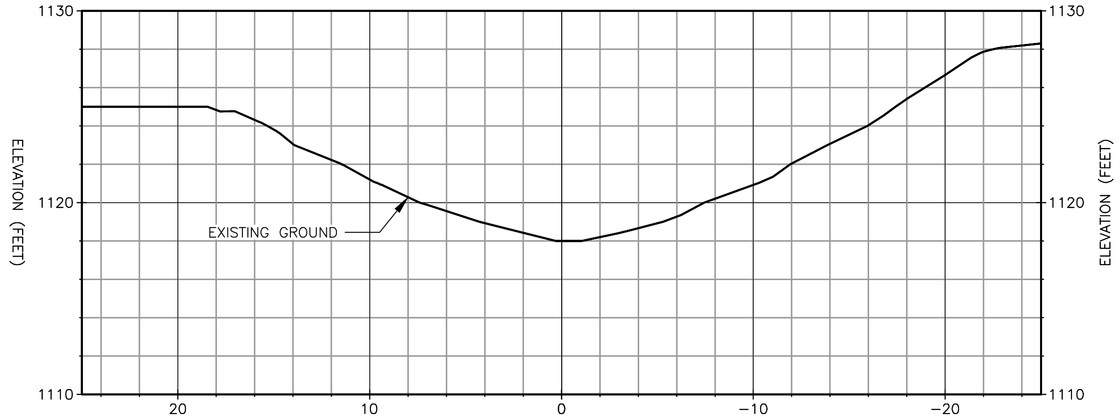
EXISTING CONDITIONS CROSS SECTIONS

PROJECT NO. 106504
SHEET NO. C5



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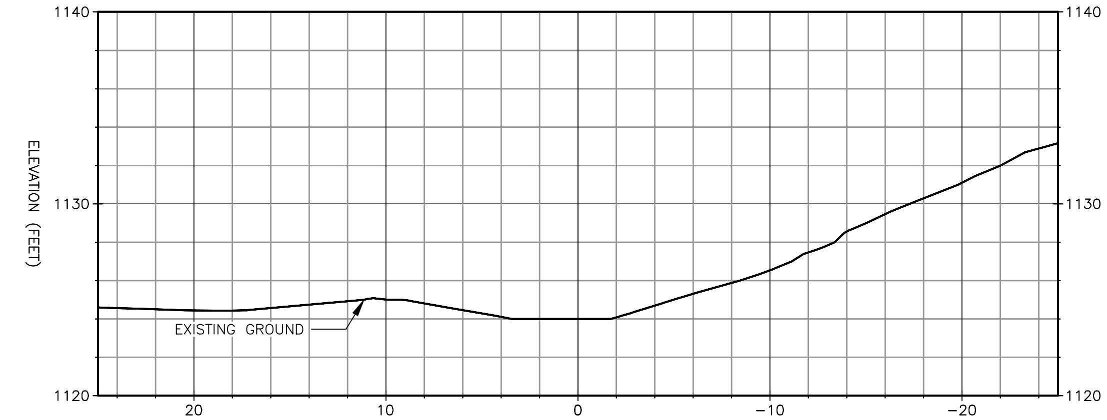

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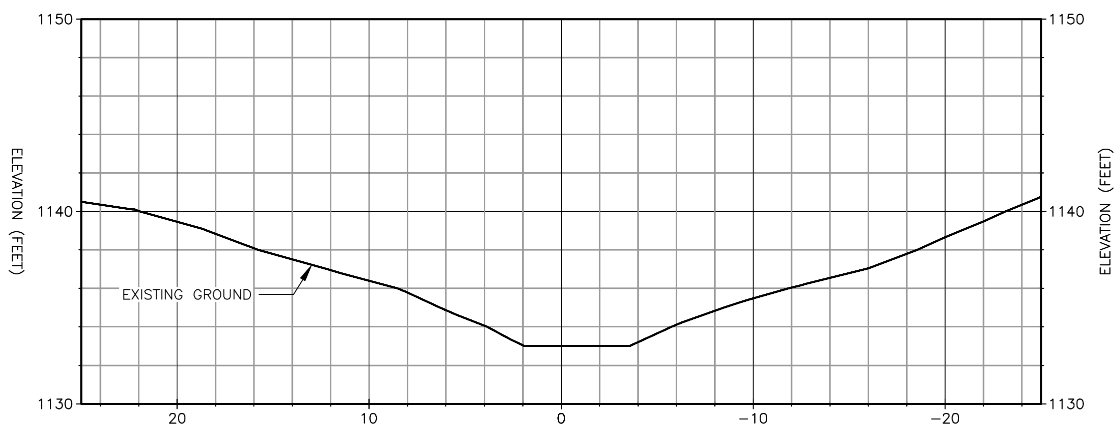

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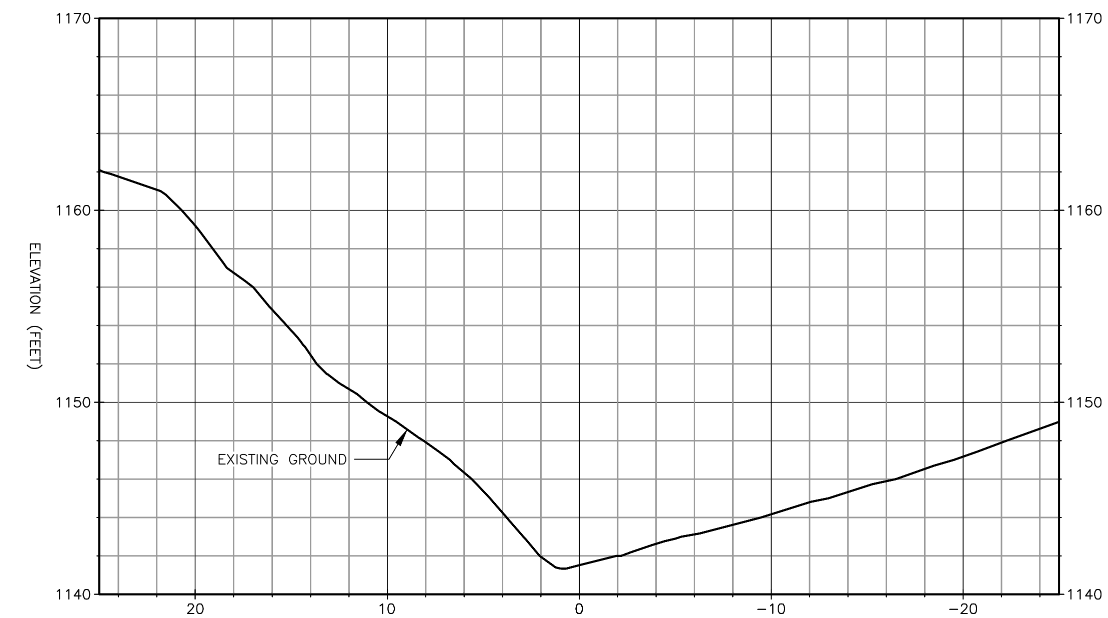

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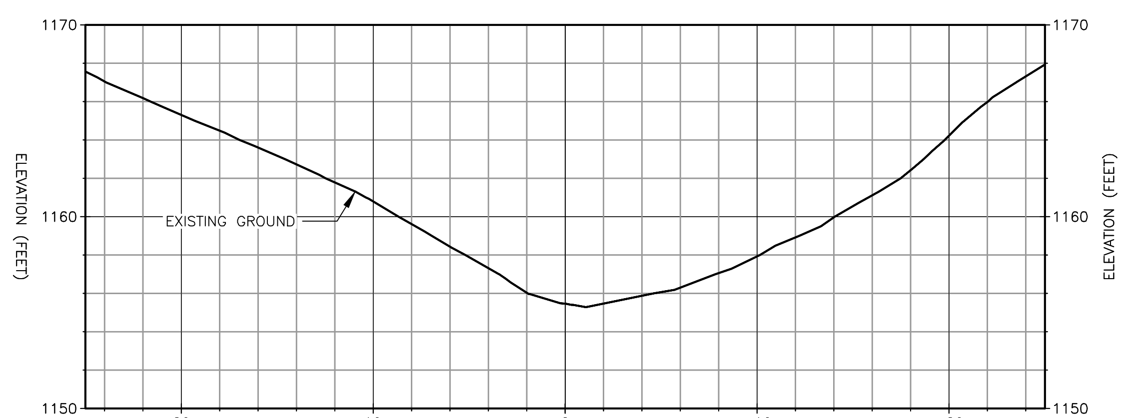

STREAM STATION 5+00

STREAM STATION 5+50

2.5 0 5

*ALL SECTION VIEWS LOOKING DOWNSTREAM

REV. NO.	DATE	DRWN	CHKD	REMARKS

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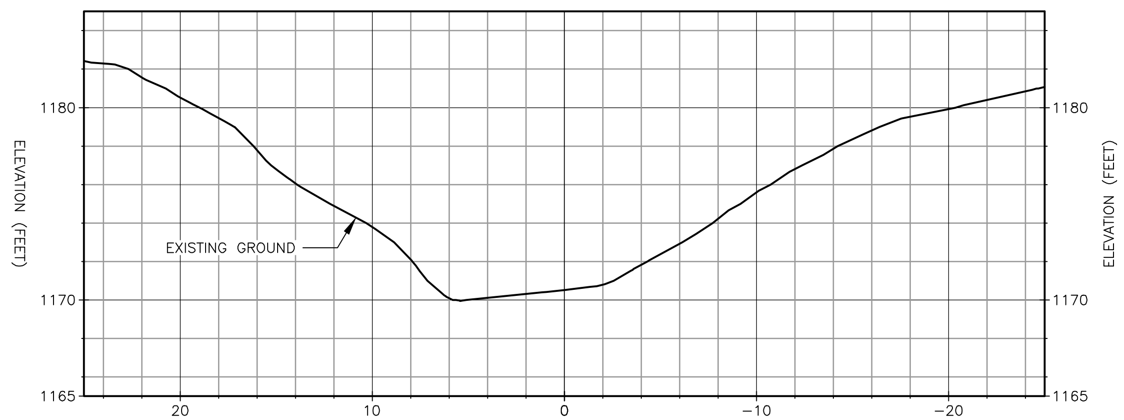
EXISTING CONDITIONS CROSS SECTIONS

PROJECT NO. 106504

SHEET NO. C6



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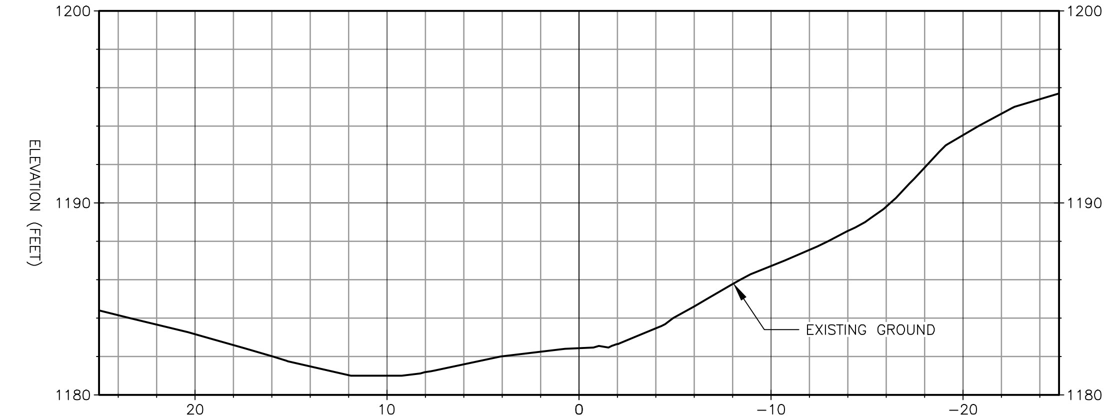

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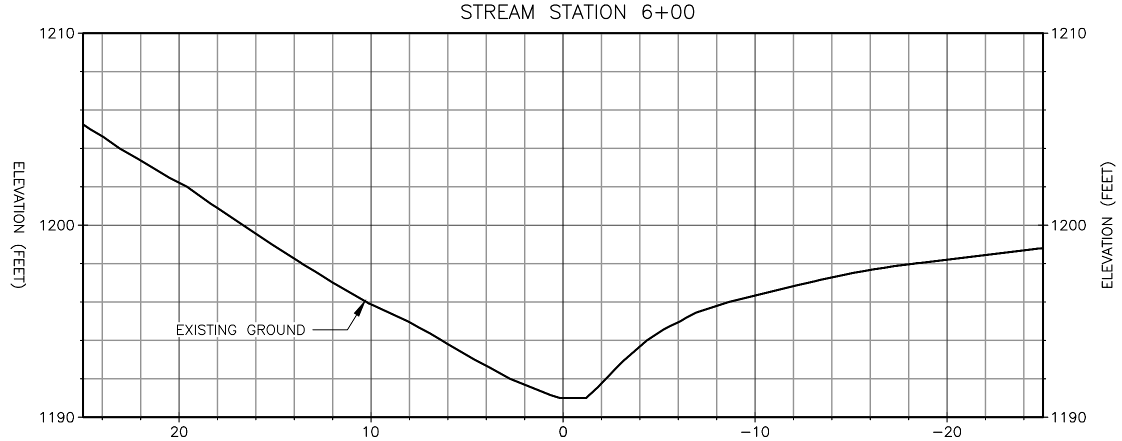

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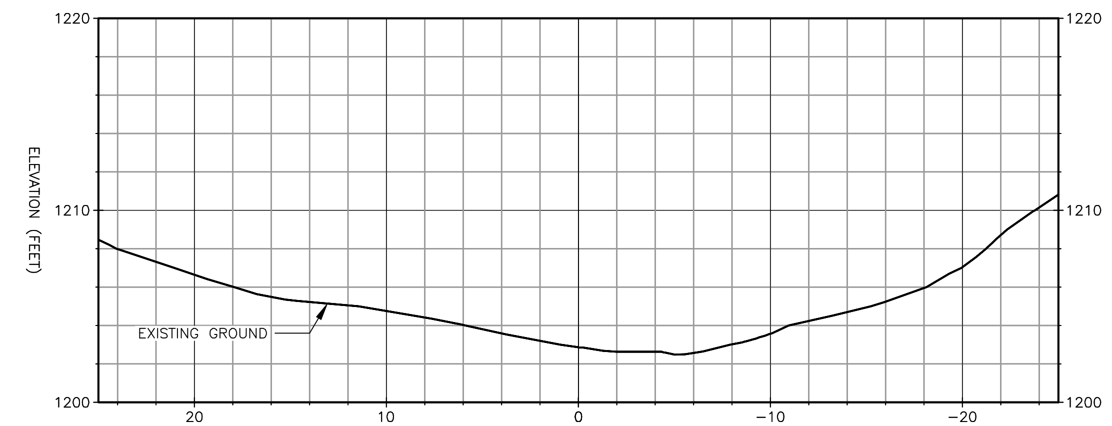

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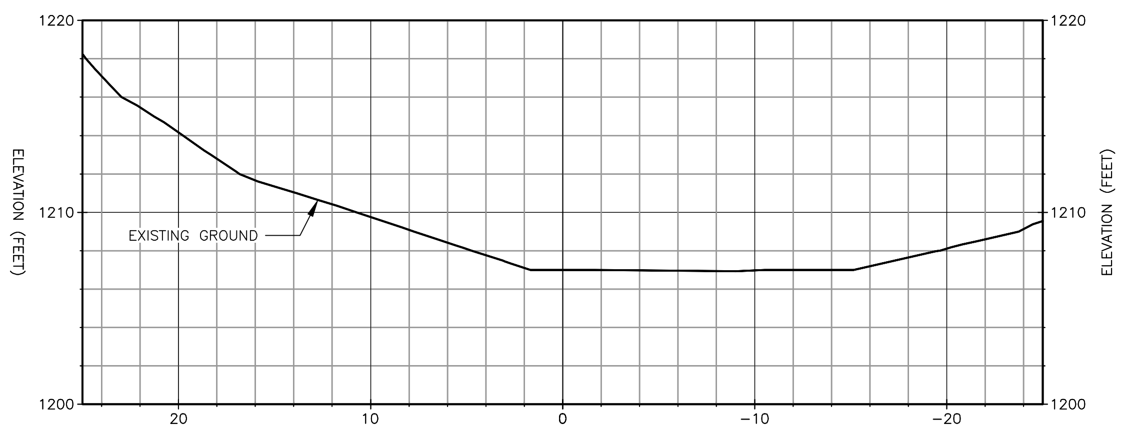

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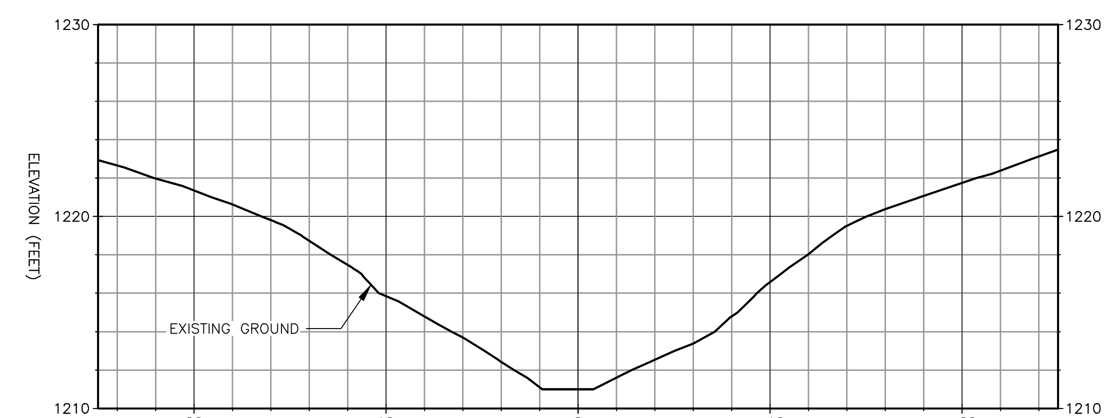

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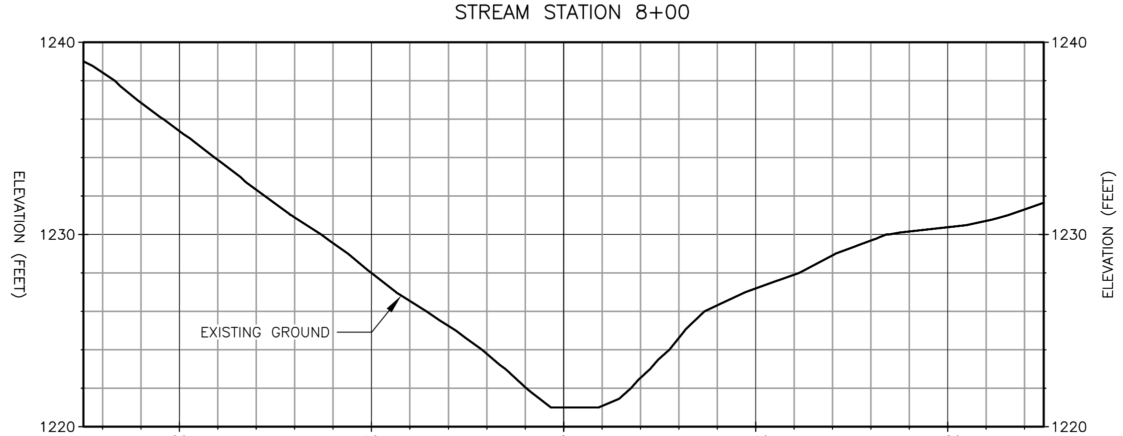

STREAM STATION 9+00

2.5 0 5

*ALL SECTION VIEWS LOOKING DOWNSTREAM

REV. NO.	DATE	DRWN	CHKD	REMARKS

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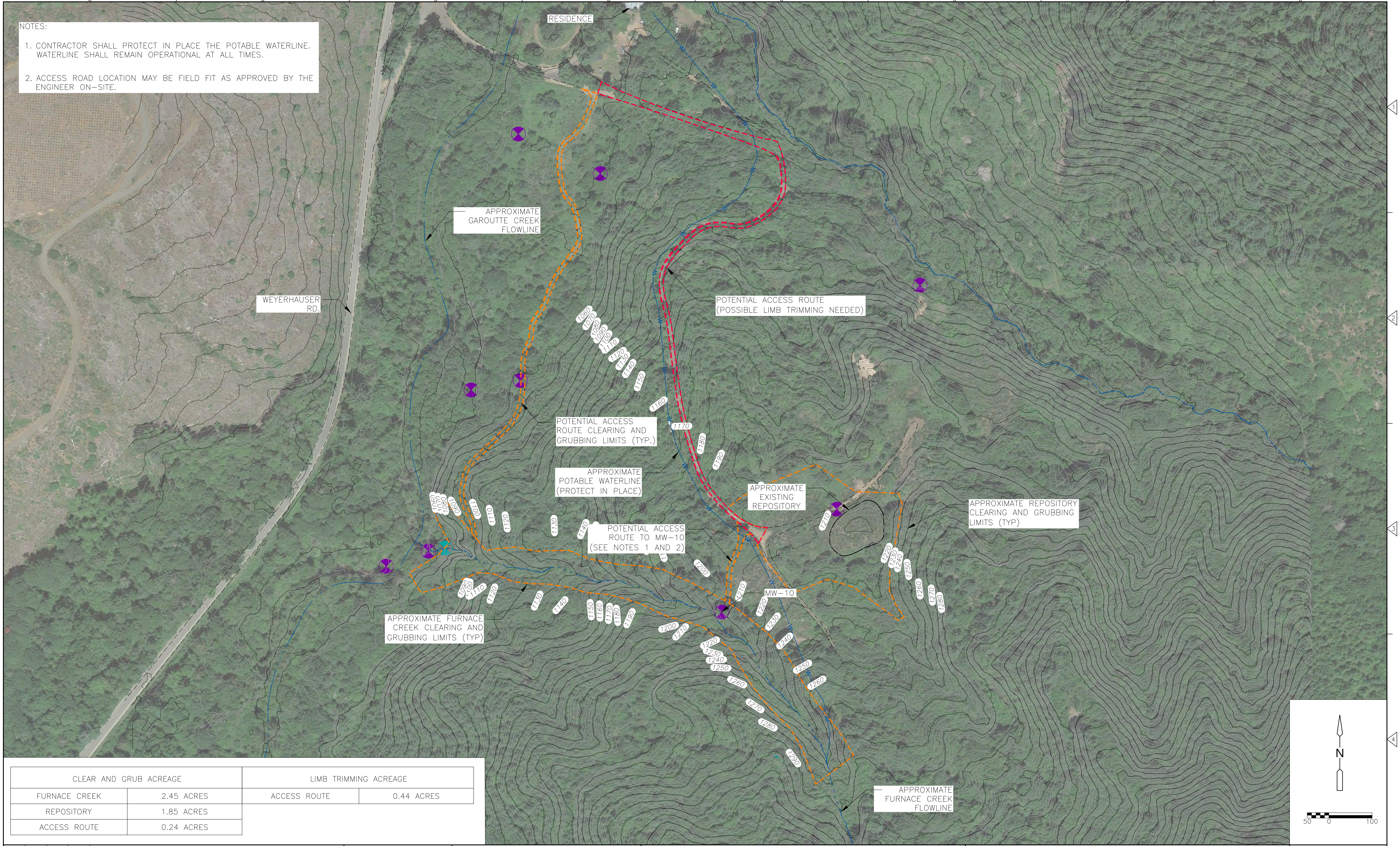
COTTAGE GROVE, OR

EXISTING CONDITIONS CROSS SECTIONS

PROJECT NO. 106504
SHEET NO. C7

NOTES:

1. CONTRACTOR SHALL PROTECT IN PLACE THE POTABLE WATERLINE. WATERLINE SHALL REMAIN OPERATIONAL AT ALL TIMES.
2. ACCESS ROAD LOCATION MAY BE FIELD FIT AS APPROVED BY THE ENGINEER ON-SITE.



CLEAR AND GRUB ACREAGE	
FURNACE CREEK	2.45 ACRES
REPOSITORY	1.85 ACRES
ACCESS ROUTE	0.24 ACRES

LIMB TRIMMING ACREAGE	
ACCESS ROUTE	0.44 ACRES

REV. NO.	DATE	DRWN	CHKD	REMARKS

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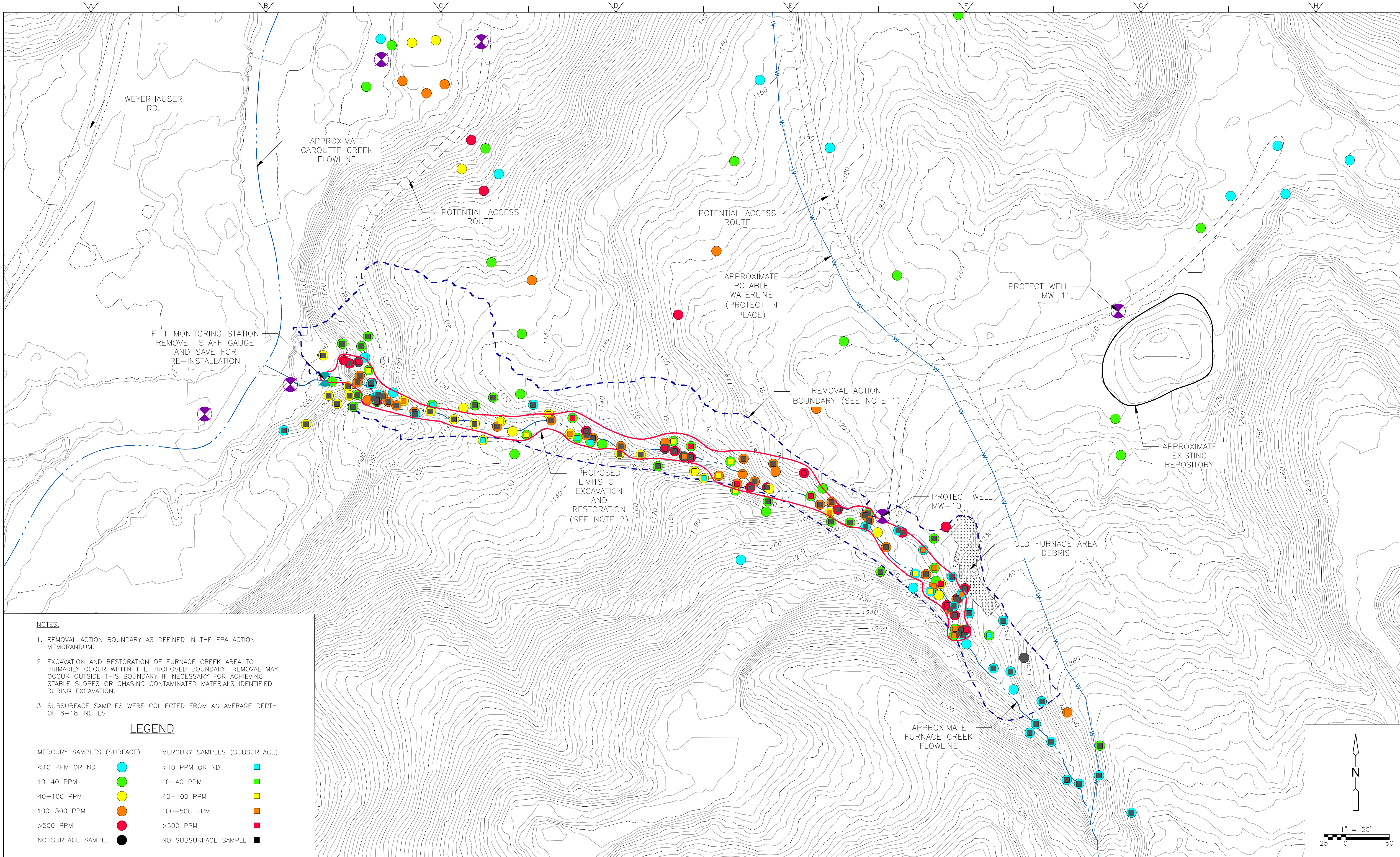
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

CLEARING AND GRUBBING

PROJECT NO. 106504
SHEET NO. C8



NOTES:

1. REMOVAL ACTION BOUNDARY AS DEFINED IN THE EPA ACTION MEMORANDUM.
2. EXCAVATION AND RESTORATION OF FURNACE CREEK AREA TO PRIMARILY OCCUR WITHIN THE PROPOSED BOUNDARY. REMOVAL MAY OCCUR OUTSIDE THIS BOUNDARY IF NECESSARY FOR ACHIEVING STABLE SLOPES OR CHASING CONTAMINATED MATERIALS IDENTIFIED DURING EXCAVATION.
3. SUBSURFACE SAMPLES WERE COLLECTED FROM AN AVERAGE DEPTH OF 6-18 INCHES

LEGEND

MERCURY SAMPLES (SURFACE)	MERCURY SAMPLES (SUBSURFACE)
<10 PPM OR ND	<10 PPM OR ND
10-40 PPM	10-40 PPM
40-100 PPM	40-100 PPM
100-500 PPM	100-500 PPM
>500 PPM	>500 PPM
NO SURFACE SAMPLE	NO SUBSURFACE SAMPLE

REV. NO.	DATE	DRWN	CHKD	REMARKS

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COTTAGE GROVE, OR

LIMITS OF EXCAVATION PLAN

PROJECT NO. 106504

SHEET NO. C9

NOTES:

1. EXCAVATION AND RESTORATION OF FURNACE CREEK AREA TO PRIMARILY OCCUR WITHIN THE PROPOSED BOUNDARY. REMOVAL MAY OCCUR OUTSIDE THIS BOUNDARY IF NECESSARY FOR ACHIEVING STABLE SLOPES OR CHASING CONTAMINATED MATERIALS IDENTIFIED DURING EXCAVATION.
2. ALL AREAS DISTURBED DURING CONSTRUCTION SHALL BE RESTORED AS DESCRIBED IN SECTION 2.3.2 OF THE IMPLEMENTATION PLAN. SEED MIXES FOR THE FLOODPLAIN, RIPARIAN, AND UPLAND AREAS ARE SHOWN IN TABLE 1, 2, AND 3, RESPECTIVELY.
3. EXCAVATION AND RESTORATION OF THE OLD FURNACE AREA DEBRIS IS NOT PART OF THE SCOPE OF THIS IMPLEMENTATION PLAN.

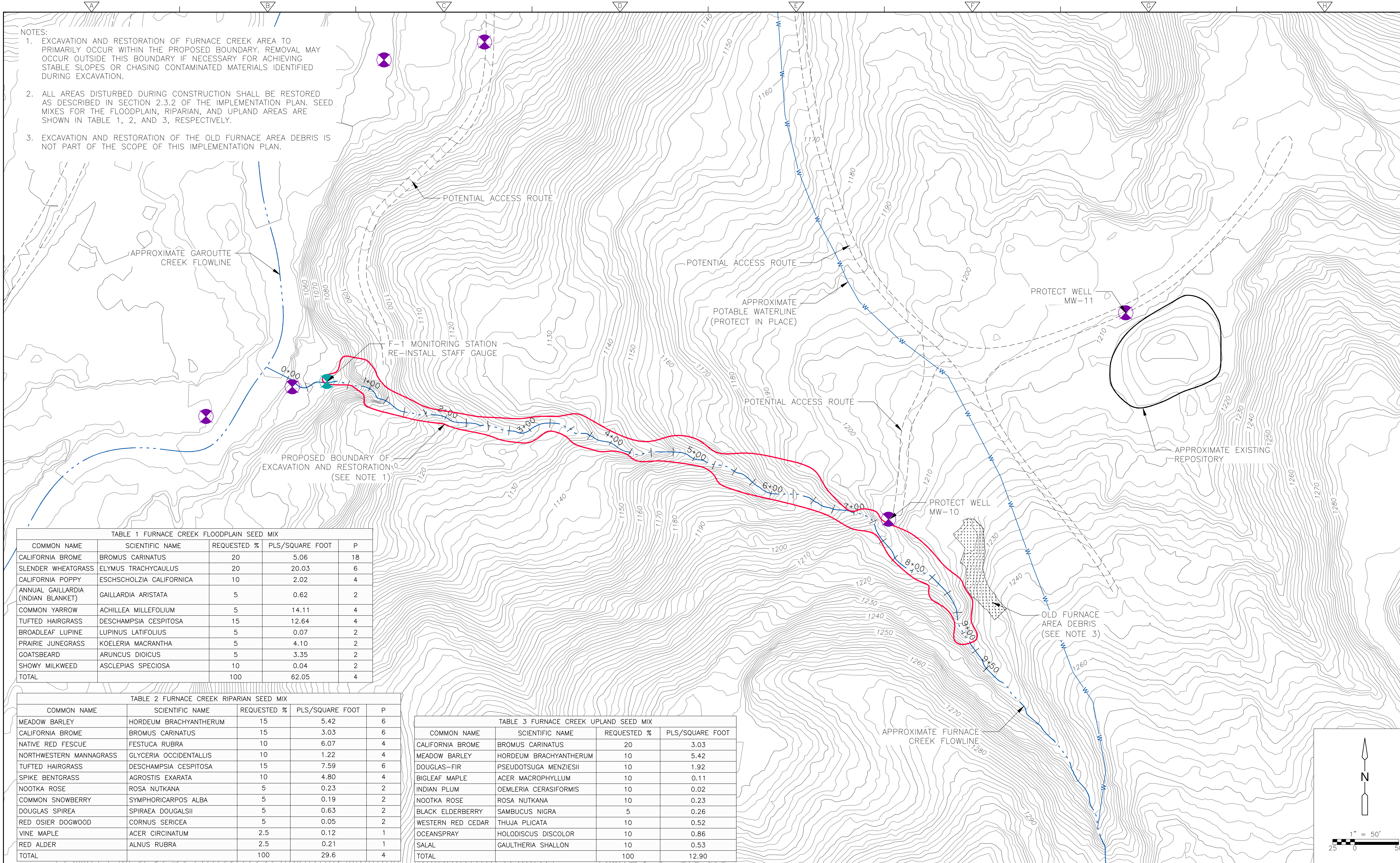

TABLE 1 FURNACE CREEK FLOODPLAIN SEED MIX

COMMON NAME	SCIENTIFIC NAME	REQUESTED %	PLS/SQUARE FOOT	P
CALIFORNIA BROME	BROMUS CARINATUS	20	5.06	18
SLENDER WHEATGRASS	ELYMUS TRACHYCAULUS	20	20.03	6
CALIFORNIA POPPY	ESCHSCHOLZIA CALIFORNICA	10	2.02	4
ANNUAL GAILLARDIA (INDIAN BLANKET)	GAILLARDIA ARISTATA	5	0.62	2
COMMON YARROW	ACHILLEA MILLEFOLIUM	5	14.11	4
TUFTED HAIRGRASS	DESCHAMPSIA CESPITOSA	15	12.64	4
BROADLEAF LUPINE	LUPINUS LATIFOLIUS	5	0.07	2
PRAIRIE JUNEGRASS	KOELERIA MACRANTHA	5	4.10	2
GOATSBEARD	ARUNCUS DIOICUS	5	3.35	2
SHOWY MILKWEED	ASCLEPIAS SPECIOSA	10	0.04	2
TOTAL		100	62.05	4

TABLE 2 FURNACE CREEK RIPARIAN SEED MIX

COMMON NAME	SCIENTIFIC NAME	REQUESTED %	PLS/SQUARE FOOT	P
MEADOW BARLEY	HORDEUM BRACHYANTHERUM	15	5.42	6
CALIFORNIA BROME	BROMUS CARINATUS	15	3.03	6
NATIVE RED FESCUE	FESTUCA RUBRA	10	6.07	4
NORTHWESTERN MANNAGRASS	GLYCERIA OCCIDENTALLIS	10	1.22	4
TUFTED HAIRGRASS	DESCHAMPSIA CESPITOSA	15	7.59	6
SPIKE BENTGRASS	AGROSTIS EXARATA	10	4.80	4
NOOTKA ROSE	ROSA NUTKANA	5	0.23	2
COMMON SNOWBERRY	SYMPHORICARPOS ALBA	5	0.19	2
DOUGLAS SPIREA	SPIRAEA DOUGALSII	5	0.63	2
RED OSIER DOGWOOD	CORNUS SERICEA	5	0.05	2
VINE MAPLE	ACER CIRCINATUM	2.5	0.12	1
RED ALDER	ALNUS RUBRA	2.5	0.21	1
TOTAL		100	29.6	4

TABLE 3 FURNACE CREEK UPLAND SEED MIX

COMMON NAME	SCIENTIFIC NAME	REQUESTED %	PLS/SQUARE FOOT
CALIFORNIA BROME	BROMUS CARINATUS	20	3.03
MEADOW BARLEY	HORDEUM BRACHYANTHERUM	10	5.42
DOUGLAS-FIR	PSEUDOTSUGA MENZIESII	10	1.92
BIGLEAF MAPLE	ACER MACROPHYLLUM	10	0.11
INDIAN PLUM	OEMLERIA CERASIFORMIS	10	0.02
NOOTKA ROSE	ROSA NUTKANA	10	0.23
BLACK ELDERBERRY	SAMBUCUS NIGRA	5	0.26
WESTERN RED CEDAR	THUJA PLICATA	10	0.52
OCEANSPRAY	HOLODISCUS DISCOLOR	10	0.86
SALAL	GAULTHERIA SHALLON	10	0.53
TOTAL		100	12.90

REV. NO.	DATE	DRWN	CHKD	REMARKS

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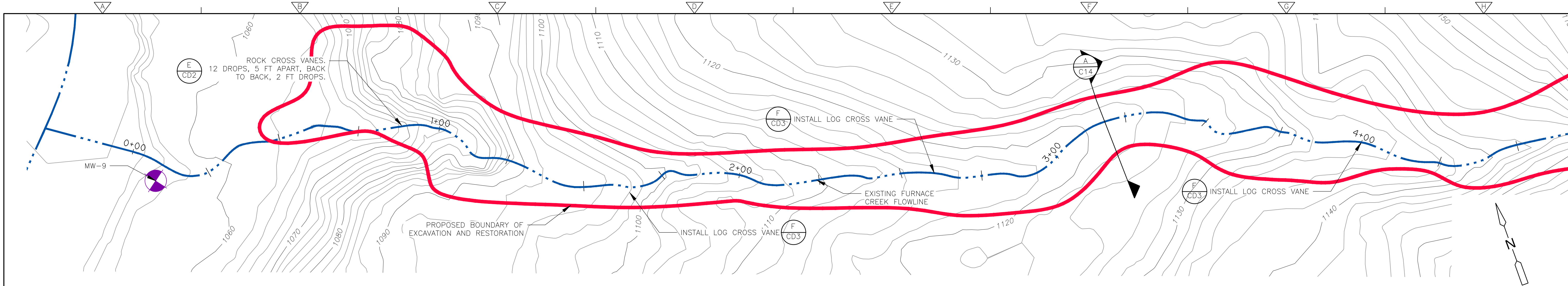
COTTAGE GROVE, OR

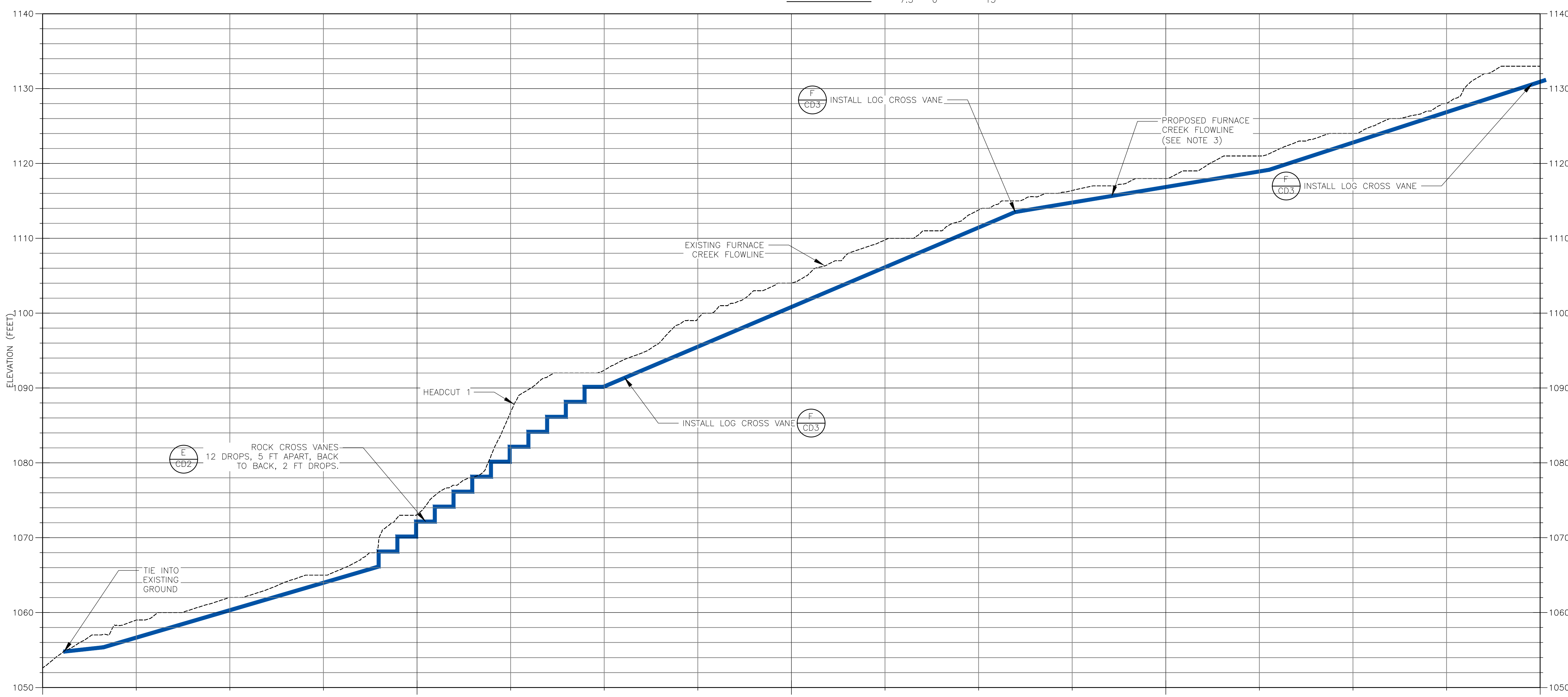
FURNACE CREEK RESTORATION PLAN

PROJECT NO. 106504

SHEET NO. C10



PLAN



PROFILE

HORIZONTAL SCALE 7.5 0 15

VERTICAL SCALE 3.75 0 7.5

NOTES:
1. TRANSITIONS BETWEEN STREAM RESTORATION FEATURES SHALL BE FIELD FIT WITH APPROVAL FROM THE ENGINEER.
2. INSTALL LOG CROSS VANES AT ALL GRADE CHANGES.
3. PROPOSED FURNACE CREEK FLOWLINE IS APPROXIMATE AND BASED ON ASSUMED EXCAVATION DEPTH OF 2-FEET.
4. KNOWN HEADCUT LOCATIONS AND INCISED AREAS HAVE BEEN IDENTIFIED. SHOULD ADDITIONAL LOCATIONS BE IDENTIFIED DURING CONSTRUCTION, ROCK CROSS VANES SHALL BE INSTALLED AS APPROVED BY THE ON-SITE FIELD ENGINEER.

REV. NO.	DATE	DRWN	CHKD	REMARKS

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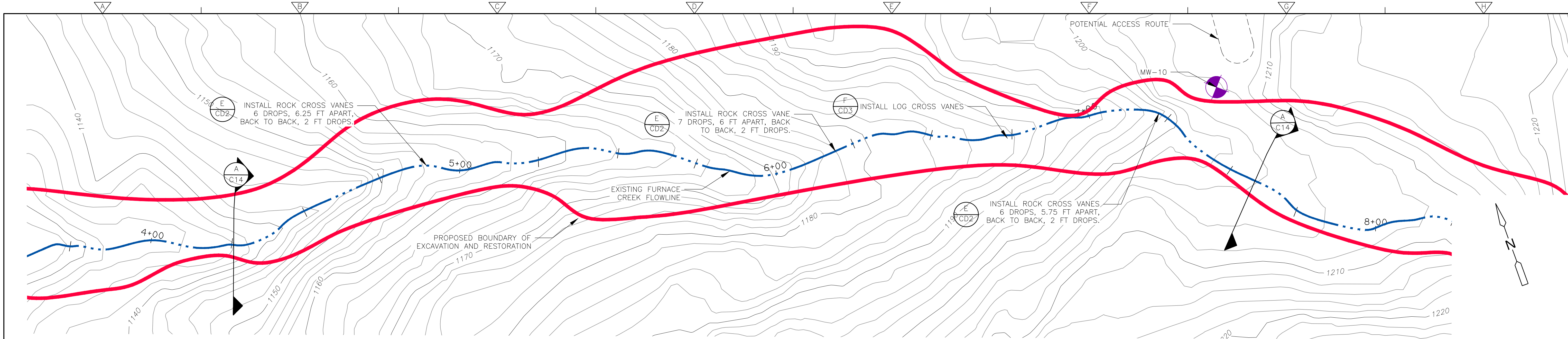
FURNACE CREEK RESTORATION
PLAN AND PROFILE STA. 0+00 TO STA. 4+00

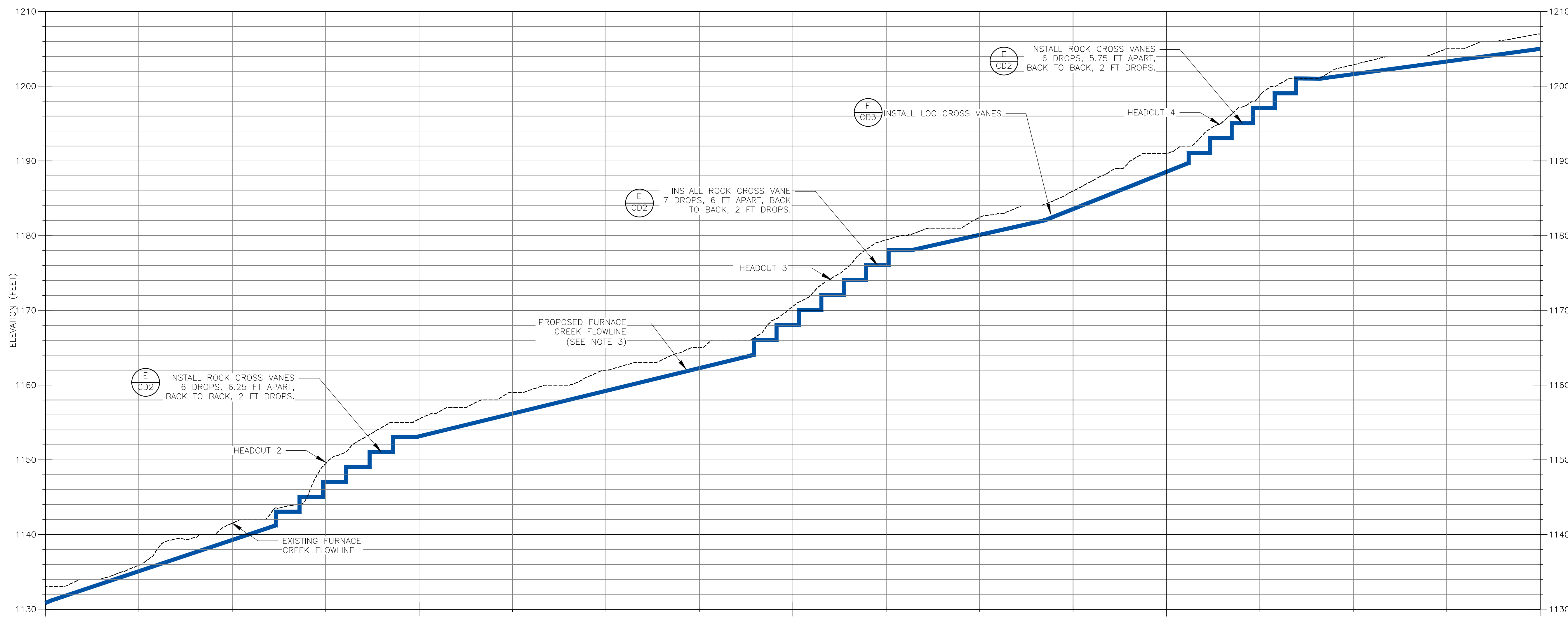
PROJECT NO. 106504

SHEET NO. C11



PLAN

7.5 0 15



PROFILE

7.5 0 15
HORIZONTAL SCALE

3.75 0 7.5
VERTICAL SCALE

NOTES:
1. TRANSITIONS BETWEEN STREAM RESTORATION FEATURES SHALL BE FIELD FIT WITH APPROVAL FROM THE ENGINEER.
2. INSTALL LOG CROSS VANES AT ALL GRADE CHANGES.
3. PROPOSED FURNACE CREEK FLOWLINE IS APPROXIMATE AND BASED ON ASSUMED EXCAVATION DEPTH OF 2-FEET.
4. KNOWN HEADCUT LOCATIONS AND INCISED AREAS HAVE BEEN IDENTIFIED. SHOULD ADDITIONAL LOCATIONS BE IDENTIFIED DURING CONSTRUCTION, ROCK CROSS VANES SHALL BE INSTALLED AS APPROVED BY THE ON-SITE FIELD ENGINEER.

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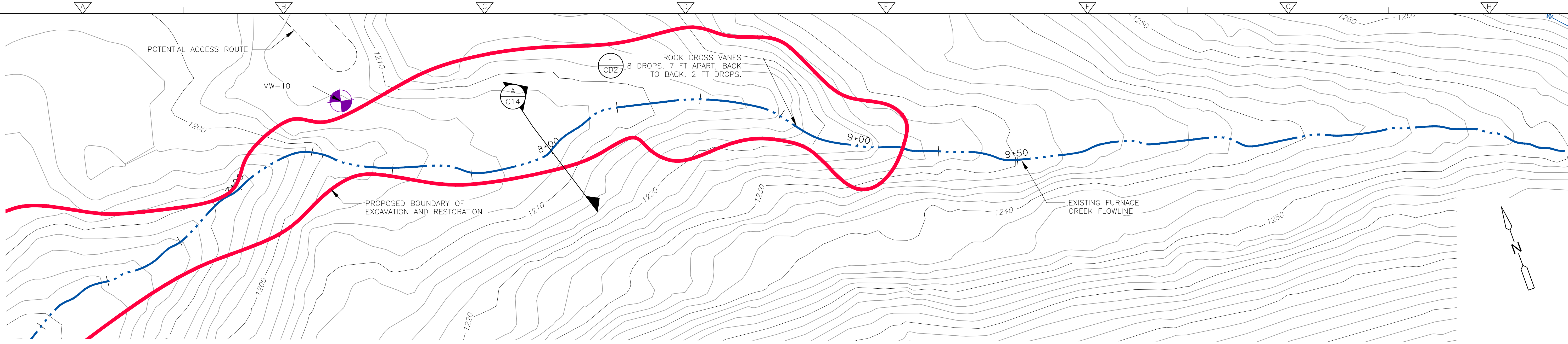
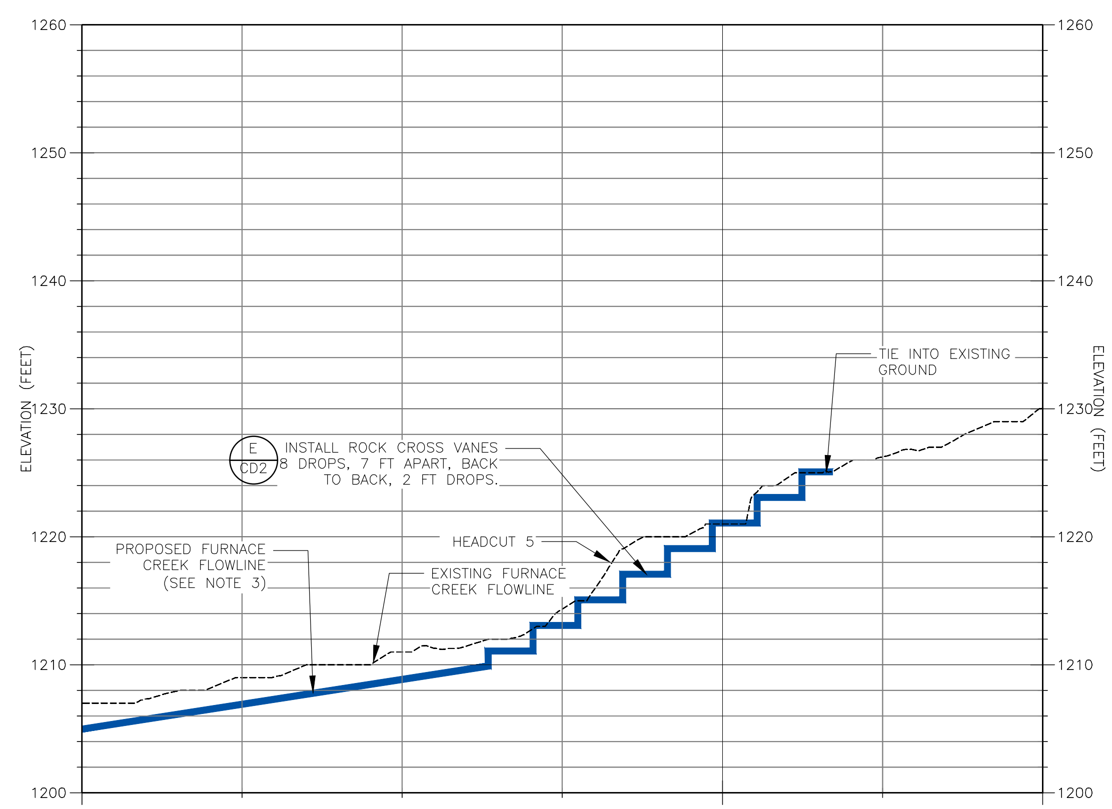
FURNACE CREEK RESTORATION
PLAN AND PROFILE STA. 4+00 TO STA. 8+00

PROJECT NO. 106504
SHEET NO. C12



PLAN



PROFILE

HORIZONTAL SCALE VERTICAL SCALE

NOTES:
1. TRANSITIONS BETWEEN STREAM RESTORATION FEATURES SHALL BE FIELD FIT WITH APPROVAL FROM THE ENGINEER.
2. INSTALL LOG CROSS VANES AT ALL GRADE CHANGES.
3. PROPOSED FURNACE CREEK FLOWLINE IS APPROXIMATE AND BASED ON ASSUMED EXCAVATION DEPTH OF 2-FEET.
4. KNOWN HEADCUT LOCATIONS AND INCISED AREAS HAVE BEEN IDENTIFIED. SHOULD ADDITIONAL LOCATIONS BE IDENTIFIED DURING CONSTRUCTION, ROCK CROSS VANES SHALL BE INSTALLED AS APPROVED BY THE ON-SITE FIELD ENGINEER.

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FURNACE CREEK RESTORATION
PLAN AND PROFILE STA. 8+00 TO STA. 9+50

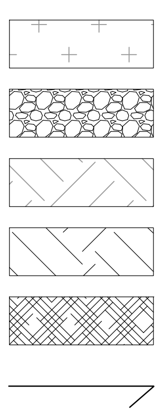
PROJECT NO. 106504

SHEET NO. C13

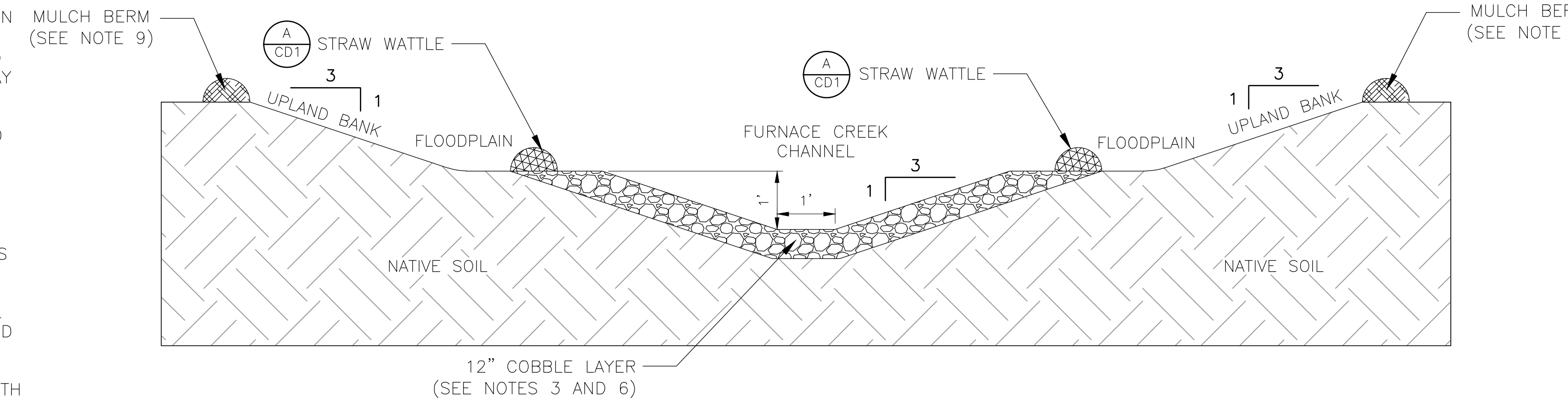
CONSTRUCTION NOTES (CONTRACTOR RESPONSIBILITY):

1. TAILINGS SHALL BE REMOVED FROM WITHIN THE CHANNEL, FLOODPLAIN, AND UPLAND BANK UNTIL VISUAL INDICATIONS SHOW NATIVE GROUND HAS BEEN REACHED, AND CONFIRMATION XRF RESULTS MEET THE RECOMMENDED DECISION CRITERIA IN THE IMPLEMENTATION PLAN.
2. IF FINAL CONFIGURATION STABLE SLOPES OF 3H:1V MAXIMUM CANNOT BE ACHIEVED DURING EXCAVATION OF TAILINGS AS DESCRIBED IN NOTE 1 OR AS SHOWN IN SECTION A, PROCEED WITH STREAM RESTORATION AS SHOWN IN SECTION B. DURING EXCAVATION, TEMPORARY CONSTRUCTION SLOPES OF 1.5H:1V MAY BE IMPLEMENTED, GIVEN THAT FINAL CONFIGURATION SLOPES DO NOT EXCEED 3H:1V. IF STABLE SLOPES ARE NOT ACHIEVABLE USING NATIVE MATERIAL, BACKFILL MAY BE USED.
3. COBBLE LAYER SHOULD BE 6-INCH MAXIMUM WELL GRADED ANGULAR OR SUB-ANGULAR COBBLE. COBBLE MATERIAL SHALL BE DURABLE AND SOUND, FREE FROM LUMPS OF CLAY OR ORGANIC MATTER AND OTHER FOREIGN MATERIAL. COBBLE MATERIAL SHALL BE A MAXIMUM PARTICLE SIZE OF 6-INCHES, WITH LESS THAN 5 PERCENT SMALLER THAN 1/2-INCH. THE COBBLE MATERIAL SHALL BE CONTINUOUSLY GRADED WITHIN THE LIMITS SPECIFIED BELOW. IF SUFFICIENT MATERIAL IS NOT AVAILABLE, EXCEPTIONS AND ALLOWANCES TO THE GRADATION RANGES MAY BE MADE AS APPROVED BY THE FIELD ENGINEER.
4. PRIOR TO THE PLACEMENT OF COBBLE FILL MATERIAL, THE CHANNEL SHALL BE GRADED SMOOTH AND SHAPED TO THE CROSS SECTION AS SHOWN, WITHIN AN ALLOWABLE TOLERANCE OF PLUS OR MINUS 3 INCHES FROM THE THEORETICAL LINE AND GRADES SHOWN ON THESE TYPICAL SECTIONS. PRIOR TO PLACEMENT OF COBBLE FILL MATERIAL, THE PREPARED CHANNEL BASE SHALL BE APPROVED BY THE FIELD ENGINEER. ALL AREAS SHALL BE GRADED TO PROVIDE A STABLE, UNIFORM SURFACE.
5. 8 OZ. NON-WOVEN GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED ON TOP OF CONTAMINATED MATERIAL/TAILINGS AS A VISUAL BARRIER BETWEEN TAILINGS AND CLEAN BORROW MATERIAL AND TO PREVENT SEDIMENT MIGRATION. GEOTEXTILE SHALL BE INSTALLED AT A MINIMUM OF 12-INCHES UPSLOPE OF TAILINGS MATERIAL ALONG THE UPLAND BANK AND UPSTREAM OF THE PLACEMENT AREA. GEOTEXTILE SHALL BE ANCHORED INTO THE NATIVE SOIL AT A MINIMUM DEPTH OF 12-INCHES. BACKFILL FOR THE ANCHOR TRENCH SHALL BE COMPACTED UNTIL FIRM AND UNYIELDING.
6. COBBLE SHALL BE PLACED IN A MINIMUM 12-INCH LAYER ON THE PREPARED CHANNEL BASE IN ACCORDANCE WITH TYPICAL SECTION A AND B. COBBLE SHALL BE SPREAD UNIFORMILY ON THE PREPARED BASE AND IN SUCH A MANNER AS TO AVOID DAMAGE TO THE UNDERLYING GEOTEXTILE (WHERE APPLICABLE). ANY DAMAGE TO THE PREPARED BASE SURFACE SHALL BE REPAIRED BEFORE PROCEEDING WITH THE WORK. COMPACTION OF COBBLE FILL MATERIAL ON THE PREPARED BASE IS NOT REQUIRED, BUT THE COBBLE MATERIAL SURFACE SHALL BE FINISHED TO PRESENT AN ADEQUATELY EVEN SURFACE, FREE FROM MOUNDS.
7. MATERIAL FOR THE SOIL COVER AS SHOWN IN SECTION B SHALL BE IDENTIFIED AND PROVIDED BY THE CONTRACTOR. MATERIAL MAY BE OBTAINED (I.E., EXCAVATED, SALVAGED) FROM AN ON-SITE LOCATION, WHERE PRACTICAL, AS DETERMINED BY THE CONTRACTOR AND ON-SITE FIELD ENGINEER. MATERIAL SHALL BE REMOVED IN AN OPERATION SEPARATE FROM OTHER EXCAVATION WORK. CARE SHALL BE EXERCISED TO AVOID THE INCORPORATION OF CONTAMINATED MATERIAL WITH STOCKPILED SOIL.
8. SOIL COVER MATERIAL SHALL MEET THE SPECIFICATIONS IN THE IMPLEMENTATION PLAN AND BE RELATIVELY FREE OF TRASH, LARGE ROCKS, STUMPS, OR BRUSH. NOXIOUS WEEDS SHALL BE PULLED AND DISPOSED OF PROPERLY PRIOR TO MATERIAL SALVAGE. MATERIAL SUITABILITY SHALL BE DETERMINED IN ACCORDANCE WITH THE IMPLEMENTATION PLAN.
9. MULCH BERM SHALL BE CONSTRUCTED OF CHIPPED LOGS AND WOODY DEBRIS. MINIMUM DIMENSIONS OF THE MULCH BERM SHALL BE 12-INCHES WIDE BY 12-INCHES HIGH.

LEGEND

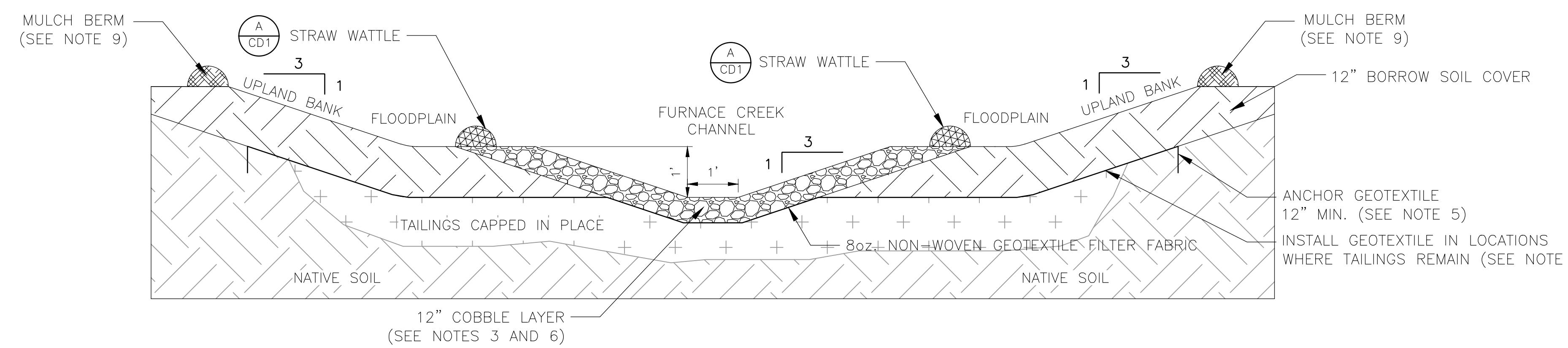


U.S. STANDARD SIEVE	PERMISSIBLE LIMITS PERCENT BY WEIGHT, PASSING
6-INCH	100
4-INCH	60-80
2-INCH	20-40
1-INCH	0-20
1/2 INCH	0-5



EXCAVATION TO NATIVE GROUND (FULL TAILINGS REMOVAL)

SECTION A
NTS



TAILINGS COVERED IN PLACE (PARTIAL TAILINGS REMOVAL)

SECTION B
NTS

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: MILLER, TAUSHA
DRAWN BY: THOMAS, T.J.
SHEET CHK'D BY: MILLER, TAUSHA
CROSS CHK'D BY: MILLER, TAUSHA
APPROVED BY: BEAUDOIN, KARA
DATE: APRIL 2018

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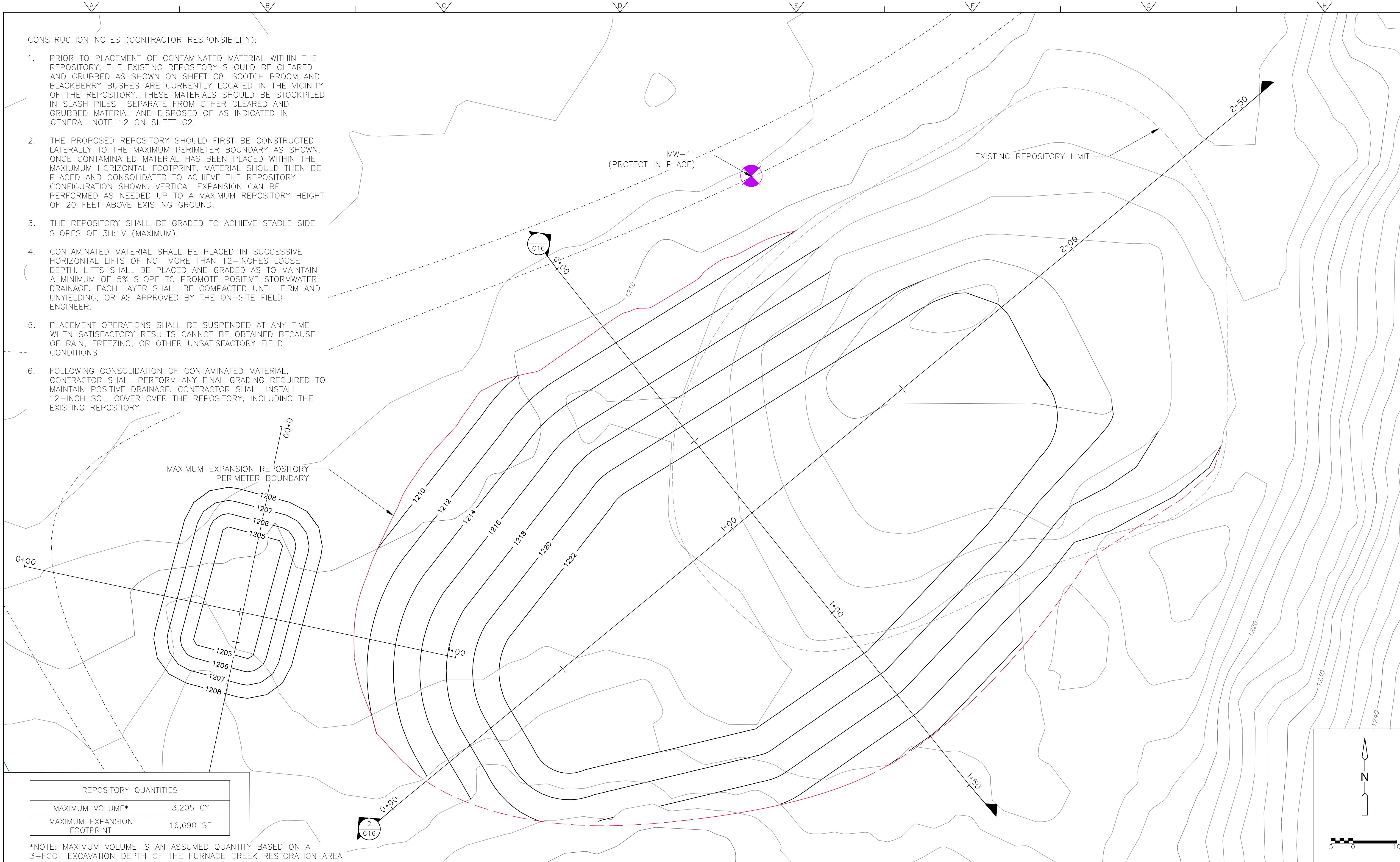
U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

CREEK REMOVAL AND RESTORATION TYPICAL SECTIONS

PROJECT NO. 106504
SHEET NO. C14

CONSTRUCTION NOTES (CONTRACTOR RESPONSIBILITY):

1. PRIOR TO PLACEMENT OF CONTAMINATED MATERIAL WITHIN THE REPOSITORY, THE EXISTING REPOSITORY SHOULD BE CLEARED AND GRUBBED AS SHOWN ON SHEET C8. SCOTCH BROOM AND BLACKBERRY BUSHES ARE CURRENTLY LOCATED IN THE VICINITY OF THE REPOSITORY. THESE MATERIALS SHOULD BE STOCKPILED IN SLASH PILES SEPARATE FROM OTHER CLEARED AND GRUBBED MATERIAL AND DISPOSED OF AS INDICATED IN GENERAL NOTE 12 ON SHEET G2.
2. THE PROPOSED REPOSITORY SHOULD FIRST BE CONSTRUCTED LATERALLY TO THE MAXIMUM PERIMETER BOUNDARY AS SHOWN. ONCE CONTAMINATED MATERIAL HAS BEEN PLACED WITHIN THE MAXIUMUM HORIZONTAL FOOTPRINT, MATERIAL SHOULD THEN BE PLACED AND CONSOLIDATED TO ACHIEVE THE REPOSITORY CONFIGURATION SHOWN. VERTICAL EXPANSION CAN BE PERFORMED AS NEEDED UP TO A MAXIMUM REPOSITORY HEIGHT OF 20 FEET ABOVE EXISTING GROUND.
3. THE REPOSITORY SHALL BE GRADED TO ACHIEVE STABLE SIDE SLOPES OF 3H:1V (MAXIMUM).
4. CONTAMINATED MATERIAL SHALL BE PLACED IN SUCCESSIVE HORIZONTAL LIFTS OF NOT MORE THAN 12-INCHES LOOSE DEPTH. LIFTS SHALL BE PLACED AND GRADED AS TO MAINTAIN A MINIMUM OF 5% SLOPE TO PROMOTE POSITIVE STORMWATER DRAINAGE. EACH LAYER SHALL BE COMPACTED UNTIL FIRM AND UNYIELDING, OR AS APPROVED BY THE ON-SITE FIELD ENGINEER.
5. PLACEMENT OPERATIONS SHALL BE SUSPENDED AT ANY TIME WHEN SATISFACTORY RESULTS CANNOT BE OBTAINED BECAUSE OF RAIN, FREEZING, OR OTHER UNSATISFACTORY FIELD CONDITIONS.
6. FOLLOWING CONSOLIDATION OF CONTAMINATED MATERIAL, CONTRACTOR SHALL PERFORM ANY FINAL GRADING REQUIRED TO MAINTAIN POSITIVE DRAINAGE. CONTRACTOR SHALL INSTALL 12-INCH SOIL COVER OVER THE REPOSITORY, INCLUDING THE EXISTING REPOSITORY.



REPOSITORY QUANTITIES	
MAXIMUM VOLUME*	3,205 CY
MAXIMUM EXPANSION FOOTPRINT	16,690 SF

*NOTE: MAXIMUM VOLUME IS AN ASSUMED QUANTITY BASED ON A 3-FOOT EXCAVATION DEPTH OF THE FURNACE CREEK RESTORATION AREA

REV. NO.	DATE	DRWN	CHKD	REMARKS

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DRAWN BY: THOMAS, T.J.
SHEET CHK'D BY: MILLER, TAUSHA
CROSS CHK'D BY: MILLER, TAUSHA
APPROVED BY: BEAUDOIN, KARA
DATE: APRIL 2018

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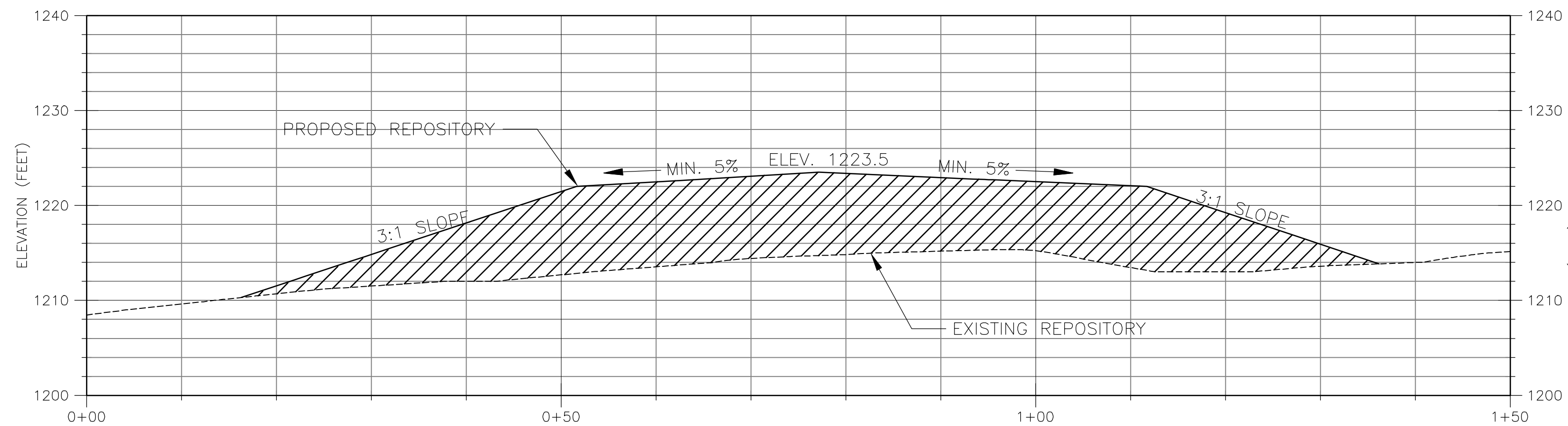
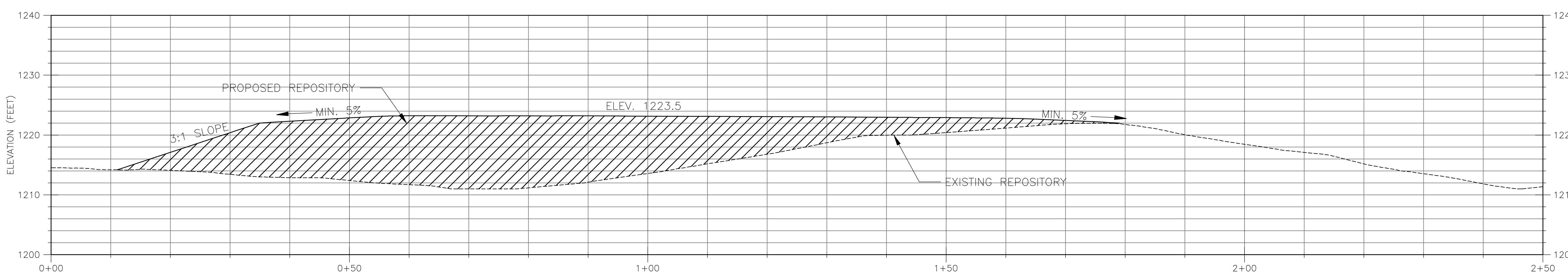
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

REPOSITORY PLAN

PROJECT NO. 106504
SHEET NO. C15



REPOSITORY
SECTION 1
C15



REPOSITORY
SECTION 2
C15

REV. NO.	DATE	DRWN	CHKD	REMARKS

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COTTAGE GROVE, OR

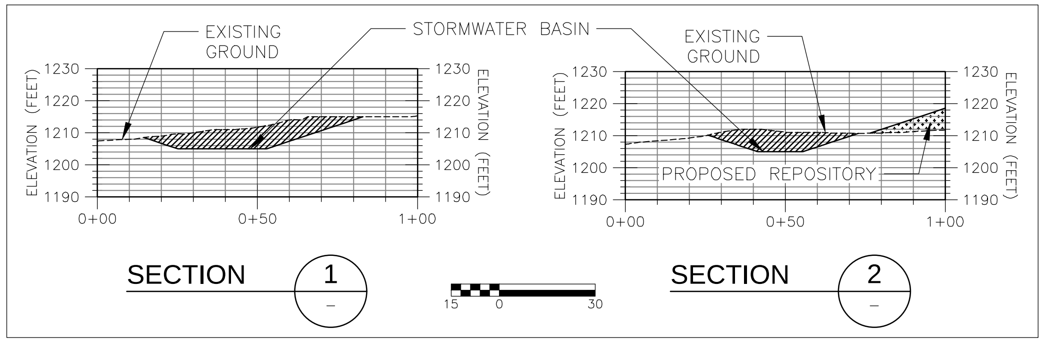
REPOSITORY SECTIONS

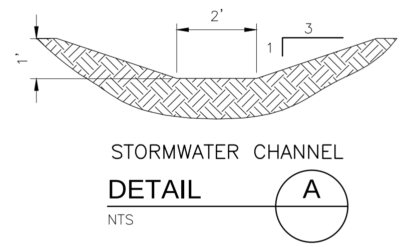
PROJECT NO. 106504
SHEET NO. C16

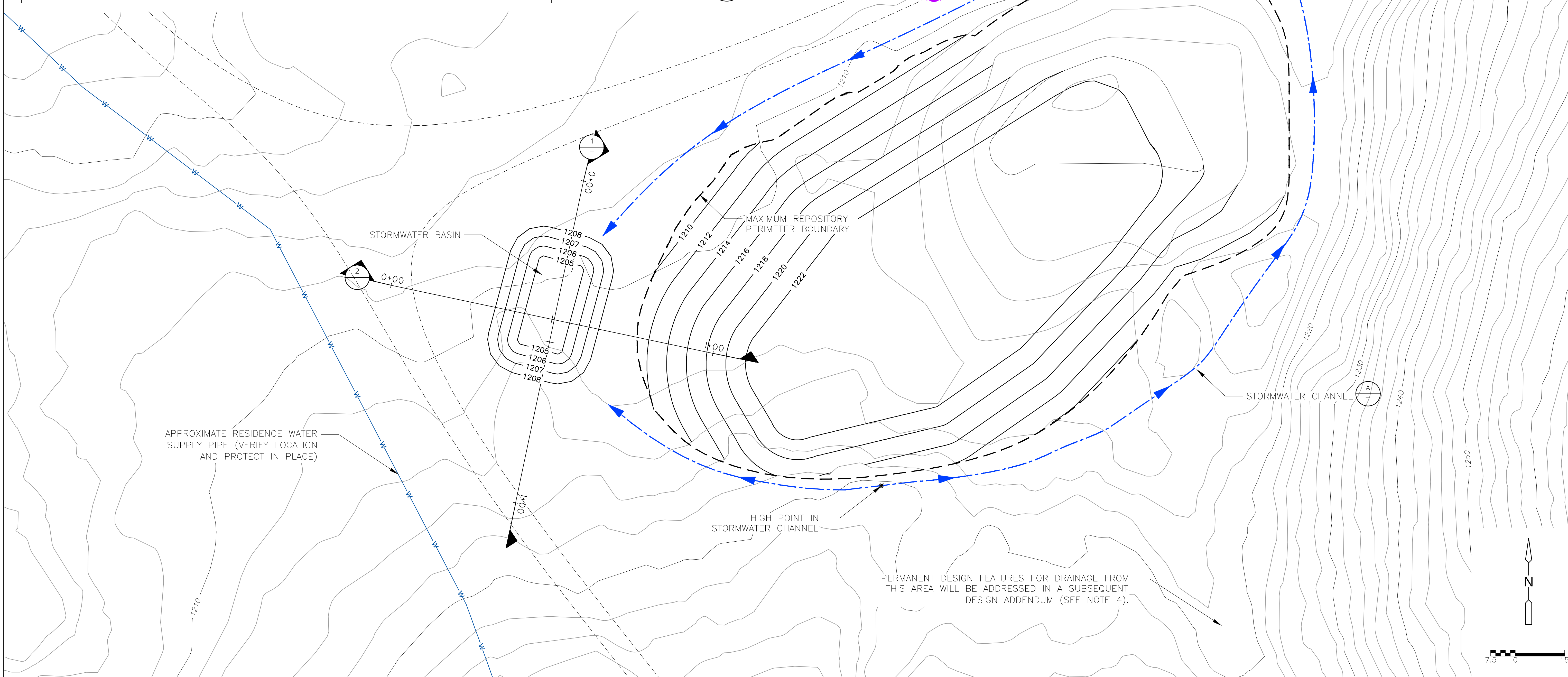
STORMWATER BASIN	
EXCAVATION (CUT)	325 CY
POND CAPACITY	2,500 CF

CONSTRUCTION NOTES:

1. MATERIALS EXCAVATED DURING THE CONSTRUCTION OF THE BASIN AND STORMWATER CHANNEL SHALL BE DISPOSED OF WITHIN THE REPOSITORY.
2. CONTRACTOR SHALL FIELD FIT STORMWATER CHANNEL WITH APPROVAL OF THE FIELD ENGINEER TO MAINTAIN POSITIVE DRAINAGE INTO THE STORMWATER BASIN.
3. TEMPORARY DRAINAGE MEASURES SHALL BE INSTALLED PRIOR TO FINAL INSTALLATION OF PERIMETER STORMWATER CHANNEL SHOWN IN AN EFFORT TO MANAGE STORMWATER GENERATED DURING CONSTRUCTION.
4. PERIMETER STORMWATER CHANNEL SHALL BE VEGETATED WITH THE UPLAND SEED MIX ON SHEET C10.
5. THE PERMANENT REPOSITORY PERIMETER STORMWATER CHANNEL AND BASIN MAY BE USED TOGETHER WITH TEMPORARY BMPS TO MANAGE DRAINAGE FROM THE SOUTH







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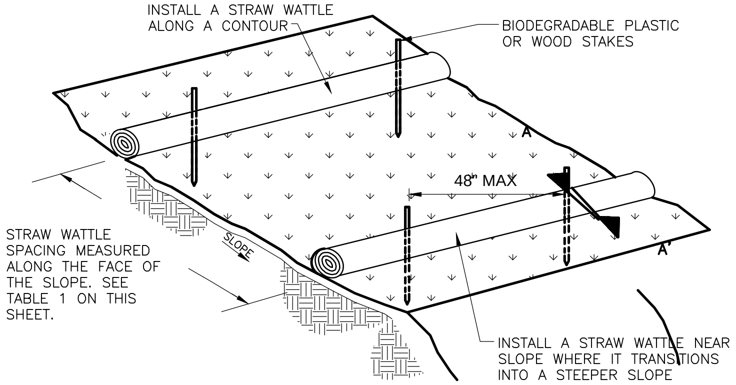
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

REPOSITORY DRAINAGE PLAN

PROJECT NO. 106504
SHEET NO. C17

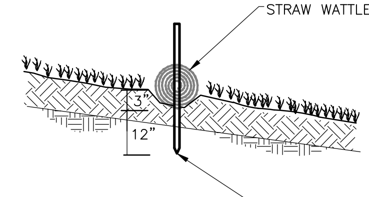


STRAW WATTLES

DETAIL A

NTS

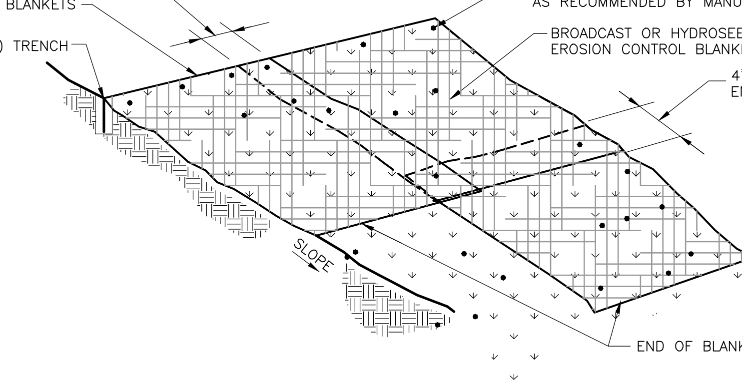
TABLE 1. STRAW WATTLE SPACING	
SLOPE	SPACING
1H:1V	10 FEET APART
2H:1V	20 FEET APART
3H:1V	30 FEET APART
4H:1V	40 FEET APART
>5H:1V	50 FEET APART



SECTION A–A'

STRAW WATTLES NOTES:

STRAW WATTLE MAY BE USED ALONG THE TOP, FACE, AND AT GRADE BREAKS OF EXPOSED AND ERODIBLE SLOPES TO SHORTEN SLOPE LENGTH AND SPREAD RUNOFF AS SHEET FLOW. WATTLES MAY BE USED AS CHECK DAMS. FOR USE AS CHECK DAMS, PLACE STRAW WATTLES AT 20 FEET MAXIMUM SPACING.



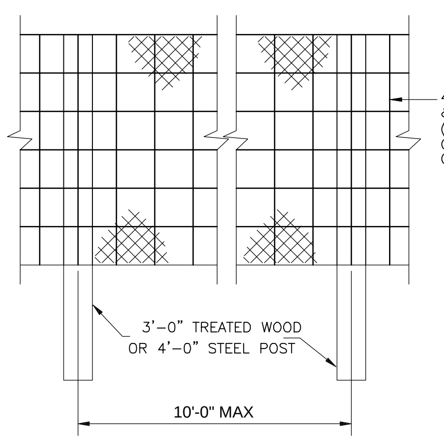
EROSION CONTROL BLANKETS

DETAIL B

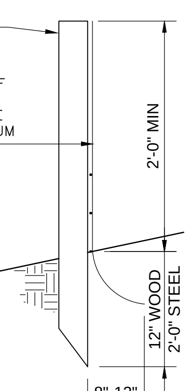
NTS

EROSION CONTROL BLANKETS DETAIL NOTES:

1. PLACE AND PREPARE TOPSOIL AND HYDROSEED (OR BROADCAST).
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING FABRIC IN 8" (MIN) TRENCH, BACKFILLING, AND COMPACTING.
3. UNROLL EROSION CONTROL BLANKETS 1) DOWN OR 2) HORIZONTALLY ACROSS THE SLOPE. FOR GRASS–LINED SWALE INSTALLATION, UNROLL EROSION CONTROL BLANKETS IN DIRECTION OF WATER FLOW. OVERLAP ALL ADJACENT EROSION CONTROL BLANKETS END OVER END (SHINGLE STYLE). MINIMIZE DISTURBANCE OF HYDROSEED DURING FIBER ROLL INSTALLATION. REPLACE DAMAGED AREAS WITH BROADCASTED SEED.
4. SECURELY FASTEN EROSION CONTROL BLANKETS TO THE 6" TOPSOIL LAYER AND SUBGRADE USING BIODEGRADABLE PLASTIC OR WOOD STAKES. STAKES SHALL BE A OF SUFFICIENT LENGTH TO SECURE TO THE SUBGRADE. STAKE SPACING AND PATTERN SHALL BE AS RECOMMENDED BY THE MANUFACTURER. STAKE SPACING AND PATTERN SHOWN HEREIN IS FOR ILLUSTRATION PURPOSES ONLY.



ELEVATION

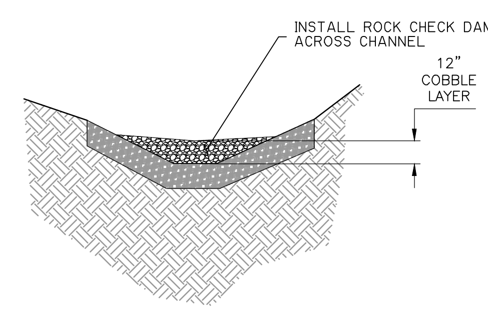


SECTION

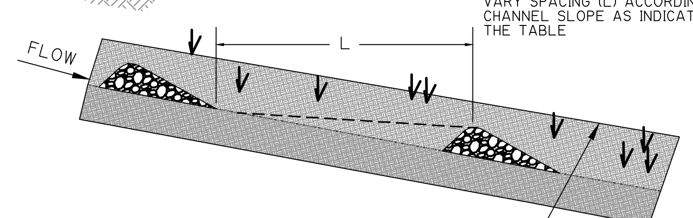
SILT FENCE

DETAIL C

NTS



CHANNEL SLOPE	CHECK DAM SPACING (L)
%	FT
1–3	250
4–6	100
7–9	65
10–12	27
13–15	21
>15	20



ROCK CHECK DAM

DETAIL D

NTS

NOTES:

1. ROCK CHECK DAMS SHOULD BE CONSTRUCTED WITH 6-INCH MAXIMUM COBBLE AS DETAILED IN SIEVE TABLE ON SHEET C14.

REV. NO.	DATE	DRWN	CHKD	REMARKS

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CROSS CHK'D BY: MILLER, TAUSHA
APPROVED BY: BEAUDOIN, KARA
DATE: APRIL 2018

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U.S. EPA - REGION 10
BLACK BUTTE MINE SUPERFUND SITE
OPERABLE UNIT 1
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

EROSION AND SEDIMENT CONTROL DETAILS

PROJECT NO. 106504

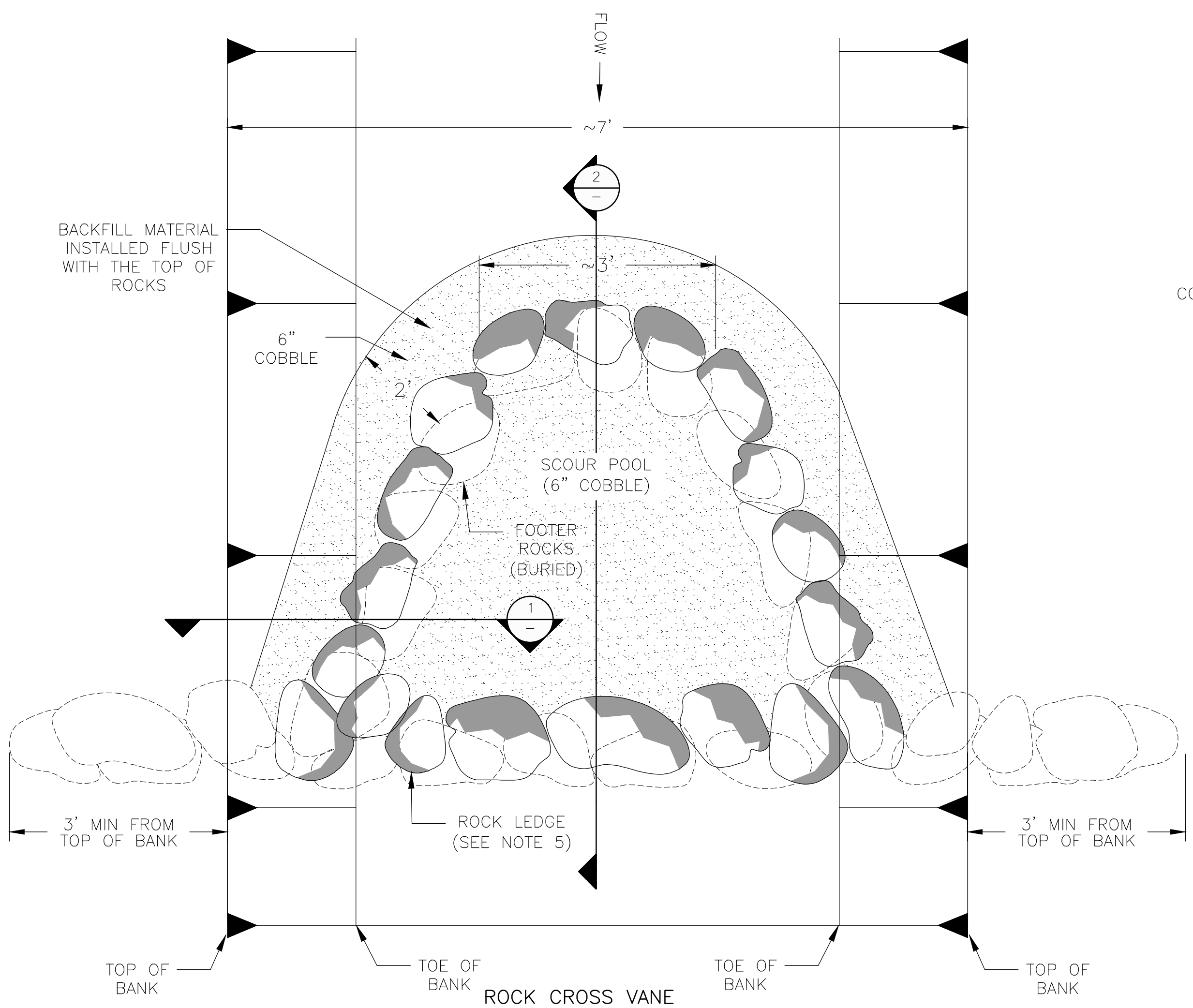
SHEET NO. CD1

NOTES:

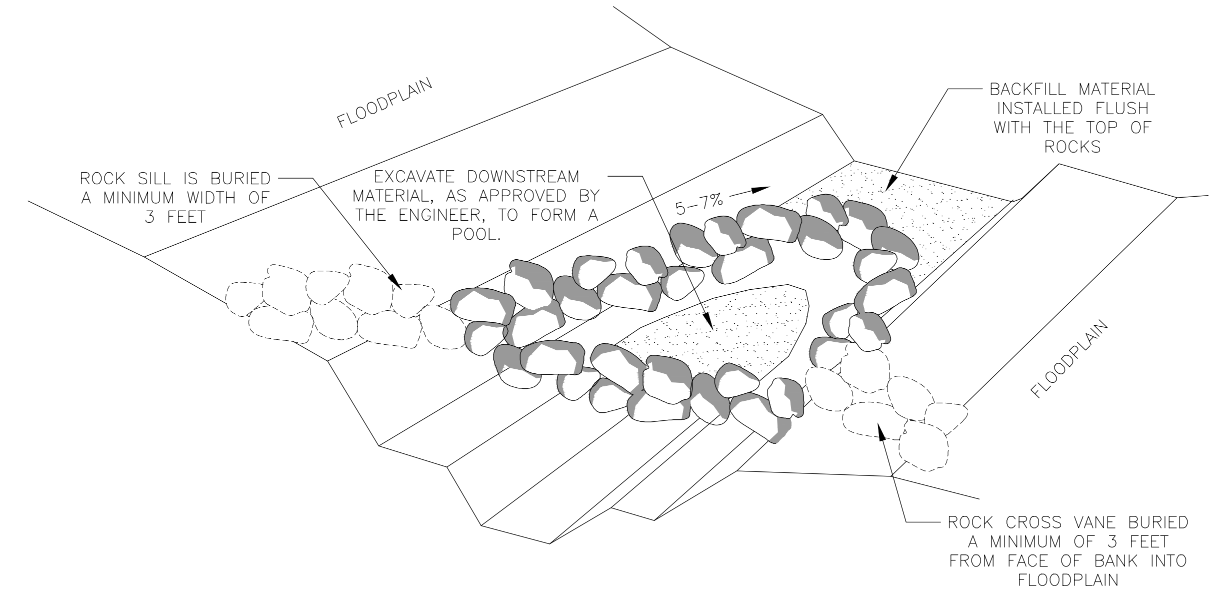
1. CAP AND FOOTER ROCK SHALL BE RIPRAP MATERIAL WITH A DIAMETER BETWEEN 18-INCHES (MINIMUM) AND 24-INCHES (MAXIMUM) IN ALL DIMENSIONS.
2. TWO-THIRDS OF THE FOOTER ROCK SHALL BE BURIED IN THE CHANNEL. THE CAP ROCK SHALL BE PLACED DIRECTLY ATOP THE FOOTER ROCK WITH A MAXIMUM TWO-THIRDS HORIZONTAL OVERLAP AS SHOWN.
3. TO PREVENT WATER FROM FLOWING UNDER THE STRUCTURE, 6" DIAMETER COBBLE (SEE GRADATION TABLE IN NOTE 3 ON SHEET C14) SHALL BE INSTALLED ON THE UPSTREAM SIDE OF THE ROCK CROSS VANE AT A MINIMUM OF 2-FEET UPSTREAM IN THE CHANNEL. MATERIAL SHALL BE PLACED FLUSH WITH THE TOP OF THE CAP ROCKS. 6-INCH DIAMETER COBBLE SHOULD BE UNDERLAIN WITH A MINIMUM 6-INCH LAYER OF ROCK BEDDING MATERIAL, MEETING THE FOLLOWING RANGE OF GRADATION SPECIFIED BELOW:

BEDDING MATERIAL GRADATION	
SIEVE SIZE (IN.)	PERCENT PASSING
4	100
2	65-95
$\frac{3}{4}$	5-35
NO. 4	0-5

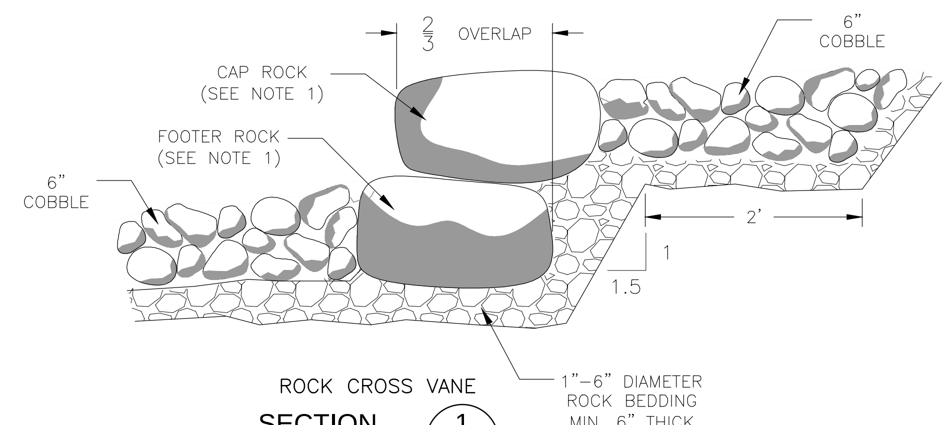
4. LONGEST ROCK DIMENSION FOR THE CAP AND FOOTER ROCK SHALL BE PLACED IN THE DIRECTION OF FLOW. SHORTEST DIMENSION SHALL BE PLACED IN THE VERTICAL DIRECTION.
5. THE FURTHEST DOWNSTREAM ROCK CROSS VANE (WITHIN A SERIES) SHALL BE INSTALLED WITH A ROCK LEDGE AS SHOWN IN PLAN VIEW. THE ROCK LEDGE SHALL BE CONSTRUCTED OF RIPRAP MATERIAL (SEE NOTE 1), WITH THE TOP OF ROCK AT THE STREAMBED ELEVATION.
6. DISTANCE BETWEEN ROCK CROSS VANES SHALL BE AS SPECIFIED ON SHEETS C11-C13 FOR EACH HEADCUT LOCATION.



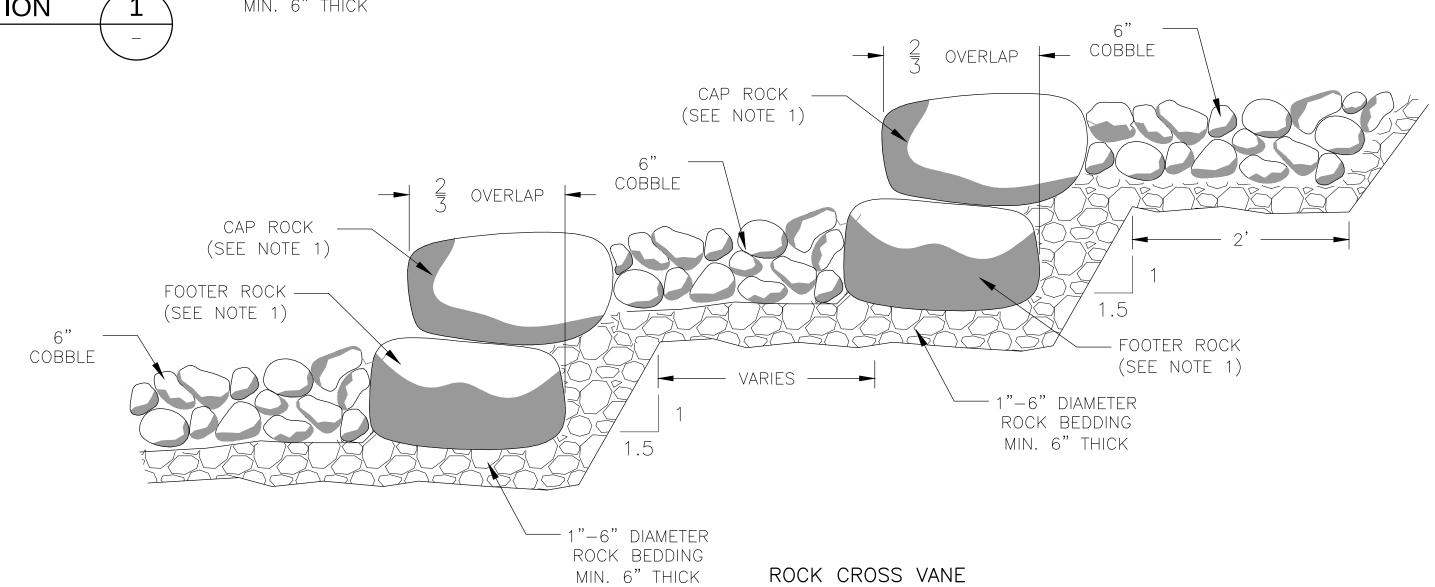
ROCK CROSS VANE
DETAIL E
NTS



ROCK CROSS VANE
ISOMETRIC
NTS



ROCK CROSS VANE
SECTION 1
NTS



ROCK CROSS VANE
SECTION 2
NTS

REV. NO.	DATE	DRWN	CHKD	REMARKS

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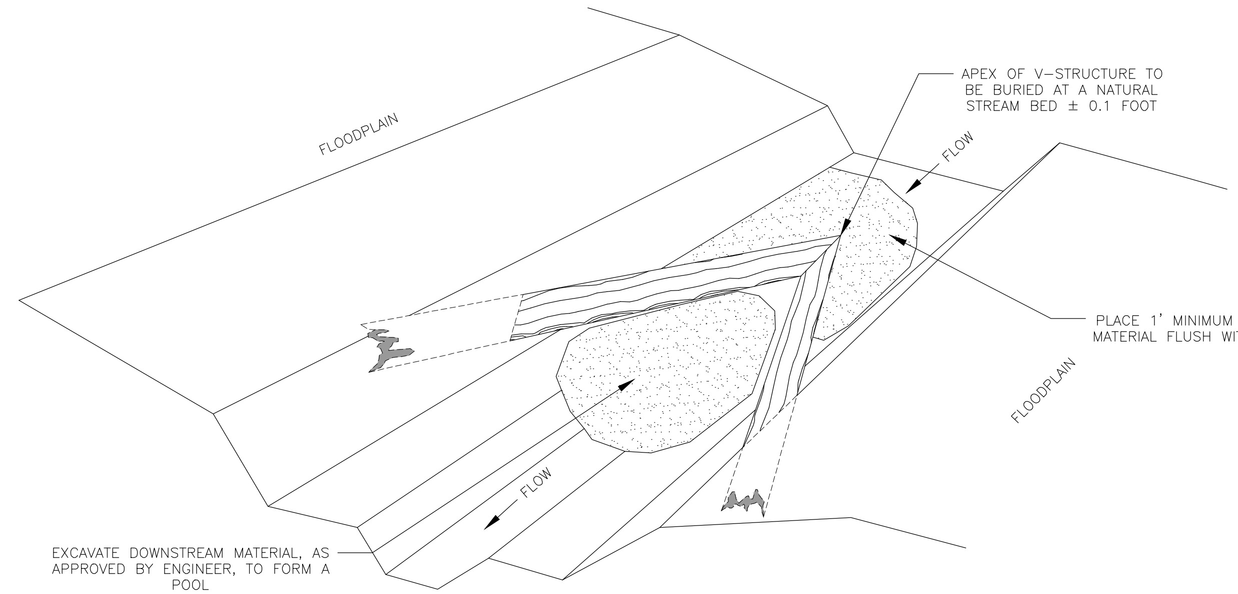
FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

FURNACE CREEK
RESTORATION DETAILS 1

PROJECT NO. 106504
SHEET NO.
CD2

NOTES:

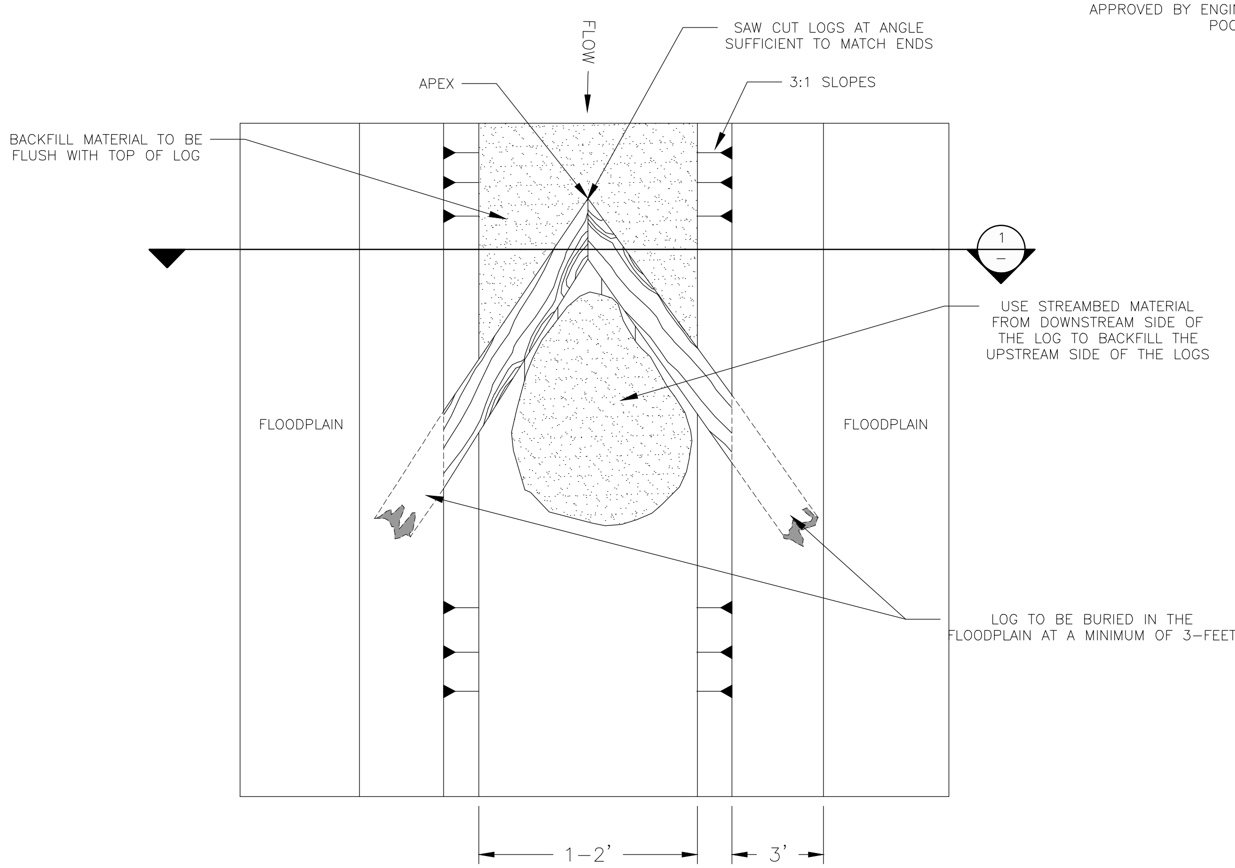
1. THE APEX (SMALL END DIAMETER) OF THE LOGS TO BE PLACED UPSTREAM AND IN THE CENTER OF THE BANKFULL CHANNEL WIDTH. THE TOP OF THE LOGS AT THE APEX OF THE V-STRUCTURE TO BE AT THE NATURAL STREAM GRADE ± 0.1 FOOT. A MINIMUM OF 3 FEET OF THE TOTAL LOG LENGTH OF THE STRUCTURE TO BE BURIED BENEATH THE FLOODPLAIN. THE V-STRUCTURE SHALL SLOPE UP FROM THE APEX AT 2%-7% AND FORM AND 20-30 DEGREE ANGLE WITH THE BANK. TO PREVENT WATER FROM FLOWING UNDER THE STRUCTURE, BACKFILL THE UPSTREAM SIDE OF THE STRUCTURE WITH STREAMBED MATERIAL, AND INSTALL 1-FOOT (MINIMUM) OF 6-INCH COBBLE MATERIAL (SEE GRADATION TABLE IN NOTE 3 ON SHEET C14). MATERIAL TO BE FLUSH WITH THE TOP OF THE LOGS OF THE V-STRUCTURE.
2. LOGS TO HAVE A MINIMUM DIAMETER OF 8 INCHES UNLESS OTHERWISE APPROVED BY THE ENGINEER.



LOG CROSS VANE

ISOMETRIC

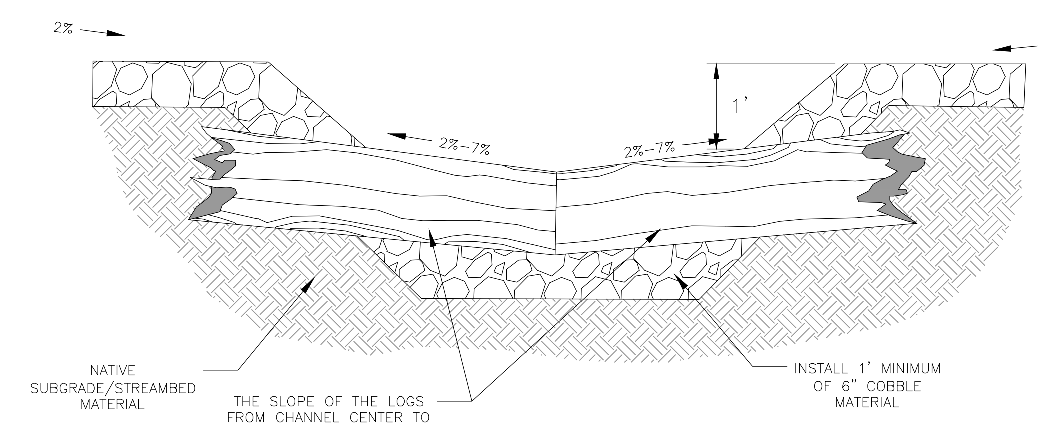
NTS



LOG CROSS VANE

DETAIL F

NTS



LOG CROSS VANE

SECTION 1 –

NTS

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FURNACE CREEK TAILINGS AREA
COTTAGE GROVE, OR

FURNACE CREEK
RESTORATION DETAILS 2

PROJECT NO. 106504

SHEET NO.

CD3

Appendix B

Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria

Memorandum

To: *Dave Tomten – EPA*

From: *Dominic Giaudrone, P.E. – CDM Smith*
Kyle Vickstrom – CDM Smith

Date: *April 23, 2018*

Subject: Furnace Creek Non-Time-Critical Removal Action Recommended Field Decision Criteria

This memorandum for the Furnace Creek area at Operable Unit (OU) 1 of the Black Butte Mine Superfund Site (Site) was prepared to present the recommended field decision criteria to be employed during implementation of the Furnace Creek non-time-critical removal action (NTCRA). The purpose of the field decision criteria is to provide the field team with numerical guidelines that can be used to assist with field identification of impacted soils and tailings during removal. This memorandum also presents recommended acceptance criteria for onsite and offsite borrow source materials. The recommended criteria presented in this memorandum are based on Site data collected as part of a preliminary investigation (EA and CDM Smith [EA Team] 2016a) and the OU1 remedial investigation (RI) (EA Team 2018a).

The preliminary removal action objectives (PRAOs) for the Furnace Creek NTCRA established in the engineering evaluation/cost analysis (EE/CA) include the following (EA Team 2016b):

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

The performance of the Furnace Creek removal action will be measured by visual confirmation of the presence or absence of tailings within the catchment, analytical confirmation using a field-portable x-ray fluorescence (FPXRF) analyzer or other reliable tool, and comparison of pre- and post-removal action Furnace Creek mercury loading at the confluence with Garoutte Creek (EA Team 2016b).

The PRAOs do not set a numeric removal goal for mercury or arsenic concentrations in the impacted soils, tailings, and catchment sediments. This approach creates a dynamic decision-making environment where removal decisions will be made based on multiple lines of evidence including visual identification, proximity to the active stream channel, potential for erosion, and concentrations of mercury and other metals. The recommended decision criteria and the basis for those criteria are presented in the following sections.

Target Removal Criteria

During the NTCRA, removal decisions will generally be guided by existing analytical data and visual observations. Black Butte Mine tailings can generally be identified visually; however, visual identification is less reliable where tailings and other mercury-impacted mine wastes are comingled with native soils. During excavation, visual identification will be supplemented with analytical testing via FPXRF, laboratory testing, or other reliable method for determining the concentration of mercury in the material. The recommended target removal criterion during the NTCRA is 20 milligrams per kilogram (mg/kg) mercury in impacted soils, tailings, and catchment sediments. The recommended target removal criterion of 20 mg/kg mercury is based on the following:

- It is the approximate lower bound of mercury concentrations in site tailings.
- It is the approximate lower limit at which the FPXRF is accurate.
- It represents greater than 90% reduction from estimated average mercury concentrations of suspended particulates in Furnace Creek during storm events.
- It is below the United States Environmental Protection Agency (EPA) Regional Screening Level (RSL) of 23 mg/kg mercury in residential soil (EPA 2017), which would reduce potential human health risks.

To inform selection of the recommended decision criteria, existing soil data from the site were analyzed to estimate the upper bound of site background and the lower bound of mercury-impacted soils and tailings. During the RI, surface and subsurface soil samples were collected within the Furnace Creek catchment from the 0 to 0.5 feet (ft) and 1 to 3 ft depth intervals, respectively, and screened using FPXRF for mercury and arsenic (Appendix D, EA Team 2018a). An inflection point analysis developed by the Department of Toxic Substances Control (DTSC) was conducted on the dataset to determine if distinct subsets exist within the soils data, and thus indicate differences between background concentrations and Site-related contamination (DTSC 1997). From this analysis, the estimated high end of the catchment background mercury concentrations is approximately 7 mg/kg (**Figure 1**). This is consistent with a previous preliminary dataset that was collected across the entire Site and outside of the OU1 boundary in 2003, which found that the upper prediction limit (UPL) for background soils is 7.7 mg/kg mercury (EA Team 2016a).

Because limited discrete data exist that definitively represent tailings, soil data collected following incremental sampling methodology (ISM) protocols were used to estimate the lower bound of mercury-impacted tailings. Decision unit (DU) incremental soil sampling data collected during the RI indicated that the Main Tailings Pile (DU3) contains the lowest average mercury concentrations for mine tailings and impacted soil at the Site (EA Team 2018a). Impacted soil consists of soil with elevated mercury concentrations resulting from mixing of tailings and soil, leaching of mercury from tailings or other mining wastes to soil, or soil otherwise impacted from historic mercury furnace operations. Three replicate sample results at DU3 (with one field sample split into three processing replicates) ranged from 20.8 to 28.3 mg/kg mercury, with an average of 23.8 mg/kg (**Figure 2**). DU3 is primarily tailings and it represents the low end of mercury concentrations in tailings at the Site. Based on these data, concentrations greater than 20 mg/kg mercury are generally indicative of tailings or impacted soil.

This analysis established that mercury concentrations below 7 to 8 mg/kg are generally indicative of site background or minimally impacted soil, and mercury concentrations greater than 20 mg/kg are generally indicative of tailings or impacted soil. While removal to background levels would be effective, it would be costly, impracticable, and likely unnecessary to achieve the removal action objectives. Furthermore, it would be complicated by the fact that FPXRF is not sensitive at these levels. The 2014 demonstration of methods applicability study (Appendix C, EA Team 2018a) concluded that Site soils and tailings could be accurately field screened for mercury concentrations down to approximately 20 mg/kg using FPXRF. Below this concentration mercury measurements were inaccurate.

Table 4.5-1 of the RI report (EA Team 2018a) presents estimated suspended particulate mercury concentrations for Furnace Creek based on surface water monitoring data. The average mercury concentration of suspended particulates in Furnace Creek was estimated to be 238.1 mg/kg near the Old Furnace tailings (UFC-2) and 248.7 mg/kg at the mouth (F-1). Removing impacted soils, sediment, and tailings to 20 mg/kg mercury therefore represents more than a 90% reduction from estimated suspended particulate concentrations within Furnace Creek. Removal of contaminated material to this concentration along with erosion and total suspended solids control within the channel (EA Team 2018a) will significantly reduce mercury loading and is an effective way to achieve PRAOs. Additionally, the 20 mg/kg target removal criterion is less than the EPA RSL of 23 mg/kg mercury in residential soil (EPA 2017). Removal of contaminated material to this concentration would reduce human health risks from direct contact; an added benefit that goes beyond the PRAOs.

The PRAOs are focused on reducing the mobility and downstream migration of mercury only; however, impacted soils and tailings at the Site typically contain elevated concentrations of both mercury and arsenic. While the PRAOs do not address arsenic, a secondary line of evidence to determine the presence of tailings and impacted soil and guide decisions for removal during the NTCRA is arsenic concentrations greater than 100 mg/kg. Inflection point analysis of the 2017 Furnace Creek catchment arsenic dataset indicates a break and slope change of the probability plot occurring at approximately 80 mg/kg arsenic (**Figure 1**). This concentration likely represents mixed tailings and soil (e.g., Furnace Creek debris flow) and is not a clear indication of tailings. However, the RI ISM sampling found that the average arsenic concentration for DUs containing significant tailings (DU1a, DU1b, DU2, DU3, and DU5) is 125.3 mg/kg (**Figure 2**). It is safe to assume that 100 mg/kg arsenic, between these two values, represents a reasonable concentration indicative of tailings. While limited conditions exist within the catchment where soil mercury concentrations are below 20 mg/kg but contain elevated levels of arsenic (e.g., samples XRF-133-

0.5 and XRF-134-1.5; **Table 1**), if field screening indicates a sample contains less than 20 mg/kg mercury and greater than 100 mg/kg arsenic, it is recommended that additional samples be collected, screened, and visually inspected to evaluate if tailings are present and determine if the material should be excavated.

Criteria for Borrow Source Material

On- and offsite borrow source materials will be needed for Site restoration. The following sections describe the recommended acceptance criteria for each of these materials.

Onsite Borrow Source Material Criteria

The recommended criteria for onsite borrow source materials is that they contain less than 7 mg/kg mercury and less than 30 mg/kg arsenic. These criteria are based on the estimated upper bound of background for the Site, balancing the desire to minimize mercury and arsenic impacts in restoration materials with the desire to use more cost-effective and sustainable onsite sources where feasible. The mercury screening criteria is based on the 2017 Furnace Creek catchment FPXRF dataset (**Figure 1**) and 2003 preliminary dataset (EA Team 2016a), which estimate the high end of and UPL for Site background soils to be approximately 7 mg/kg mercury. The arsenic screening criteria was selected as the high end of background arsenic concentrations at the Site determined from the soil incremental sampling (EA Team 2018a). Average soil arsenic concentrations range from 18.5 to 31.4 mg/kg in the background (DU6 and DU7), Garoutte Creek Floodplain (DU4), and undeveloped north residential parcel (DU8a). An arsenic screening criterion of 30 mg/kg for onsite borrow source material represents the high end of the measured background concentrations at the Site.

Offsite Borrow Source Material Criteria

More stringent criteria are recommended for offsite borrow source materials. The recommended criteria for offsite borrow source materials is that they contain less than 2 mg/kg mercury and less than 20 mg/kg arsenic. These screening criteria are based on the average background concentrations determined from the soil incremental sampling (EA Team 2018a). The two Site background DUs (DU6 and DU7) contain average concentrations that range from 0.825 to 1.7 mg/kg mercury and 17.9 to 19.1 mg/kg arsenic (**Figure 2**). The rationale is that any materials purchased from offsite sources should not exceed average Site background concentrations. The Oregon Department of Environmental Quality (ODEQ) determined that the UPL for background soils within the Cascade Range is 0.24 mg/kg mercury and 19 mg/kg arsenic (ODEQ 2013). The recommended screening criteria of 2 mg/kg mercury and 20 mg/kg arsenic for offsite borrow sources are comparable to Site background concentrations and reasonable based on regional background metals concentrations.

References

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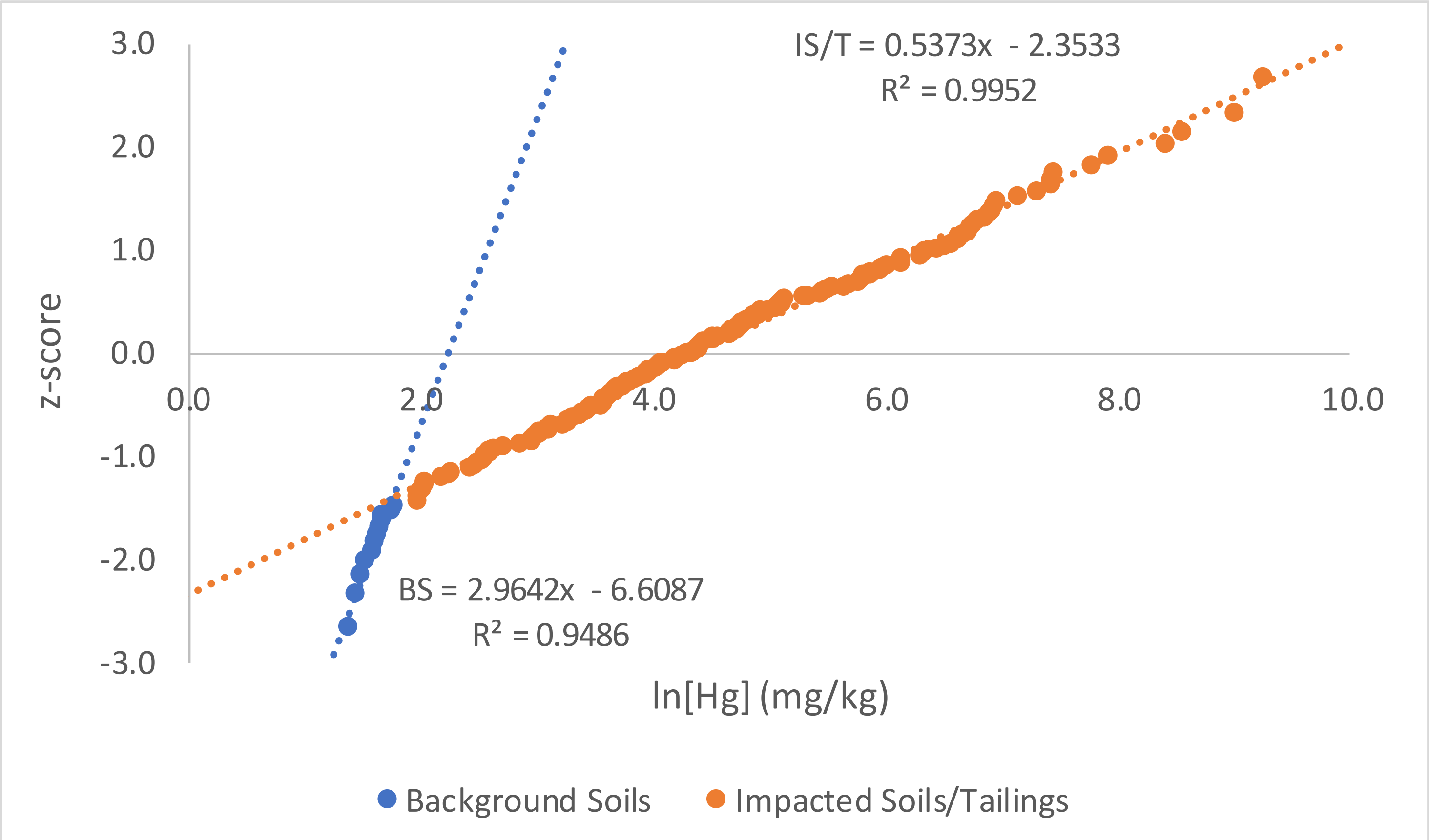
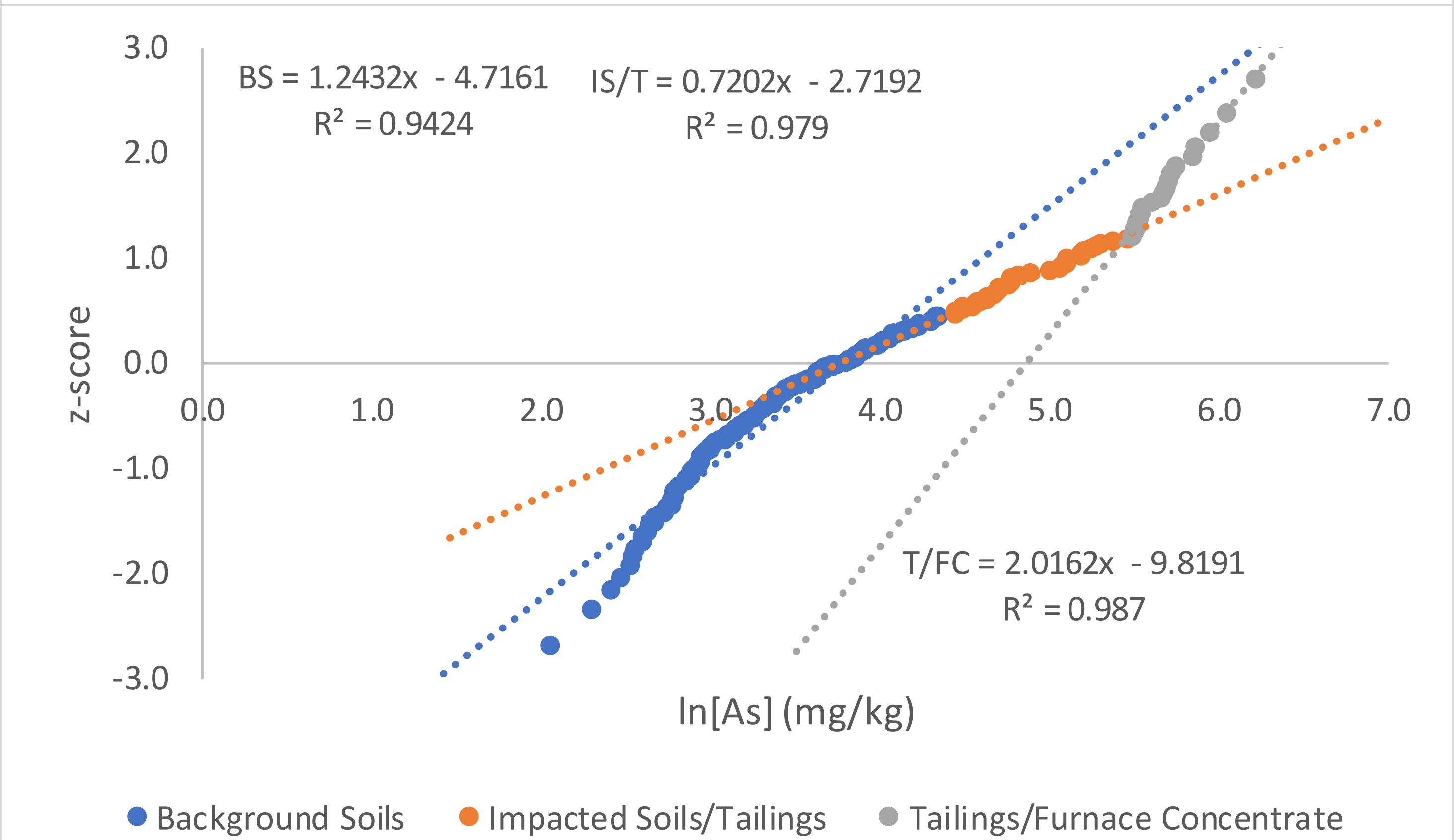
EPA. 2017. Regional Screening Level Summary Table, accessed March 2018, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017

ODEQ. 2013. *Development of Oregon Background Metals Concentrations in Soil,* accessed March 2018, http://www.oregon.gov/deq/FilterDocs/DebORbackgroundMetal.pdf

cc: Randy Nattis, EPA





Notes:
As – arsenic
Hg – mercury
mg/kg – milligrams per kilogram

EA CDM Smith	Black Butte Mine Superfund Site	**Figure 1** Inflection Point Analysis Probability Plots

Figure 2

Black Butte Mine Superfund Site Incremental Sampling TAL Metals Concentrations

Legend

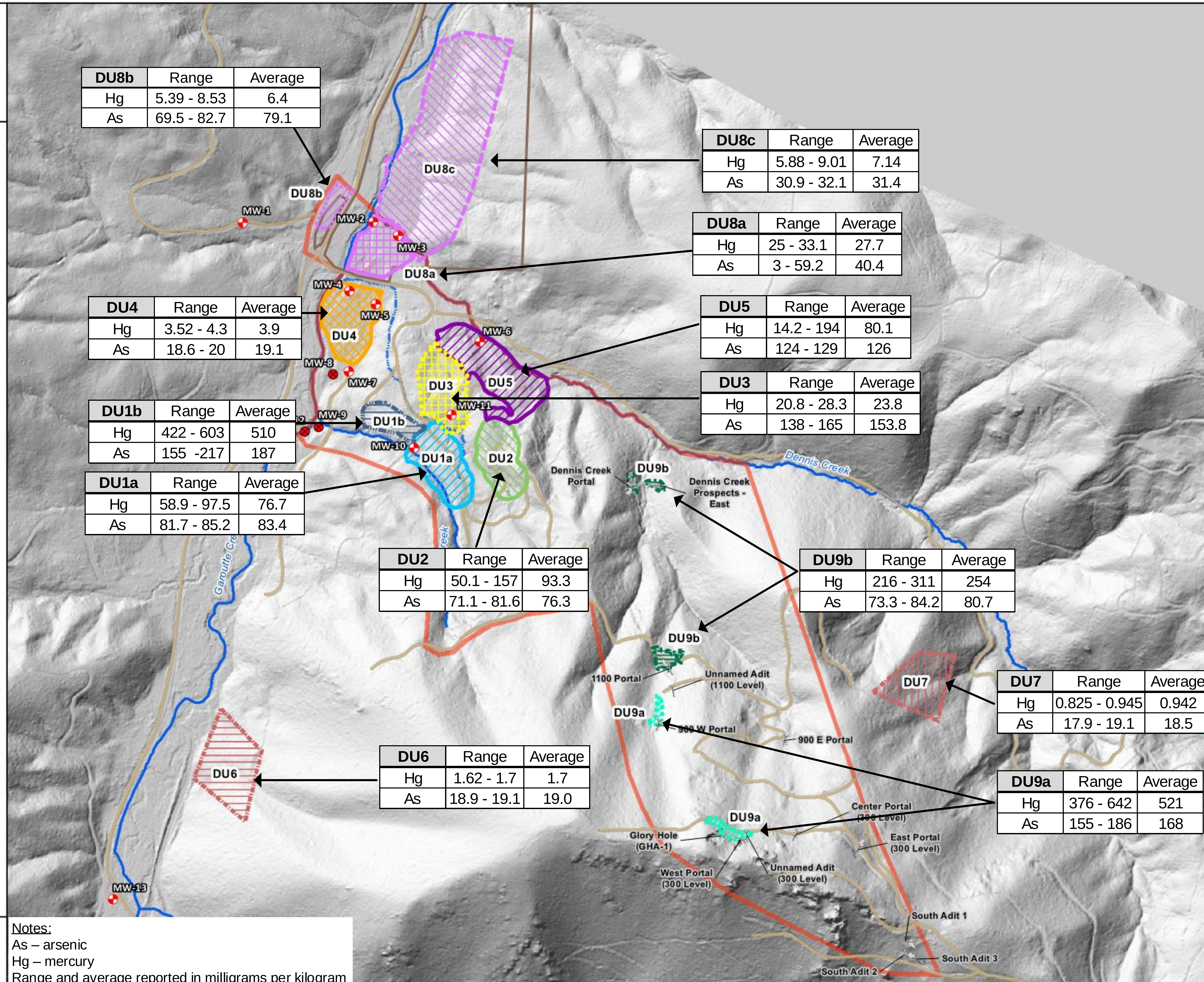
- Inclined Adit - Entry
- Inclined Adit - No Access
- Groundwater Monitoring Well (Sonic)
- Groundwater Monitoring Well (Hand Driven)
- Road
- Creek/Stream/Drain...
- Intermittent Creek/ Stream/Drainage
- OU1 Boundary
- Mine Residence Parcel
- DU1a: Old Furnace Cap Area/Upper Furnace Creek
- DU1b: Old Furnace Tailings
- DU2: New Furnace
- DU3: Main Tailings
- DU4: Garoutte Creek Floodplain
- DU5: Dennis Creek
- DU6: Background 1
- DU7: Background 2
- DU8a: Main Residential Parcel
- DU8b: Quonset Hut Parcel
- DU8c: North Residential Parcel
- DU9a: Glory Hole and 1950 Adit
- DU9b: Dennis Creek Adit and 1670 Adit

N

0 350 700 1,400

Feet

1 inch = 700 feet



DU8b	Range	Average
Hg	5.39 - 8.53	6.4
As	69.5 - 82.7	79.1

DU8c	Range	Average
Hg	5.88 - 9.01	7.14
As	30.9 - 32.1	31.4

DU8a	Range	Average
Hg	25 - 33.1	27.7
As	3 - 59.2	40.4

DU4	Range	Average
Hg	3.52 - 4.3	3.9
As	18.6 - 20	19.1

DU5	Range	Average
Hg	14.2 - 194	80.1
As	124 - 129	126

DU3	Range	Average
Hg	20.8 - 28.3	23.8
As	138 - 165	153.8

DU1b	Range	Average
Hg	422 - 603	510
As	155 -217	187

DU1a	Range	Average
Hg	58.9 - 97.5	76.7
As	81.7 - 85.2	83.4

DU2	Range	Average
Hg	50.1 - 157	93.3
As	71.1 - 81.6	76.3

DU9b	Range	Average
Hg	216 - 311	254
As	73.3 - 84.2	80.7

DU7	Range	Average
Hg	0.825 - 0.945	0.942
As	17.9 - 19.1	18.5

DU6	Range	Average
Hg	1.62 - 1.7	1.7
As	18.9 - 19.1	19.0

DU9a	Range	Average
Hg	376 - 642	521
As	155 - 186	168

Notes:
As – arsenic
Hg – mercury
Range and average reported in milligrams per kilogram

Table 1 Furnace Creek FPXRF Screening Dataset

Sample ID	Sample Depth (ft)	Hg (mg/kg)	As (mg/kg)
XRF-120-0.5	0.5	ND	7.9
XRF-121-0.5	0.5	7.5	38.3
XRF-122-0.5	0.5	4.4	48.9
XRF-123-0.5	0.5	5.9	13
XRF-124-0.5	0.5	4.6	16.4
XRF-125-0.5	0.5	7.6	30.6
XRF-126-0.5	0.5	126	95.3
XRF-126-1.0	1.0	318	90.2
XRF-127-0.5	0.5	ND	11.9
XRF-128-0.5	0.5	17.5	30.2
XRF-128-1.5	1.5	7.3	16.1
XRF-129-0.5	0.5	ND	15.3
XRF-130-0.5	0.5	ND	16.4
XRF-131-0.5	0.5	ND	11.3
XRF-131-2.0	2.0	336	185
XRF-132-0.5	0.5	34.9	54.6
XRF-133-0.5	0.5	9.4	103.9
XRF-134-1.5	1.5	12.7	120.2
XRF-135-0.5	0.5	ND	112.9
XRF-136-0.5	0.5	5	18.8
XRF-137-0.5	0.5	11.2	14.6
XRF-138-0.5	0.5	1681	425
XRF-139-0.5	0.5	2400	308
XRF-140-0.5	0.5	112	41.5
XRF-141-0.5	0.5	121	245
XRF-142-0.5	0.5	330	50.4
XRF-143-0.5	0.5	984	274
XRF-144-0.5	0.5	ND	17.6
XRF-145-0.5	0.5	823	191
XRF-146-0.5	0.5	7.2	37.5
XRF-146-1.5	1.5	35.9	55.1
XRF-147-0.5	0.5	5219	260
XRF-148-0.5	0.5	170	45.5
XRF-149-0.5	0.5	19.1	26.3
XRF-149-2.0	2.0	209	32.6
XRF-150-0.5	0.5	ND	13.6
XRF-151-0.5	0.5	4.2	19.5
XRF-152-0.5	0.5	52.9	18.1
XRF-152-2.0	2.0	2773	121
XRF-153-0.5	0.5	12	24.8
XRF-153-1.0	1.0	229	118.9
XRF-154-0.5	0.5	8195	55.2
XRF-154-1.5	1.5	1501	253
XRF-155-2.0	2.0	782	98.6
XRF-156-0.5	0.5	96	23.2
XRF-156-1.5	1.5	13.4	25.2

Table 1 Furnace Creek FPXRF Screening Dataset

Sample ID	Sample Depth (ft)	Hg (mg/kg)	As (mg/kg)
XRF-157-0.5	0.5	1015	197
XRF-158-0.5	0.5	4	21.5
XRF-158-2.0	2.0	124	27.8
XRF-159-0.5	0.5	19.8	15.7
XRF-159-2.0	2.0	147	37.8
XRF-160-0.5	0.5	ND	19.6
XRF-161-0.5	0.5	83	31.6
XRF-161-2.0	2.0	12.8	19.2
XRF-162-0.5	0.5	244	111.7
XRF-163-0.5	0.5	118	69.4
XRF-164-0.5	0.5	11.7	75.9
XRF-165-0.5	0.5	1712	98.1
XRF-166-0.5	0.5	166	63
XRF-167-0.5	0.5	116	14.1
XRF-167-1.5	1.5	139	25.9
XRF-168-0.5	0.5	107	48.1
XRF-169-0.5	0.5	4.9	37.8
XRF-169-2.0	2.0	40.6	34.7
XRF-170-0.5	0.5	ND	29.2
XRF-171-0.5	0.5	22.2	58.2
XRF-172-0.5	0.5	29.3	61
XRF-173-0.5	0.5	467	77.7
XRF-174-0.5	0.5	26	18.9
XRF-174-1.0	1.0	752	181
XRF-175-0.5	0.5	1059	316
XRF-175-1.5	1.5	1683	304
XRF-176-0.5	0.5	8.8	23.5
XRF-176-1.5	1.5	48.6	14.5
XRF-177-0.5	0.5	22.6	20.2
XRF-177-2.0	2.0	22.2	22.3
XRF-178-0.5	0.5	155	86.1
XRF-179-0.5	0.5	68	24.8
XRF-179-1.5	1.5	297	134.9
XRF-180-0.5	0.5	29.7	26.5
XRF-181-0.5	0.5	35.3	69.5
XRF-182-0.5	0.5	543	238
XRF-183-0.5	0.5	117	56.3
XRF-184-0.5	0.5	328	353
XRF-185-0.5	0.5	4501	261
XRF-186-0.5	0.5	165	117.8
XRF-186-1.5	1.5	135	74
XRF-187-0.5	0.5	36.5	16.2
XRF-187-2.0	2.0	555	289
XRF-188-0.5	0.5	460	217
XRF-189-0.5	0.5	713	150.2
XRF-190		357	124.3

Table 1 Furnace Creek FPXRF Screening Dataset

Sample ID	Sample Depth (ft)	Hg (mg/kg)	As (mg/kg)
XRF-191-0.5	0.5	26.3	18.1
XRF-191-2.0	2.0	51.7	20.8
XRF-192-0.5	0.5	135	26.7
XRF-192-2.0	2.0	10391	385
XRF-193-0.5	0.5	106	19.1
XRF-193-2.0	2.0	66	34.3
XRF-194-0.5	0.5	901	181
XRF-195-0.5	0.5	467	298
XRF-195-3.0	3.0	20.5	58.8
XRF-196-2.0	2.0	672	86.8
XRF-197-0.5	0.5	48.5	17.4
XRF-197-1.5	1.5	57.3	26
XRF-198-0.5	0.5	25	16.5
XRF-198-2.0	2.0	92	76.5
XRF-199-0.5	0.5	30.7	19.2
XRF-200-0.5	0.5	51.6	16.9
XRF-201-0.5	0.5	35.7	12.8
XRF-201-2.0	2.0	81	19.6
XRF-202-0.5	0.5	44.1	23.6
XRF-202-2.0	2.0	5.3	31.6
XRF-203-0.5	0.5	113	47.9
XRF-204-0.5	0.5	159	104.1
XRF-205-0.5	0.5	354	107.6
XRF-206-0.5	0.5	954	202
XRF-207-0.5	0.5	ND	50
XRF-208-0.5	0.5	39.8	13.5
XRF-208-2.0	2.0	7.6	10
XRF-209-0.5	0.5	13.9	29.9
XRF-209-2.0	2.0	5.7	29.2
XRF-210-0.5	0.5	42.6	22.1
XRF-210-1.5	1.5	76	63.9
XRF-211-0.5	0.5	46.2	20.6
XRF-212-0.5	0.5	130	59.6
XRF-213-0.5	0.5	39.2	22.2
XRF-213-1.0	1.0	762	250
XRF-214-0.5	0.5	81	28.1
XRF-214-2.0	2.0	386	165.5
XRF-215-0.5	0.5	27.1	39.5
XRF-216-0.5	0.5	163	66.9
XRF-217-0.5	0.5	89	49.2
XRF-218-0.5	0.5	92	37.2
XRF-219-0.5	0.5	37.7	16.1
XRF-219-2.0	2.0	60	14
XRF-220-0.5	0.5	42.3	18.3
XRF-220-2.0	2.0	ND	31.6
XRF-221-0.5	0.5	82	24

Table 1 Furnace Creek FPXRF Screening Dataset

Sample ID	Sample Depth (ft)	Hg (mg/kg)	As (mg/kg)
XRF-221-1.5	1.5	31.5	12.6
XRF-222-0.5	0.5	73	27.5
XRF-222-1.5	1.5	44.7	18
XRF-223-0.5	0.5	12.4	37.7
XRF-224-0.5	0.5	84	45.1
XRF-225-0.5	0.5	5.3	29.6
XRF-226-0.5	0.5	198	249
XRF-227-0.5	0.5	106	89.5
XRF-228-0.5	0.5	392	252
XRF-229-0.5	0.5	5.1	119.7
XRF-230-0.5	0.5	282	159.7
XRF-231-0.5	0.5	ND	32.8
XRF-232-0.5	0.5	53	22.9
XRF-232-2.0	2.0	235	161.2
XRF-233-0.5	0.5	409	254
XRF-234-0.5	0.5	9.5	33.4
XRF-234-2.0	2.0	5.2	46.3
XRF-235-0.5	0.5	634	505
XRF-235-1.5	1.5	837	165.4
XRF-236-0.5	0.5	66	29.7
XRF-237-0.5	0.5	253	108.7
XRF-238-0.5	0.5	15.2	53.2
XRF-239-1.0	1.0	856	350
XRF-240-0.5	0.5	564	166
XRF-241-0.5	0.5	13.4	47.2
XRF-242-0.5	0.5	1262	294
XRF-243-0.5	0.5	ND	50.4
XRF-244-0.5	0.5	29.2	42.3
XRF-245-0.5	0.5	1031	254
XRF-246-0.5	0.5	20.7	28.3
XRF-246-2.0	2.0	ND	36
XRF-247-0.5	0.5	77	74.2
XRF-248-0.5	0.5	70	110.4
XRF-249-0.5	0.5	38	26.8
XRF-249-2.0	2.0	58.1	67.9
XRF-250-0.5	0.5	19.4	111.1
XRF-251-0.5	0.5	81	40
XRF-252-0.5	0.5	37.2	20.2
XRF-253-0.5	0.5	56	59.3
XRF-254-0.5	0.5	32.2	86.2
XRF-255-0.5	0.5	7.2	39.4
XRF-256-0.5	0.5	56	96.6

Notes:

- As: arsenic -Hg: mercury -ND: not detected
- ft: feet -mg/kg: milligrams per kilogram