RECORD OF DECISION

Final Cleanup for the Upper Blackfoot Mining Complex State Superfund Facility

Lewis and Clark County, Montana

Prepared by:

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Declaration of Record of Decision

FACILITY NAME AND LOCATION

The Upper Blackfoot Mining Complex (UBMC) Facility is a high priority state Superfund facility listed on the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) Priority List. The UBMC Facility is approximately 15 miles east of Lincoln and within Lewis and Clark County, Montana.

STATEMENT OF PURPOSE AND BASIS

This Record of Decision (ROD) is the document that presents the Montana Department of Environmental Quality's (DEQ's) selected remedial action for the non-federal lands within the UBMC Facility and was developed in accordance with CECRA. DEQ is overseeing remediation on the non-federal lands within the UBMC under CECRA, while the U.S. Forest Service (USFS) is responsible for the remediation on the National Forest System (federal) lands within the UBMC. The remedial action selected in the ROD is based on the administrative record, which consists of the documents DEQ cited, relied upon, or considered in selecting the remedy for the UBMC Facility. The administrative record is identified in Part 2, Section 14.0 of the ROD. The complete administrative record is available for public review at the offices of DEQ, Remediation Division, located at 1225 Cedar Street in Helena, Montana. A partial compilation of the administrative record is available at the Lincoln Library (Lewis and Clark Library Branch); the Lewis and Clark County Library (Helena); and on DEQ's website at http://deq.mt.gov/Land/statesuperfund/ubmc.

ASSESSMENT OF THE FACILITY

DEQ is authorized to take remedial action whenever there has been a release or a threatened release of a hazardous or deleterious substance into the environment that poses or may pose an imminent and substantial endangerment to the public health, safety, or welfare, or the environment. Section 75-10-711, MCA. CECRA defines a hazardous or deleterious substance in Section 75-10-701(8), MCA. The primary contaminants that DEQ identified at the UBMC Facility are metals (aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc). These contaminants are described in Part 2 of the ROD. DEQ has determined that these contaminants are hazardous or deleterious substances under CECRA. Based on the administrative record, DEQ has determined that hazardous or deleterious substances have been spilled, leaked, discharged, leached, dumped, or disposed into the environment, which constitutes a release or threatened release under Section 75-10-701(19), MCA.

The potential for an "imminent and substantial endangerment to public health, safety, and welfare, or the environment" is present when contaminant concentrations in the environment exist or have the potential to exist above risk-based screening levels (ARM 17.55.102) and an imminent and substantial endangerment does exist if contaminant concentrations exceed site-specific cleanup levels (SSCLs). DEQ has determined that contaminant concentrations at the UBMC Facility exceed risk-based screening levels and SSCLs. Therefore, DEQ has determined that a release or a threatened release of hazardous or deleterious substances from the UBMC

Facility poses an imminent and substantial endangerment to the public health, safety, or welfare, or the environment and further remedial action is necessary. In selecting the remedial action, DEQ evaluated the criteria found in Section 75-10-721, MCA.

DESCRIPTION OF THE REMEDY

Section 75-10-721(2)(c), MCA, directs DEQ to consider present and reasonably anticipated future uses of a facility when selecting remedial actions. The alternative selected must then meet SSCLs protective of the reasonably anticipated future uses. DEQ's evaluation of reasonably anticipated future uses of the UBMC Facility is found in Part 2, Section 6.0 of the ROD. In summary, DEQ determined that the reasonably anticipated future uses of the UBMC are primarily open space/recreational with some limited part-time or full-time residential use, with the exception of the Water Treatment Plant (WTP) and its infrastructure and the three existing repositories, which is industrial.

The remedy for the UBMC Facility consists of remediation of contaminated media to meet SSCLs as described in the ROD, with reliance on institutional controls. Numerous interim actions have occurred at the UBMC Facility. DEQ considered the interim remedial actions and integrated that information and those actions into the remedy to the extent possible. Major components of the remedy are summarized below. Details of the remedy are provided in Part 2, Section 11.0 of the ROD. Some of the primary components of the remedy include:

Solid Media – Soil

The final remedy includes a combination of excavation and onsite disposal, and site-wide elements including access controls (signage and/or fencing) and institutional controls (ICs) to address the metals contaminants in soil at the UBMC Facility.

The final remedy will remove most metals impacted soils to the SSCLs and place those soils in the onsite UBMC Repository. Removal is expected to achieve substantial and long-term risk reduction through excavation and removal to an onsite repository. The integrity of the UBMC repository as well as the Carbonate and Paymaster repositories that were constructed as interim actions will be monitored in the long term.

Some areas at the UBMC are remote and difficult to access. These areas are characterized by steep slopes that are mostly heavily timbered and with few serviceable roads. In addition, some areas like Stevens Gulch are located within the footprint of the UBMC copper-molybdenum ore body. Any new road construction or improvements necessary to turn older roads into haul roads would risk exposing mineralized areas with the potential for increasing human health and environmental problems. In these difficult to access mining-related areas, where excavation and removal to an onsite repository are not possible without the potential for causing additional environmental harm, access controls will provide limited long-term risk reduction in lieu of the considerable disturbance and increased risk that may be caused by road construction needed to reach these remote areas.

In one area, maintaining the current subsurface geochemical/oxidation state conditions in the vicinity of the Paymaster constructed wetland system is essential to limiting widespread deposition of ferrous iron and increased metal mobility of at least arsenic and possibly other metals. Therefore, ICs to prohibit excavation and construction in these areas will be protective of human health.

Solid Media – Sediment

The final remedy includes a combination of excavation and onsite disposal of sediments, access controls (signage and/or fencing) to address the metals contaminants in sediments located in hard to access and sensitive environment areas, and monitored natural recovery (MNR).

The final remedy will remove most metals impacted sediment associated with the Upper Marsh or mining-related features and place them in the onsite UBMC Repository. In areas where sensitive environments are not an issue, sediments will be cleaned up to SSCLs which will, in turn, enhance the reestablishment of aquatic organisms. Removal was selected over the other alternatives because it is expected to achieve substantial and long-term risk reduction through excavation and placement in an onsite repository.

The same accessibility challenges found with soils also exists for sediments found in or near the mining-related features. In the difficult to access mining-related areas, where excavation and removal to an onsite repository are not possible without the potential for causing considerable environment harm, access controls will provide limited long-term risk reduction in lieu of the considerable disturbance and increased risk that may be caused by road construction needed to reach these remote areas. The final remedy also includes site-wide elements, such as signage and ICs, to limit exposure where contaminated sediments remain in sensitive environments (fens and other sensitive wetland areas).

The final remedy also includes MNR in areas that are already showing signs of recovery. Ecological indicators such as diversity within the macroinvertebrate community, macroinvertebrate bioassays, and improvement in water quality from upstream to downstream suggest that the Blackfoot River is recovering below the Upper Marsh. The western portion of the Upper Marsh will also benefit from the upstream removal of contaminant sources that will take place over the next several years. In specific areas, MNR was selected over the other alternatives and is expected to achieve long-term risk reduction as a result of the source removal in upstream areas.

Groundwater

The final remedy includes active water treatment of adit and seep discharges, passive treatment of shallow groundwater, and ICs to restrict well development in select areas.

Active water treatment will continue to address adit discharges and seeps from the Anaconda and Mike Horse mines through active mechanical/physical treatment combined with active chemical reagent at the WTP. Treatment of the Mike Horse adit discharge and seeps will also include the continued treatment of the Upper Mike Horse bedrock groundwater aquifer. The integrity of the adit plugs that were installed as interim actions will be monitored in the long term.

Passive water treatment, with a permeable reactive barrier (PRB), is the selected remedy for the Carbonate Mine shallow groundwater. The final remedy for the Carbonate Mine groundwater and Upper Mike Horse bedrock groundwater also includes ICs in the form of a restrictive covenant, controlled groundwater area, or both.

Surface Water

There are no remedial actions proposed to solely address UBMC surface water. Achieving the SSCLs for surface water quality will come from successful implementation of the final remedies for soil, sediment, and groundwater that surround the UBMC surface water bodies. Performance monitoring and long-term monitoring will evaluate the effectiveness of the remedies for the other media and confirm that SSCLs are met in surface water.

The final remedy for mining-related feature discharges, seeps, and/or springs will address surface water quality through containment (retention). The same accessibility challenges found with some soils and sediments also exists for some discharges, seeps and/or springs found in or near the mining-related features. In areas where accessibility is not an issue, these features will be addressed through the construction of lined retention ponds.

STATUTORY DETERMINATIONS

The selected remedy will attain a degree of cleanup that assures present and future protection of public health, safety, and welfare, and the environment, and complies with federal and state environmental requirements, criteria, and limitations that are applicable or relevant to the remedial action and Facility conditions. DEQ considered current and reasonably anticipated future uses of the Facility and ICs in selecting the remedy. The selected remedy mitigates risk, is effective and reliable in the short- and long-term, is practicable and implementable, uses engineering controls, and is cost-effective. DEQ has considered all public comment received during the public comment period on the Proposed Plan and has responded to these comments in Part 3 of the ROD.

AUTHORIZING SIGNATURE

Tom Livers 3/10/16

Tom Livers
Director
Montana Department of Environmental Quality

Date

UBMC ROD
Part 2: Table of Contents

FIGURES

TABLES

APPENDICES

ACRONYM LIST

°F	Degrees Fahrenheit
ABA	Acid-Based Accounting
AOC	Administrative Order on Consent
ARCO	Atlantic Richfield Company
ARM	Administrative Rules of Montana
ASARCO	American Smelting and Refining Company
ATSDR	Agency for Toxic Substances and Disease Registry
BER	Montana Board of Environmental Review
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BMP	best management practice
BTEX	Benzene, Ethylbenzene, Toluene, Xylenes
CDC	U.S. Centers for Disease Control and Prevention
CECRA	Comprehensive Environmental Cleanup and Responsibility Act
cfs	Cubic feet per second
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DEQ	Department of Environmental Quality
DEQ-7	Circular DEQ-7 Montana Numeric Water Quality Standards
DHHS	U.S. Department of Health and Human Services
DOJ	Montana Department of Justice
EA	Evaluation Area
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U. S. Environmental Protection Agency
ERCLs	Environmental Requirements, Criteria, and Limitations
EU	Exposure Unit

FS	Feasibility Study
gpm	Gallons per minute
GPS	Global Positioning System
HELP	Hydrologic Evaluation of Landfill Performance
HHRA	Human Health Risk Assessment
IARC	International Agency for Research on Cancer
IC	Institutional Control
MCA	Montana Code Annotated
MDHES	Montana Department of Health and Environmental Sciences
MDSL	Montana Department of State Lands
METG	Montana Environmental Trust Group
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MGWPCS	Montana Groundwater Pollution Control System
MNA	Monitored Natural Attenuation
MNR	Monitored Natural Recovery
MPDES	Montana Pollutant Discharge Elimination System
NRDP	Montana Department of Justice Natural Resource Damage Program
NRIS	Natural Resource Inventory System
O&M	Operation & Maintenance
PLP	Potentially Liable Person
PRB	Permeable Reactive Barrier
QSC	Qualifying Soil Concentration
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SCM	Site Conceptual Model
SPLP	Synthetic Precipitation Leaching Procedure
SRS	Site Response Section
SSCL	Site-Specific Cleanup Level
TMDL	Total Maximum Daily Load

UBMC	Upper Blackfoot Mining Complex
µg/dL	Micrograms per Deciliter
USFS	United States Forest Service
VCRA	Voluntary Cleanup and Redevelopment Act
WBZ	Water Bearing Zone
WRA	Watershed Restoration Agreement
WTP	Water Treatment Plant
WTS	Paymaster Passive Wetland Treatment System
WWTS	Wetlands-based Water Treatment System
XRF	X-Ray Fluorescence
yd^3	Cubic Yard

1.0 FACILITY NAME, LOCATION AND DESCRIPTION

The Upper Blackfoot Mining Complex (UBMC) Facility encompasses part of a former hardrock mining district. The Montana Department of Environmental Quality (DEQ) is overseeing remediation on the non-federal lands within the UBMC under the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA). This Record of Decision (ROD) identifies DEQ's selected remedy for the non-federal lands within the UBMC. The U.S. Forest Service (USFS) is responsible for selecting the final remedy on the National Forest System (federal) lands within the UBMC.

In July 2007, the USFS released its Action Memorandum identifying the required cleanup at a portion of its property within the UBMC. The USFS amended that Action Memorandum in July 2012. For those federal lands within the UBMC that were not included in the Action Memorandum, as amended, the USFS will issue a separate decision selecting the final remedy for that property.

The UBMC covers an area of approximately six square miles, including several sections within Township 15 North, Range 6 West, and is located approximately 15 miles east of Lincoln, Lewis and Clark County, Montana, in the headwaters area of the upper Blackfoot River (Figure 1). The UBMC includes a mixture of federal and non-federal lands that lie within a portion of the historical Heddleston mining district (Heddleston district) in the Rocky Mountains and includes a number of individual historical underground metal (silver-lead-copper-zinc) mines (Figure 2). Historical mining activity at the UBMC has resulted in contamination at discrete locations within the Facility.

2.0 FACILITY HISTORY

2.1 OWNERSHIP AND OPERATIONAL HISTORY

The Heddleston district portion of the UBMC was named for William Heddleston who, with his partner George Padbury, discovered the Calliope lode in 1889 (GCM, 1993). A small mining operation was begun and an arrastra, a small primitive mill, was built on Pass Creek to process the ore. Prior to 1915, prospectors discovered a number of lodes containing lead, zinc, and copper, including the Mike Horse, Carbonate, Paymaster, Midnight, and Anaconda mines. Throughout its history, the majority of the district's mineral wealth came from the production of lead and zinc, with some copper and silver. The district's early development was hampered by difficult access created by the lack of suitable roads. As a result, only minor shipments of ore were made to offsite smelters during this early period of mining (GCM, 1993).

The district saw a revival of mining activity in 1915 when the Mike Horse Mine was taken over by the Sterling Mining and Milling Company of Ellensburg, Washington. A major lead deposit was developed at the Mike Horse Mine and in 1919 a concentrating mill was built to process the mine's ores, as well as the ore from the nearby Anaconda and Paymaster Mines. The Mike Horse Mine produced a modest amount of ore as concentrate by the end of the 1920s. The Mike Horse Mine was idle until 1938 when it was leased to the Mike Horse Mining and Milling Company. The following year, a 150 tons-per-day flotation mill was built, and, in 1940, a 15-mile electric power line was strung from Marysville to the mine. In 1941, the Mike Horse Dam was constructed across Beartrap Creek just upstream of the confluence with Mike Horse Creek (Figure 2) to serve as an impoundment for the tailings from the newly constructed Mike Horse Mine flotation mill. The Mike Horse deposit continuously produced lead/zinc ore, containing some silver, for the next decade (GCM, 1993).

In 1945, the assets of the Mike Horse Mining and Milling Company were purchased by American Smelting and Refining Company (ASARCO), and it kept the Mike Horse Mine operating until 1955, at which point the mine closed due to declining metals prices and near exhaustion of the ore body. The Rogers Mining Company of Helena leased and operated the mine sporadically from 1958 until early 1964 when the Anaconda Company of Butte acquired a lease to mine the Mike Horse deposit from ASARCO. The Anaconda Company conducted exploration activities from 1962 through 1973 in the Heddleston district (although not on the Mike Horse Mine claims), including detailed geologic mapping; geochemical sampling; drilling of 340 rotary, diamond, and reverse circulation drill holes; and the driving of two adits to collect bulk samples. This exploration work defined a substantial underground copper/molybdenum porphyry deposit. In 1979, following cessation of the Anaconda Company's exploration activities in the Heddleston district, the Anaconda Company was merged into the Atlantic Richfield Company (ARCO). ASARCO purchased all of ARCO's holdings in the Heddleston district in 1981. From 1981 until resolution of its bankruptcy filing, ASARCO performed limited exploration work on the property, as well as mine reclamation activities (with ARCO's participation) (GCM, 1993).

Although the Mike Horse Mine was the mainstay of the district, other small mining operations were also active during the twentieth century. The Paymaster Mine was in operation early in the 1900s but had closed by the mid-1920s. In the early 1960s, it was reopened with minor development work conducted by Paramount Estates of New York. The Anaconda Mine was developed early in the 1900s and produced minor amounts of ore containing gold, silver, copper, and lead intermittently through 1940. Both properties were purchased by the Anaconda Company in the mid-1960s and subsequently acquired by ASARCO (GCM, 1993).

Total tonnage of ore produced from the Heddleston district is less than 450,000 tons, with 385,000 tons of that production coming from the Mike Horse Mine from 1945 to 1952. Although exact production figures for the district are not available, it appears that greater than 95 percent of the production from the district came from the Mike Horse Mine with only minor amounts of production coming from the Anaconda, Carbonate, and Paymaster mines (GCM, 1993).

The UBMC Facility contains both federally-owned lands (National Forest System) and non-federal lands (historical ASARCO patented mining claims, ASARCO fee lands, and other private or state property) located within or near the boundaries of the Lewis and Clark National Forest and within Lewis and Clark County, Montana (Figure 1). The Lewis and Clark County records for land ownership were queried to identify property owners within the UBMC and lands immediately west of the UBMC (Lewis and Clark County, 2006); these records were reviewed again in 2016 (DEQ, 2016a). ASARCO transferred its patented mining claims and fee lands to the Montana Environmental Trust Group, LLC (Trust), on December 9, 2009, as part of the settlement of State and federal claims in the ASARCO bankruptcy. The Facility lies predominantly south of US Highway 200, about 15 miles and about 5 miles west of Rogers Pass, at which US Highway 200 crosses the Continental Divide.

2.2 REGULATORY HISTORY

In 1987, the Montana Legislature allocated funds to the Montana Department of State Lands (MDSL; now part of DEQ) for reclamation of the Mike Horse Mine (part of the UBMC) under the State's abandoned mine reclamation program, with additional funding allocated in 1989. MDSL performed site characterization activities and reclamation planning from 1987 through 1990, including plans for mine waste removal and water treatment designs (MDSL, 1990). In 1990, however, the Montana Department of Health and Environmental Sciences (MDHES, now DEQ – both agencies will be collectively referred to as DEQ within this document), determined that potentially liable persons (PLPs) existed for the Mike Horse Mine, and the state's reclamation plans were put on hold (MDHES, 1990-91).

In June 1991, DEQ identified ASARCO and ARCO as PLPs under CECRA for hazardous or deleterious substance contamination at the UBMC. DEQ identified the need for the PLPs to complete a remedial investigation (RI) and feasibility study (FS) and to implement a remedy to be determined by DEQ (MDHES, 1991).

Between February 1992 and May 1993, ASARCO and ARCO proposed implementation of a voluntary reclamation program at the UBMC in lieu of completing the RI and FS. Terms and conditions of ASARCO's and ARCO's proposal are outlined in a May 1993 letter, including preparation and submittal of annual work plans and other documents. DEQ reviewed plans and work, but did not approve any of the work (MDHES, 1993a). Interim actions proceeded under this agreement until 1998, when interim actions of the Paymaster Mine and No. 3 Tunnel area proceeded under the newly established Montana Voluntary Cleanup and Redevelopment Act (VCRA) (MFG, 1996). (The No. 3 Tunnel Area is on USFS property but was included in the VCRA plan.) ASARCO chose to forego submitting a construction completion report, required under the VCRA closure process, and that action resulted in DEQ voiding its approval of the voluntary cleanup plan (ASARCO, 2003).

In 1995, ASARCO received a Montana Pollutant Discharge Elimination System (MPDES) permit for discharge of treated water from the Mike Horse and Anaconda mine adit discharges (MDHES, 1995). The MPDES permit (MTR-0030031) regulated the discharge of treated water to the Blackfoot River from a passive wetlands-based water treatment system (WWTS) that was constructed in 1995-96.

In 1996, ASARCO received a Montana Groundwater Pollution Control System (MGWPCS) permit (permit MGWPCS-001001) for treatment and subsurface discharge of a small (two gallons per minute (gpm) or less) seasonal flow from the Paymaster adit (DEQ, 1997). The Paymaster MGWPCS permit expired in September 2003 and was not renewed, since no discharge was ever recorded from the Paymaster Mine water treatment wetlands cell (DEQ, 2006). ASARCO also held an authorization to discharge storm water from the UBMC under Montana's general permit for storm water discharges (Authorization MTR300157; MDHES, 1993). The storm water permit remained in effect until May 2011, when DEQ's Site Response Section (SRS) assumed administrative duties to monitor water quality compliance under its CECRA authority (MDHES, 1993b; DEQ, 2011a).

In June 2000, upon petition by ASARCO, the Montana Board of Environmental Review (BER) approved temporary water quality standards in portions of Mike Horse Creek, Beartrap Creek, and the upper Blackfoot River (Hydrometrics, 1999); the temporary standards were established in the Montana surface water quality regulations (Administrative Rules of Montana (ARM) 17.30.630). The temporary standards modified the water quality standards for a number of metals, including cadmium, copper, iron, lead, manganese, and zinc, as well as pH, until 2008. As part of the temporary standards petition process, ASARCO developed a conceptual plan for mitigation of all mining contamination causing water quality exceedances that was identified in the Temporary Standards Implementation Plan (Implementation Plan) (Hydrometrics, 2000).

In November 2002, ASARCO entered into an Administrative Order on Consent (AOC) with the USFS for performance of an Engineering Evaluation/Cost Analysis (EE/CA) to develop removal action alternatives for contamination on certain federal lands within the UBMC. The AOC covered federal lands along portions of Mike Horse Creek, Beartrap Creek (including the Mike Horse tailings impoundment), and the Blackfoot River upstream of the confluence with Pass Creek (Figure 1). These areas were affected by historical mining operations, including those related to the Mike Horse Mine and tailings impoundment (Hydrometrics, 2007).

In 2003, DEQ brought legal action in state district court against ASARCO, ARCO, and ARCO Environmental Remediation, LLC, for recovery of DEQ's past and future remedial action costs associated with the UBMC, to require the companies to implement required remedial actions, and for a declaratory judgment to establish liability for all future remedial action costs, including cleanup costs, which DEQ would incur in connection with the UBMC (First Judicial District Court, 2003). In 2007, DEQ amended its legal action to include a claim for natural resource damages.

In 2005, ASARCO prepared a draft data summary report as part of an interim settlement of the pending litigation (Hydrometrics, 2005a). DEQ reviewed the draft report and provided comments to ASARCO and ARCO. DEQ's review of the revised document (Hydrometrics, 2005b) indicated that the companies had not incorporated DEQ's comments adequately.

Therefore, DEQ revoked the interim settlement agreement and completed the report itself (Tetra Tech, 2007).

In August 2005, ASARCO filed for Chapter 11 bankruptcy. DEQ, the Montana Department of Justice (DOJ) through its Natural Resource Damage Program (NRDP), and the USFS filed claims in the bankruptcy. The parties settled these claims as part of two separate settlement agreements. The first settlement involved both ASARCO and ARCO and provided the State of Montana and United States with approximately $40 million. ASARCO remained responsible for the water treatment plant and maintenance of the Mike Horse, Paymaster, and Carbonate repositories (U.S. Bankruptcy Court, 2008). As part of these settlements, DEQ dismissed the state court action. DEQ and NRDP entered into a Watershed Restoration Agreement (WRA) with the USFS, whereby DEQ would implement the cleanup selected by the USFS for federal lands addressed in the Action Memorandum (WRA, 2008). DEQ and NRDP also entered into a Memorandum of Agreement which addressed DEQ and NRDP coordination regarding UBMC remedial and restoration actions related to the 2008 settlement agreement. In 2009, the State of Montana, United States, and ASARCO entered into a second settlement agreement whereby ASARCO's UBMC real property holdings and water treatment plant obligations and repository maintenance obligations were transferred to the Trust, along with approximately $10 million in funding (US Bankruptcy Court, 2009). The Trust is the current owner of most of the UBMC property being addressed in this ROD (Figure 1) and is responsible for operating and maintaining the water treatment plant.

In December 2006, the BER revoked the temporary water quality standards due to the failure of ASARCO to implement the Implementation Plan (BER, 2006). One of the Implementation Plan requirements was that the WWTS be modified to meet water quality standards. However, the WWTS continued to represent a source of metals loading to the Blackfoot River as reported in the Water Quality Restoration Plan for Metals in the Blackfoot Headwaters Total Maximum Daily Load (TMDL) Planning Area (DEQ, 2003). In 2007 and 2008, ASARCO continued to treat water from the Mike Horse and Anaconda mine adit discharges using the WWTS. In 2008, ASARCO constructed a chemical and ceramic microfiltration water treatment plant (WTP) (CDM, 2008) at the same location, replacing the WWTS in January 2009. These discharges were regulated under MPDES permit MTR-0030031 until May 2011 when DEQ's SRS assumed administrative duties to monitor water quality compliance under its CECRA authority (DEQ, 2011).

In July 2007, the USFS released the EE/CA prepared by ASARCO as well as an Action Memorandum that selected the cleanup on certain federal lands within the UBMC (Hydrometrics, 2007). The Action Memorandum included: (1) total removal of the Mike Horse Dam and tailings impoundment with placement of the waste into a within-drainage repository; (2) complete removal of mine waste from Lower Mike Horse Creek and placement of the waste into a within-drainage repository; (3) removal of all concentrated and intermixed tailings from the active floodplain of Beartrap Creek and placement of the waste into a within-drainage repository; and (4) complete mine waste removal (estimated at 45,000 cubic yards (yd^3)) from the Upper Blackfoot River and placement of the waste into a within-drainage repository. The Paymaster Repository, previously constructed by ASARCO as part of its VCRA plan, was identified as the preferred within-drainage repository, subject to further verification that it was a suitable location (USFS, 2007).

Subsequently, several design level investigations of the Paymaster Repository area for placement of additional mine waste were conducted and the USFS determined that the Paymaster Repository was not suitable due to concerns regarding constructability, space, volume, cost, and protectiveness. Based upon those investigations, in July 2012, the USFS issued an amendment to the 2007 Action Memorandum and selected a new repository location, often referred to as the Section 35 Repository; the USFS determined it was the most protective location for a new repository and the most appropriate based upon constructability, space, volume, cost, and protectiveness (USFS, 2012).

In 2007, DEQ initiated an RI of the UBMC in order to identify the nature and extent of contamination which had not been adequately characterized. The RI field work was performed in the fall 2007 and summer 2008. DEQ conducted a supplemental investigation in November 2011 to address specific data gaps (Pioneer, 2012). The RI Report (Tetra Tech, 2013a) discusses the results of the 2007, 2008, and 2011 work.

In 2009, DEQ initiated a baseline risk assessment that included a baseline ecological risk assessment (BERA) and a baseline human health risk assessment (HHRA). The primary objective of the BERA was to evaluate site-specific risk to plants, invertebrates, fish, birds, and mammals to support risk management decisions and future remedial actions at the UBMC (Tetra Tech, 2013b). The primary objective of the HHRA was to evaluate site-specific risk to human health from exposure to soil, sediment, groundwater, and surface water (Tetra Tech, 2014). Because metals are natural occurring in the environment, DEQ collected facility-specific background samples from unimpacted areas at the UBMC that are representative of natural conditions (Tetra Tech, 2013a). The site-specific risks in both risk assessments were quantified and site-specific cleanup levels (SSCLs) were developed.

In 2011, NRDP issued its Conceptual Restoration Plan for the UBMC (RDG, 2011). NRDP began implementation of its restoration plan in 2015, in conjunction with DEQ's interim actions and implementation of the Action Memorandum, as amended. Consistent with the DEQ and NRDP Memorandum of Agreement, DEQ and NRDP will be coordinating the UBMC remedial and restoration actions.

In 2013, DEQ began to develop, screen, and evaluate remedial action alternatives in an FS. Using the RI characterization, DEQ developed and screened a list of remedial action technologies in the initial alternatives screening document (Pioneer, 2013). Remedial technologies most applicable to the UBMC were retained for further screening and evaluation in the FS and used to develop the remedial alternatives for the UBMC (Pioneer, 2016).

2.3 PREVIOUS INTERIM ACTIONS

The earliest monitoring activities at the UBMC date back to the 1960s with the majority of sampling performed by ASARCO or ARCO beginning in 1991 and continuing through 2005 (Tetra Tech, 2007). DEQ evaluated the previous data prior to the RI to determine if there was already sufficient data to determine the nature and extent of contamination. While the samples, collected from 1994-2005, were gathered using generally consistent sampling and analytical techniques, they were limited in scope and additional data was needed. Tables 1 and 2 summarize past monitoring activities. Because of the limited scope of historic data collection, DEQ completed a comprehensive RI (Tetra Tech, 2013a).

ASARCO and ARCO conducted numerous interim actions to address environmental impacts from historical mining activities at the UBMC and to meet various permit requirements. Accumulations of mine waste, including mine waste rock and tailings, were identified in portions of the UBMC. Several mine waste piles were located in drainage bottoms resulting in metals leaching to surface water. From 1993 through 1997, ASARCO and ARCO removed mine waste piles associated with various UBMC mines and placed the waste in engineered repositories. ASARCO and ARCO did not conduct adequate confirmation sampling during these removals, so those areas were sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous interim actions.

Other interim actions performed by ASARCO and ARCO at various UBMC mines included filling two mine shafts, plugging several mine adits, and treating mine waste in place. In 1996, ASARCO and ARCO constructed two wetland systems, the WWTS to treat drainage from the Mike Horse and Anaconda mine adits, and the Paymaster passive wetland treatment system (WTS) to treat drainage from the Paymaster Adit. In 2006, ASARCO also completed additional mine waste removal at the Mike Horse Mine. All of these interim actions were investigated and the results were presented in the RI. Using the data from the RI, DEQ performed two risk assessments, HHRA (Tetra Tech, 2014) and BERA (Tetra Tech, 2013b), to evaluate if there was any unacceptable risk for current or potential future uses. The assessments were organized into 13 exposure units (EUs) that were identified by physical location, habitat type, and waste sources. The extent of contamination in each EU is discussed by media in the Facility Contamination section (Section 5.3) and further explained in the Human Health and Ecological Risk Assessments section (Section 7), while the Selected Remedy section (Section 11) includes discussion about the remedy for each EU. Figure 3 provides a site map showing:

- The location of each EU (mine and other waste areas investigated in the RI) that underwent interim actions in the 1990s;
- other interim actions that followed such as the construction of the WTP; and
- and other non-interim action areas (EU 2 – Blackfoot River dispersed tailings, EU 7 – Mary P Mine waste pile, EU 11 – Beartrap Creek dispersed tailings, EU 12 – Upper Marsh, and EU 13 – Blackfoot River stream sediments) investigated during the RI (Figure 3).

The following is a site-by-site chronology of interim actions completed at the UBMC and includes the EU number (if applicable) associated with that particular mine area and the timeframe for the actions performed at that particular mine area. If surface water and/or groundwater are impacted at an EU, it will also be discussed since the interim actions objectives generally included improving the contaminated waters in those areas.

2.3.1 Anaconda Mine – EU 1 (1994-96)

The Anaconda Mine is located at the headwaters of the Blackfoot River adjacent to the confluence of Anaconda Creek and Beartrap Creek (Figure 1). The area is divided into a lower waste pile area located next to the Blackfoot River at the site of the WTP and an upper waste pile area (EU1A and EU1B) on the hillside beginning approximately 200 feet in elevation above the WTP and the Blackfoot River (Figure 4).

2.3.1.1 Lower Waste Pile Area

Approximately 33,500 yd^3 of mine waste was removed from the lower and upper Anaconda Mine areas in 1994 and 1995 and placed in the Mike Horse Repository (Figure 2; Hydrometrics, 1995; Hydrometrics, 1996; Pioneer, 2016). Most of the removed mine waste came from two waste piles originally located on the floodplain of the Blackfoot River (Figure 4). The piles' proximity to the floodplain resulted in leaching of metals and erosion and subsequent transport of mine waste to the river (Hydrometrics, 1995). The lower Anaconda Mine area confirmation sampling was performed in 1995 in the larger eastern pile removal area, which is mostly within the area of Cell 4 and Cell A at the WTP. The confirmation sampling for the western pile removal area was performed in 2008 during the construction of the WTP. Additional confirmation sampling was performed between the eastern and western piles when Cell 5 was rebuilt in 2011. Two to six feet of clean fill was used over this area to construct the WWTS. Therefore, the confirmation sampling results are considered representative of subsurface soil (greater than two feet below ground surface (bgs)) and were compared to the construction worker SSCLs and soil leaching-to-groundwater location-specific SSCLs for EU2 – the Blackfoot River floodplain EU where the WTP is located. The soil leaching-to-groundwater SSCL for arsenic is specific to the WTP area and was developed using the results from the soil synthetic precipitation leaching procedure (SPLP) (see Section 7.6) result of 340 milligrams per kilogram (mg/kg). This procedure simulates rainfall and the ability for metals to leach into the groundwater. The confirmation sampling results for all three of these subsurface areas are protective for construction workers. All of the confirmation sampling results for the lower waste pile areas are also protective of groundwater (see Table 3). The nearest monitoring wells are in the lower Anaconda Mine area. All the groundwater monitoring results (ANMW-3, ANMW-7, ANWS-1; Figure 4) for the lower Anaconda Mine area meet SSCLs (Table 4A; Tetra Tech, 2007; Tetra Tech, 2013a).

2.3.1.2 Upper Anaconda Mine Waste Removal Areas – EU 1A

Two additional mine waste dumps located on the hillside adjacent to the Anaconda Mine were also reclaimed in 1995 (Figure 4). The largest of the dumps was removed and placed in the Mike Horse Repository. Because of its distance from any surface water drainage, the other dump was reclaimed in-place by amending with cement kiln dust, re-grading, covering with growth medium, and applying a seed/mulch mixture (Hydrometrics, 1996). ASARCO and ARCO did not conduct any confirmation sampling at the upper waste removal area, so it was sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous interim actions in that area. Arsenic, cadmium, copper, lead, and zinc exceed the SSCLs (Table 5A; Tetra Tech, 2013b; Tetra Tech, 2014) at least once for each metal in the reclaimed area.

2.3.1.3 Upper Anaconda Mine Waste Piles – EU 1B

ASARCO did not address three smaller mine waste pile areas further up the hillside (Figure 4). These waste piles were also sampled during the RI in 2007 and 2008 to determine the metals concentrations in each pile. Arsenic, cadmium, copper, lead, and zinc exceed the SSCLs (Table 5A; Tetra Tech, 2013b; Tetra Tech, 2014) at least once for each metal at the waste pile areas.

2.3.1.4 Wetlands-based Water Treatment System (WWTS)

In 1995 and 1996, ASARCO and ARCO constructed the WWTS at the former location of the Anaconda mine (lower waste pile area) adjacent to the Blackfoot River and just downstream from the confluence of Anaconda Creek and Beartrap Creek. Original plans included a second phase of wetland cells to be built on USFS lands and operated in series with the existing wetland treatment system, thus doubling the treatment system capacity. However, ASARCO and ARCO did not acquire the needed land and chose to complete the undersized system (ASARCO, 1995). To compensate for the smaller wetlands area, ASARCO began adding a soluble organic carbon source (methanol) to the WWTS in 1999 (Hydrometrics, 1999). The organic carbon addition continued through 2008, when the new WTP replaced the WWTS in 2009.

Construction of the WWTS included importing two to three feet of wetland cell substrate material (blend of Bartlett Creek borrow, limerock, and compost or peat) and four to six feet of fill material (Bartlett Creek pit-run gravel) for the cell embankments. Components of the treatment system included a 600,000 gallon oxidation/settling pond and a sand filter bed at the Mike Horse Mine for removal of iron from the Mike Horse Adit discharge (MFG, 1993; Hydrometrics, 1996; Hydrometrics, 1997), an open limestone channel at the Anaconda Mine for iron removal and alkalinity generation for the Anaconda Adit/Shaft discharge (Hydrometrics, 1997), and a four-cell constructed WWTS located at the Anaconda Mine that was designed to remove metals from the combined Mike Horse Adit and Anaconda Adit discharges through sulfide generation (Hydrometrics, 1997). In addition, flow-through bulkhead plugs with piping and controls were installed in the Anaconda and Mike Horse adits, with the water discharge directed to the WWTS (Hydrometrics, 1996; Hydrometrics, 1997). Discharge from the treatment system entered the Blackfoot River and was permitted under the MPDES program.

Operational problems occurred at Cell 4 (Figure 4) of the WWTS in the years prior to removal of the system. Cell 4 was designed for subsurface flow to create an anaerobic environment to enhance sulfate reduction and metals removal efficiencies (Hydrometrics, 2006a). The problems resulted in 1) surface flow conditions in the cell, which affected system performance, and 2) increased operation and maintenance requirements (Hydrometrics, 2006a). Due to the aerobic conditions caused by surface flow, increasing the methanol feed rate would not improve treatment efficiency. In 2006, ASARCO completed maintenance repairs at Cell 4, including unplugging of piping at Cell 4 (Hydrometrics, 2006a). Nevertheless, the WWTS continued to exceed the discharge requirements of ASARCO's MPDES permit and continued to be a source of metals for the Blackfoot River. In 2009, ASARCO replaced the WWTS with the WTP to treat the Mike Horse and Anaconda adit discharge at an efficiency that would comply with the MPDES permit.

2.3.1.5 Water Treatment Plant (WTP)

In 2008, in response to the BER's revocation of the temporary water quality standards, ASARCO constructed the WTP (Figure 4) to treat the Mike Horse and Anaconda adit discharges. Seep capture systems were included in the construction to treat seeps at the upper Mike Horse waste piles area, the base of the Mike Horse Repository, and next to Cell 4 (CDM, 2008). The WTP operations began in January 2009 and replaced the WWTS located adjacent to the Anaconda Mine. The WTP also bypassed the Mike Horse adit pretreatment system that included the oxidation/settling pond and sand filter bed, but continued the use of the flow-through bulkhead plug with piping and controls at the Mike Horse adit to convey adit discharge to the WTP. The flow-through bulkhead plug at the Anaconda adit was also retained to convey adit discharge to the WTP. The WTP incorporates ceramic microfiltration technology with active chemical reagent treatment to primarily remove cadmium, copper, manganese, and zinc (CDM, 2008).

The discharge point for the WTP is the same discharge/outfall that was used for the WWTS. The discharge/outfall is to the Blackfoot River at the west end of the property (Figure 4). ASARCO's permit for the WTP was a revised version of the original MPDES permit (MTR-0030031) for the WWTS. To eliminate duplication between two programs within DEQ, DEQ's Site Response Section has assumed administrative duties to monitor water quality compliance.

2.3.2 Capital Mine – EU 3 (1997)

The Capital Mine is a relatively small mine located in upper Stevens Gulch (Figures 3 and 5) on patented mining claims that were part of interim actions by ASARCO and ARCO in 1997 (Hydrometrics, 1998). Interim actions at the Capital Mine included removal of 725 yd^3 of mine waste from the Stevens Gulch drainage bottom and placement of the waste in the Paymaster Repository (Figure 2). The removal area was amended with cement kiln dust. The excavation area was regraded and revegetated, and 200 feet of stream channel reconstructed. ASARCO and ARCO did not conduct confirmation sampling at the Capital waste removal area, so it was sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous actions in the area. Arsenic, copper, lead, and zinc exceed the SSCLs (Table 5A; Tetra Tech, 2013b; Tetra Tech, 2014) at least once for each metal.

2.3.2.1 Surface Water and Groundwater

Stevens Creek first surfaces intermittently above the Capital Mine and, during some drier precipitation periods, its surface flow may terminate before reaching the main stem of the Blackfoot River. Surface water samples were collected along Stevens Creek from 1995 through 2008 (Tetra Tech, 2007; Tetra Tech, 2013a). Sediment and mine waste samples were collected along Stevens Creek during the RI in 2007 and 2008 (Tetra Tech, 2013a).

The Capital Mine waste pile was a source of contaminated sediment to Stevens Creek. At the time of removal, the approximately 15 feet high waste pile was bisected by Stevens Creek, suggesting that the waste pile was a significant sediment loading source (MFG, 1997). The RI sampling results for the Capital Mine area indicate that the waste pile was a source of arsenic, copper, lead, and zinc concentrations that exceeded the SSCLs. During the RI, numerous other mine related disturbances were also observed through stretches of the Stevens Creek channel below the Capital Mine interim action area. While these mining-related features below the Capital Mine are likely sediment sources, it appears that most of the metals present in these waste piles are below the SSCLs, with the exception of copper (Tetra Tech, 2013a). The exceedances of copper are very near its SSCL, which is based on background. The copper exceedances in sediment may also be attributable to nearby exposed areas of the copper-molybdenum ore body within the Stevens Gulch drainage (Figure 6). When combined with runoff from the steep, mountainous drainage, the sediment loading in this area is likely from multiple or diffuse sources.

Surface water and streambed sediment samples were collected from seven locations along Stevens Creek (Figures 7 and 8; Tetra Tech, 2007; Tetra Tech, 2013a). Sediment metals concentrations decrease from upstream, beginning at the Capital Mine, to downstream at sediment sample location BRSW-108 (Table 6). The decreasing arsenic, lead, zinc, and (to some extent) the copper concentrations demonstrate some natural recovery of the downstream sediments post removal of the Capital Mine waste pile. No sediment samples were collected prior to removal of the Capital Mine waste pile. The pre and post removal surface water data set suggests that the water quality has improved since removal of the waste pile; however, the post removal data set is limited (only two samples) (Table 7). The decreases in cadmium, copper, and lead surface water concentrations are significant when compared to pre-removal concentrations. Therefore, the removal of the Capital Mine waste pile likely removed the primary source of metals contamination that contributed to the poor water and sediment quality in the drainage. Regardless, SSCLs were exceeded in all surface water samples, except for a sample collected downgradient of the Capital Mine waste removal area (SGSW-102), which did not exceed any SSCLs. The exceedances are not protective of aquatic life, but are protective of human health.

There are no monitoring wells in the vicinity of the Capital Mine. Groundwater sampling results from one alluvial well (SGGW-101) and one bedrock well (SGGW-102) in the lower part of Stevens Gulch (Figure 7) showed no exceedances of SSCLs. The RI concluded that "water levels within SGGW-101 and SGGW-102 indicate a strong upward hydraulic gradient at this location (lower most segment of the gulch) such that bedrock groundwater is likely recharging the overlying alluvial aquifer" and confirmed "the infiltration of all the flow from the lowermost portion of Stevens Gulch into the alluvial aquifer between station BRSW-108 on Stevens Gulch and the Blackfoot River" for the sampling event (Tetra Tech, 2013a).

2.3.2.2 Capital Mine Adit

Also as an interim action in 1997, a grout seal was placed in the Capital Mine adit to eliminate seasonal discharge of water from the adit. The front of the adit was then collapsed, backfilled, and regraded to match the surrounding contours. A surface water sample collected from the adit flow prior to plugging exceeded SSCLs for aluminum, cadmium, copper, iron, lead, manganese, and zinc. Post-removal samples were not collected because the adit seal prevented adit discharge (Hydrometrics, 1998).

2.3.3 Carbonate Mine – EU 4 (1993-94)

The Carbonate Mine is located at the south end of Swamp Gulch and immediately north of Highway 200 (Figure 3 and 9). For discussion purposes, the Carbonate Mine area was divided into two parts. The lower part contained waste rock, tailings, and a small tailings impoundment. The upper part included waste rock and an open mine shaft and, once removal occurred, serves as the location of the Carbonate Repository.

2.3.3.1 Surface Water and Groundwater

There are two surface water sampling stations (Figure 9, Table 8) located on the creek in Swamp Gulch in the Carbonate Mine area. The upstream/background station is BRSW-14 and is located above all Carbonate area mining impacts. The downstream station is BRSW-15 and is located on the south side of Highway 200 at the outfall from the culvert that empties into the Upper Marsh. Surface water quality, monitored since 1991, improved following completion of waste removal in 1994. Prior to waste removal, surface water sampling directly downstream of the site at BRSW-15 showed elevated levels of total cadmium, copper, iron, manganese, lead, and zinc. Between 1995 and 1998 (the last year samples were collected), the levels for these six metals were all below DEQ-7 numeric water quality standards (DEQ-7 standards; DEQ, 2012a) for human health, but continued to have DEQ-7 aquatic standards exceedances for cadmium, copper, iron, and lead. The background station, BRSW-14, indicates that the creek in Swamp Gulch is a source of highly mineralized water (Table 8). Background was calculated, based on 15 sampling events, using ProUCL (EPA, 2009) and is found in Appendix D, Section D1. Surface water

SSCLs were exceeded for human health (lead and manganese) and aquatic life (cadmium, copper, iron, lead, and zinc). When compared to BRSW-14, all post-cleanup metals concentrations at BRSW-15 were less than those found at BRSW-14 (Hydrometrics, 1995; Hydrometrics, 1996; Hydrometrics, 1997; and Hydrometrics, 1998).

There are six monitoring wells (Figure 9; one is an upgradient background well) in the lower Carbonate area that were sampled during the RI. The groundwater monitoring results showed varying trends between the shallower alluvial wells and deeper wells. In the lower Carbonate area, one shallow well (LCMW-12S) and one deep well (LCMW-6D) exceeded the SSCLs (Table 4A) for iron and/or manganese. The other three wells (LCMW-5, LCMW-6S, LCMW-12D), shallow and deep, had at least one exceedance of the SSCLs. The background well (SWGW-103) had elevated cadmium, copper, iron, manganese, and zinc, but did not exceed the SSCLs for any metals (Pioneer, 2016).

The Carbonate Repository area, located on the hillside above the lower Carbonate area, has four monitoring wells (Figure 9). One monitoring well, UCMW-4, was drilled in the upper Carbonate area prior to construction of the repository. It was drilled to a total depth of 59 feet and never produced any groundwater (Hydrometrics, 1994). The water level in the well was most recently checked in 2015. Monitoring well UCMW-11 (Figure 9) was drilled in 1994 and groundwater exceeds SSCLs. Two more wells were drilled during the RI (SWGW-101 and SWGW-102; Figure 9) in the upper Carbonate area that also never produced any groundwater. Monitoring well SWGW-101 was drilled to a total depth of seven feet and monitoring well SWGW-102 was drilled to a total depth of 23 feet. The water levels in these wells were most recently checked in 2015.

A conceptual site model (CSM) was prepared with the current information to better understand the groundwater at the Carbonate Mine (Pioneer, 2016). The CSM indicates that while the Blackfoot River does not appear to be gaining any appreciable dissolved cadmium concentrations, the Carbonate Mine site does appear to contribute a dissolved cadmium load that is sufficient to increase the dissolved cadmium concentrations in downgradient monitoring well LCMW-1. Furthermore, once the contaminated groundwater encounters the groundwater-surface water interface, the combined dilution/dispersion/attenuation may result in approximately 80 percent reduction of dissolved cadmium concentrations (base flow cadmium (0.044 milligrams per liter (mg/L) concentration) in groundwater leaving Carbonate Mine site). It is possible that additional attenuation of dissolved cadmium is occurring in groundwater, at the groundwater-surface water interface, or in the Blackfoot River (Pioneer, 2016).

Although elevated levels of some of these metals continue to be present in groundwater samples, most notably at monitoring well UCMW-11 (installed post-removal) immediately downgradient of the repository, these elevated levels may be attributable to the completion of the monitoring well within the highly mineralized geologic zone (MFG, 1994; Tetra Tech, 2013a). There is currently no evidence to indicate that the repository is a source for these metals (Pioneer, 2016).

2.3.3.2 Lower Carbonate Area

Approximately 15,400 yd^3 of mine waste rock and tailings were removed from Swamp Gulch drainage (lower Carbonate mine area) and placed in the repository constructed at the upper Carbonate. Prior to placement into the repository, the waste was mixed with quicklime to reduce its leaching potential. The former tailings impoundment area was backfilled with borrow gravel and cover soil (13 to 17 inches deep), and the area graded to establish a wetland and meadow within the Swamp Gulch drainage (Hydrometrics, 1994; Hydrometrics, 1995; and MFG, 1993). ASARCO and ARCO did not conduct confirmation sampling at the lower Carbonate area, so it was sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous removal actions in that area (Figure 9). Arsenic, cadmium, copper, iron, lead, manganese, and zinc exceed the SSCLs (Table 5A; Tetra Tech 2013b; Tetra Tech 2014) at least once for each metal.

2.3.3.3 Upper Carbonate Area

Approximately 7,500 yd^3 of mine waste rock sat within the proposed footprint for the Carbonate repository. Because ASARCO and ARCO incorporated this waste rock into the repository footprint, confirmation samples were not taken below the interface between the waste rock and the surface soil. Also addressed within the repository footprint was an open mine shaft; approximately 44 yd^3 of concrete were poured into and on top of the open mine shaft at the Carbonate Mine before placing repository material over the top (Hydrometrics, 1994).

2.3.3.4 Upper Carbonate Repository

ASARCO and ARCO performed the siting assessment and design for the repository in the upper Carbonate Mine area in 1993. The assessment and design considered stability, drainage, potential settlement, mine shaft remediation, infiltration/water balance using the hydrologic evaluation of landfill performance (HELP) model, acid/leachate production, erosion control, floodplain protection, and revegetation (MFG, 1993). Periodic inspections occur to ensure there are no disturbances to the repository (DEQ, 2016).

2.3.4 Edith Mine – EU 5 (1995)

The Edith Mine is located just north of the Blackfoot River and west of the river's confluence with Shave (or Shaue) Gulch (Figure 3 and 10). ASARCO and ARCO removed approximately 5,000 yd^3 of mine waste from several waste piles/waste areas in 1995 and placed them in the Mike Horse Repository. Mine waste removal areas were amended with lime-bearing material to neutralize soil acidity, and the area was seeded to promote vegetation establishment (Hydrometrics, 1996). There was no confirmation sampling performed for the Edith waste piles, so they were sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous actions in the area. Arsenic and lead each exceeded their respective SSCL once (Tetra Tech, 2013b; Tetra Tech, 2014).

The nearest monitoring wells (Figure 10) are EDP-1, EDP-2, EDMW-2, and EDGW-105 completed within the vicinity of the Edith Mine area and show that groundwater is affected by the local mineralized geology. There are also two wells (SHGW-101 and SHGW-102) that are located nearby in the Shave Gulch drainage (Figure 15). However, as explained below, the geologic subsurface conditions (Spokane shale) found in the Shave Gulch monitoring wells area are different from the geologic subsurface conditions (diorite and gabbro (diorite), and quartz monzonite porphyry and quartz porphyry) that are found in the Edith Mine area. Therefore, the groundwater metals concentrations from the Shave Gulch monitoring wells were not compared to the groundwater conditions found in the Edith Mine area.

All groundwater metals concentrations, except iron and manganese, are lower than the groundwater SSCLs. Iron and manganese exceeded the SSCLs for groundwater at one monitoring well (EDP-2), while manganese exceeded the SSCL for groundwater at monitoring well EDMW-2. The Edith Mine area monitoring wells are located within the diorite, and quartz monzonite porphyry and quartz porphyry geologic formations, which also include the north copper-molybdenum ore zone (Figures 17 and 27). In turn, deposits of alluvium overlay these geologic formations (Tetra Tech 2013a). In 2009, during a geochemical and geotechnical investigation at nearby Shave Gulch, DEQ sampled subsurface soils in the same diorite formation (TerraGraphics, 2010). The iron and manganese subsurface soil analytical results from this non-mining area are comparable to the pre-removal iron and manganese mine waste and surrounding soils analytical results for the Edith Mine area (Table 9; ASARCO and ARCO, 1994). All of the post removal iron and manganese surface soil analytical results are below the soil SSCLs for iron and manganese (Tetra Tech, 2013a). In addition, the two Edith Mine monitoring wells with high iron and manganese concentrations are located in either a fen area or a forested emergent wetland area. Groundwater monitoring locations EDP-2 and UMPZ-2, a piezometer located outside the area of tailings contamination in the Upper Wetlands (Figure 22), are both located in fen areas and have similar iron and manganese concentrations. Groundwater monitoring locations EDMW-2 and UMPZ-4, a piezometer located outside the area of tailings contamination in the Upper Wetlands (Figure 22), are both located in forest emergent wetland areas and have similar manganese concentrations. Both of these wetland environments slowly produce peat, indicate long-term geologic and hydrologic stability, and commonly accumulate iron, copper, manganese, and other metals. Since the surface soil metals concentrations in this area are all below soil SSCLs (with the exception of the one arsenic and one lead exceedance of SSCLs), the iron and manganese exceedances in the groundwater appear to be a result of the fen and forested emergent wetland environments and the highly mineralized subsurface conditions found in the diorite geologic formation.

During the RI, samples were also collected from waste in an area just south of the central Edith area. Concentrations of metals in this area (CEA 4; Figures 10 and 19) exceeded the SSCLs for several metals. However, in the FS evaluation, it was determined that CEA 4 is an area of dispersed fine tailings associated with the Blackfoot River floodplain and is being removed as a part of the EE/CA Blackfoot River floodplain removal (Pioneer, 2016). CEA 4 is addressed in the USFS Action Memorandum (USFS, 2007).

2.3.5 Consolation Mine – EU 6 (1997)

The Consolation Mine is a relatively small mine located in lower Shave Gulch (Figures 3 and 11) on patented mining claims that were reclaimed by ASARCO and ARCO in 1997 (Hydrometrics, 1998). The Consolation Mine consisted of two collapsed adits (upper and lower) and associated mine waste piles. The mine waste occurred as a relatively thin pile covering about 2.5 total acres of hillside below the adits. ASARCO and ARCO consolidated the mine waste into the lower adit area by pushing the upper mine waste downhill into the adit, and hauling the lower mine waste pile uphill to the adit. Approximately 2,200 yd^3 of mine waste was placed into the prepped adit area, re-graded to match the surrounding topography, the upper 12 inches amended with cement kiln dust, covered with soil (12-inch minimum), and the entire removal area revegetated (Hydrometrics, 1998). ASARCO and ARCO did not conduct confirmation sampling for the Consolation Mine area, so it was sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous interim actions in the area. Arsenic, cadmium, copper, lead, and zinc exceed the SSCLs (Table 5A; Tetra Tech, 2013b; Tetra Tech, 2014) at least once for each metal. Monitoring wells and surface water sampling sites were never established in the immediate Consolation Mine area. However, there are downgradient surface water (SHSW-102, Figure 7) and groundwater (SHGW-101, SHGW-102; Figure 7) monitoring stations in Shave Gulch and those sampling results did not exceed SSCLs (Tetra Tech, 2007; Tetra Tech, 2013a).

2.3.6 Mike Horse Mine – EU 8 (1993-97, 2006-07)

The Mike Horse Mine (Figures 3, 12a, and 12b) is located on Mike Horse Creek southwest of the confluence of Mike Horse and Beartrap creeks. For discussion purposes, the Mike Horse Mine area was divided into two parts. The lower Mike Horse Mine area included waste rock, debris, and the Level 300 adit and associated adit discharge of acid mine drainage, while the upper Mike Horse Mine area included numerous adits and waste rock/mine waste.

2.3.6.1 Surface Water and Groundwater

While showing some improvement from the interim actions, the surface water in the upper and lower mine area continues to be heavily impacted by metals. All four surface water sampling stations (BRSW-4, BRSW-4A, MHSW-101, MHSW-102; all located in the upper area, Figure 12a) exceeded at least one SSCL (Table 4B) for human health or aquatic life. Exceedances for human health include cadmium, lead, and zinc, while aquatic life exceedances include cadmium, copper, lead, and zinc. Manganese also exceeded the SSCL (Tetra Tech, 2013b; Tetra Tech, 2014).

There are 11 monitoring wells (one is an upgradient background well) in the Mike Horse Mine area that were sampled during the RI. Four of the five wells (UMHMW-1S & 1D, UMHMW-2S & 2D) completed in the upper mine area show that groundwater is heavily impacted by mineralization and/or past mining activities (Figure 12a). The two shallow wells were completed in unconsolidated colluvium/fill material and indicate that this groundwater is a source of metals loading to Mike Horse Creek. Groundwater monitoring results for the two shallow wells exceeded SSCLs for cadmium, copper, lead, manganese, and zinc. The wells also have low to moderate pH values (3.8 to 5.9) and elevated sulfate concentrations, typically greater than 2500 mg/L (Hydrometrics, 2002).

Groundwater monitoring results for the two deep wells (UMHMW-1D and UMHMW-2D) exceeded SSCLs for arsenic, cadmium, lead, manganese, and zinc. Based on physical parameters and cation analyses, the shallow and bedrock groundwater systems appear to have separate sources of recharge. The background well (MW-1; Figure 12a) did not exceed SSCLs for any metals.

MSE conducted a drilling and geologic characterization program in the upper Mike Horse drainage from 1992 through 1996 as part of a joint U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy bedrock grouting demonstration project (MSE, 1994; MSE, 1997). The MSE investigation included drilling core holes and monitoring wells, and focused on characterization of the local bedrock groundwater system and possible interaction between it and the Mike Horse mine workings. The investigation results show that the deep groundwater is influenced by mineralization associated with the Mike Horse Fault bedrock fractures and is flowing into the Mike Horse Mine workings. Although the Mike Horse Mine workings include more than 30,000 feet of tunnels, drifts, raises and winzes, baseflow discharges from the mine average 35 gpm (MSE, 1997; Hydrometrics, 2002; Tetra Tech, 2007; CDM, 2008).

The six wells, three shallow and three deep, completed in the lower mine area (Figure 12b) and sampled during the RI are less impacted than the upper area wells. Groundwater monitoring results for the two shallow wells (MHGW-109, MHGW-112; MHGW-115 is dry) exceeded SSCLs (Table 4A) for cadmium, manganese, and zinc.

Of the three deep wells (MHMW-8, MHGW113, UMHMW-3), only one well (MHMW-8) had groundwater monitoring results that exceed SSCLs. However, the metals exceedances in groundwater at MHMW-8 suggest that the metals concentrations may be a result of the Mike Horse Repository construction. Fifteen water samples were collected from MWMH-8 starting in June 1994. The pH started at 7.7 and then decreased to 5.8 over the period 1994 to 1999. Since the first sample from MHMW-8 was the year before construction began at the 300 level and the Mike Horse Repository, it appears that there is a correlation with the construction activity and the diminishing water quality. Cadmium increased from 0.002 to 0.24 mg/L and zinc increased from 0.76 to 37 mg/L. During this period, the conductivity and the sulfate concentration also increased (Tetra, Tech 2007; Spectrum, 2015).

Finally, upgradient MSE well MW-1 and downgradient well UMHMW-3 meet groundwater SSCLs, which helps identify the limits of the poor quality bedrock groundwater area in the Upper Mike Horse to the vicinity of the Mike Horse and Little Nell veins (Figures 13 and 24).

2.3.6.2 Lower Mine Area

ASARCO and ARCO's actions at the lower mine area included removal and offsite disposal of 270 yd^3 of hydrocarbon contaminated soil along with the removal of a 1,000 gallon fuel tank, the removal of waste rock and debris from Mike Horse Creek, and the reconstruction of the Mike Horse Creek channel through the reclaimed area. The stockpiled hydrocarbon contaminated soil was tested as required for disposal at the BFI Landfill in Missoula. Four confirmation soil samples were also taken from the excavation following removal. No benzene, ethylbenzene, toluene, or xylenes (BTEX) were detected in the stockpiled contaminated soil, so BTEX analysis was not performed for the confirmation samples. The total extractable hydrocarbons concentrations in the four confirmation samples ranged from <10-36 mg/kg, below the 200 mg/kg DEQ risk-based corrective action screening level used at that time that would require further testing (Hydrometrics, 1995; Hydrometrics, 1996).

As previously mentioned, ASARCO and ARCO constructed the WWTS to treat drainage from the Mike Horse Adit, as well as the combined discharges from an adit and shaft at the Anaconda Mine near the confluence of the Blackfoot River and Anaconda Creek. The lower Mike Horse mine area construction associated with the WWTS included installing the flow-through bulkhead plug with piping and controls in the Level 300 adit and the 600,000 gallon oxidation/settling pond (pretreatment pond) and the sand filter bed – constructed on top of the Mike Horse Repository – for removal of iron from the Mike Horse Adit discharge (Figure 12b; MFG, 1993). In 2008, ASARCO constructed two seep capture systems that were incorporated into the design of the new WTP. One capture system is located at the toe of the repository to capture its seepage (Figure 12b) and the other system is located in the upper mine area and is designed to capture the shallow groundwater flow from the upper waste area in proximity to the Level 200 adit (Figure 12a; CDM, 2008).

2.3.6.3 Mike Horse Repository

Interim actions at the lower Mike Horse Mine area also included construction of a repository in 1995 and 1996. ASARCO and ARCO performed the siting assessment and design for the repository in 1994 (Figure 12b). The assessment and design considered stability, drainage, potential settlement, mine shaft remediation, infiltration/water balance (HELP modeling), acid/leachate production, erosion control, floodplain protection, and revegetation (Hydrometrics, 1997; Hydrometrics, 1998).

The Mike Horse Repository construction included a subsurface shallow groundwater collection and drainage system to maintain groundwater levels below the repository base, a limestone gravel drainage layer beneath the repository, amendment of the upper 18 inches of mine waste in the repository to limit long-term acid generation, a 12-inch growth medium layer on the repository slopes with vegetative cover, and a geosynthetic clay liner on the upper, flat repository crest (Hydrometrics, 1995). The groundwater collection and drainage system was included to address water seeps that were discovered during the repository construction. Approximately 45,000 yd^3 of mine waste from the Mike Horse, Anaconda, and Edith mines were placed in the Mike Horse Repository (Hydrometrics, 1996).

The Mike Horse Repository was located within the 100-year floodplain and the sampling conducted during the RI indicated that repository seeps are impacting groundwater and surface water. It was clear from information obtained in the RI that the Mike Horse Repository was inappropriately located and constructed. Removals identified in the USFS Action Memorandum, as amended, began in 2014. To minimize the potential for recontamination and to maximize efficiencies and resources, waste in the same drainage (Mike Horse Creek and specific parts of the Mike Horse Mine area and the repository) and near the area that is addressed by the USFS Action Memorandum, as amended, were removed as an interim action beginning in 2014. The removal of the Mike Horse Repository began in 2014 and the material was placed into the UBMC Repository. The interim action in the Mike Horse area will be completed in 2016, and includes removal of the remaining waste in the repository area to meet SSCLs, removal of a waste rock dump, contaminated sediments, and other miscellaneous waste sources in the Mike Horse Creek floodplain (DEQ, 2014b). All waste removed will be placed into the UBMC Repository. The upper Mike Horse Mine seepage collection system will also be relocated in the floodplain and/or modified to improve the effectiveness of the capture system as it protects the surface water in Mike Horse Creek from the contaminated shallow groundwater (DEQ, 2014b). This work is more particularly described (including SSCLs removal criteria) in the Phase 2 Construction, Construction Specifications, Drawings, and Bidding Documents (Pioneer, 2014).

2.3.6.4 Upper Mine Area

In 1998, ASARCO and ARCO performed in-place reclamation of approximately five acres of disturbed land in the upper mine area (Figure 12a). It consisted of consolidation and re-grading of mine waste to minimize surface area and limit infiltration, incorporating amendments into the mine waste to raise pH and limit the solubility of metals, placement of local borrow soil over the mine waste, construction of ditches and berms to divert storm water runoff around mine waste areas, and seeding of all disturbed areas. Re-grading of the mine waste piles and establishment of a vegetative cover was intended to reduce infiltration of rainfall and snowmelt water, and erosion of mine waste, thus improving water quality in adjacent Mike Horse Creek (Hydrometrics, 1998). In 2005-2006 the in-place reclamation was followed by partial removal of mine waste from the UMH-4 and UMH-5 waste areas (Figure 12a). A total of 74 confirmation samples, on a 25-foot grid, were taken and analyzed for arsenic, cadmium, copper, lead, manganese, and zinc. All analyzed metals exceeded SSCLs at least once for each metal and had a soil pH range of 4.0-

8.2 (Hydrometrics, 2004). Interim actions also included construction of a surface water diversion system to divert Mike Horse Creek water around the disturbed area.

2.3.7 Paymaster Mine – EU 9 (1996)

The Paymaster Mine was a relatively small operation that mined ore from three adits in lower Paymaster Creek drainage. ASARCO and ARCO implemented interim actions in 1996 under a VCRA plan that included waste rock removal, construction of a small wetland treatment system (Paymaster WTS) to treat a small flow from the Paymaster adit, and construction of the Paymaster Repository (Figures 2, 3, 14, 15, and 16).

2.3.7.1 Surface Water and Groundwater

Six surface water sampling stations (Figure 16) are located along Paymaster Creek. The upstream/background stations (PCSW-1, PCSW-3, PCSW-4, and PCSW-5) are located above all Paymaster Mine area mining impacts. Stations PCSW-4 and PCSW-5 are at sampling locations upstream of where the Mike Horse fault intersects Paymaster Creek (Figure 17). Stations PCSW-1 and PCSW-3 are at sampling locations located downstream of where the Mike Horse fault intersects Paymaster Creek and upstream of the historical Paymaster patented mining claims. Further downstream surface water locations (BRSW-13 and BRSW-21) are located adjacent to the Paymaster Mine area. Location BRSW-21 is at the upstream end of the mine area and BRSW-13 is downstream of the mine area. The background stations upstream and downstream of the Mike Horse fault indicate that Paymaster Creek surface water quality changes through this reach. The stream pH drops from 6.0-6.9 at the upstream stations to 3.7-6.3 at the downstream stations. Iron, manganese, and zinc surface water concentrations increase downstream of the fault. DEQ-7 aquatic life surface water standards are exceeded for copper, iron, and zinc, as well as possible exceedances (detection limits are higher than the aquatic standards) for cadmium and lead. Prior to and after the Paymaster Mine area removal, the downstream water quality changed very little. DEQ-7 aquatic life surface water standards were exceeded for cadmium, copper, iron, lead, and zinc. Copper is the only metal to increase in concentration from BRSW-21 to BRSW-13. Except as noted in Table 10, there were no DEQ-7 human health standard exceedances for the Paymaster Creek surface water (MFG, 1994; TetraTech, 2007).

Within the Paymaster Mine area there are eight monitoring wells and two piezometers that were sampled during the RI (Figure 15). The eight wells (PMGW-116, PMGW-117, PMGW-118, PMGW-119, PMGW-120, PMMW-13, PMMW-14, PMMW-15) completed within the vicinity of the Paymaster Mine area show that groundwater is affected by the local mineralized geology. Groundwater monitoring results consistently show elevated levels of contaminants of concern (COCs) (aluminum, cadmium, copper, iron, lead, manganese, and zinc) in the Paymaster Mine area background wells (Table 11), as well as and the wells located within the historical mining area. SSCLs for cadmium, iron, and manganese were exceeded in the Paymaster wells and the background wells. Cadmium exceeded SSCLs twice, once at Paymaster Mine well PMMW-13 (0.00512 mg/L; SSCL is 0.005 mg/L) and once at background well PMGW-117 (0.00562 mg/L). Iron and manganese also exceeded the SSCLs. SSCLs for copper and manganese were exceeded at the two deep wells (PMGW-119, PMGW-120). PMGW-119 is a background well and PMGW-120 is a Paymaster Mine well. The SSCL for iron was also exceeded at PMGW-120. The background piezometers (PMPZ-3, PMPZ-4) had similar elevated metals concentrations and also exceeded the SSCL for iron (Tetra Tech, 2013). Based on the metal concentrations found in the shallow and bedrock wells, the water quality in the Paymaster Mine area wells is similar to the water quality in the background wells. This similarity in water quality suggests that the Paymaster Mine area groundwater is reflective of the highly mineralized background conditions.

2.3.7.2 Waste Pile Areas

Three distinct waste rock piles (Figures 3 and 14), totaling approximately 8,065 yd^3, were removed from the Paymaster Creek drainage bottom area. Arsenic, copper, and iron exceeded SSCLs in the 1996 confirmation samples performed for the Paymaster Mine waste pile areas. Because the sampling was limited – four samples total for the three waste pile areas – the waste pile areas were sampled again during the RI in 2007 and 2008 to assess the effectiveness of the previous actions. The two southern most waste pile areas had SSCL exceedances for copper (Figure 14; EU 9A; Tetra Tech, 2013b; Tetra Tech, 2014).

The larger northern pile area (Figure 14; EU 9B) was the construction site for the WTS cells. During the RI, four test pits were dug through the 2-4 feet thick substrate material, depending on test pit location, in the northern cell of the wetland system and into the subsurface soil below to further evaluate the effectiveness of the 1996 waste removal. Subsurface samples were taken from the first two feet underlying the substrate material at 0-6”, 6-12”, and 12-24” intervals for a total of three samples from each of the four test pits. Underlying subsurface soil results indicated that arsenic (181 – 1370 mg/kg) and iron (45,900 – 218,000 mg/kg) continue to exceed their respective SSCLs, while the other metals exhibited concentrations below their respective SSCLs (Tetra Tech, 2013a).

In some locations, high iron concentrations, low pH, and ferricrete deposits (iron rich hardened soil layers) may be naturally occurring in Paymaster Gulch. The high iron concentrations and the compacted and almost cemented nature of some of the native material encountered in the test pits during the RI may be due to naturally occurring iron-oxide precipitation (Tetra Tech, 2013a).

Groundwater that seeped out of test pit walls resulted in iron oxidation once the water encountered atmospheric oxygen. Field parameter measurements in 2007 and 2008 support that groundwater is a chemically reducing environment. A low pH was recorded in 2007, and low oxidation reduction potential (the transfer of electrons between different chemicals determines if the water has a high or low oxidation/reduction potential) and dissolved oxygen were recorded in 2007 and 2008, all of which suggest possible reducing conditions and support field observations of rapid precipitation of iron in the test pit seeps. These observed conditions indicate that the area is likely saturated with iron in the pore water, groundwater, and soil and that oxygen in soil appears to be present at least at shallow depths below ground surface (e.g., presence of iron oxide staining and some ferricrete in test pit soils) (TetraTech, 2013a).

Results for groundwater samples collected in 2007 and 2008 from the Paymaster constructed wetlands’ downgradient monitoring wells (PMMW-15, PMGW-120; Figure 15) indicated no detection of arsenic concentrations at or above the SSCLs. These data suggest that although the native soil horizon is enriched in arsenic (and potentially other trace metals), arsenic and other metals have likely adsorbed to or co-precipitated with iron-complexes and may also be bound to organics within the soil. The prevalence of iron (45,900-218,000 mg/kg) and organic matter in the subsurface soils actively adsorbs dissolved metals, thereby reducing impacts to groundwater. The stability of arsenic in this solid form (adsorbed to the iron) is supported by non-detect (<0.002) arsenic in all upgradient and downgradient (Figure 15) Paymaster Gulch groundwater piezometers and monitoring wells. Future changes to the current subsurface geochemical/oxidation state conditions in the vicinity of the WTS/former waste pile area will likely increase metal mobility of at least arsenic and possibly other metals (Tetra Tech, 2013).

2.3.7.3 Paymaster Repository

ASARCO and ARCO also constructed the Paymaster Repository at the Paymaster Mine area in 1996 and 1997 (Figure 15). The siting assessment and design for the repository was performed in 1996. The assessment and design considered stability, drainage, potential settlement, mine shaft remediation, infiltration/water balance (HELP model), acid/leachate production, erosion control, floodplain protection, and revegetation. Waste from the Paymaster Mine, No. 3 Tunnel (4,955 yd^3), and Capital Mine (725 yd^3) were placed in the repository. In addition to these mine wastes, approximately 8,412 yd^3 of mine tailings from a DEQ abandoned mine reclamation project (the Big Blackfoot tailings) were placed in the Paymaster Repository. All material was fully amended with cement kiln dust to neutralize acidity and decrease metal solubility prior to placement in the Paymaster Repository (TetraTech, 2007). In 2004 the top bench of the repository was opened to allow for upward expansion of the repository. Approximately 13,500 yd^3 of mine waste and dry sludge from the sludge drying beds was hauled from the Mike Horse Mine area and placed into the Paymaster Repository (Hydrometrics, 2006).

2.3.7.4 Paymaster Wetland Treatment System

Interim actions at the Paymaster Mine also included collection of a small volume of seasonal discharge from the historic Paymaster adit and treatment through the WTS. The system was comprised of a pair of passive wetland treatment cells and an adit drainage collection system (piping and vault) that was combined with collapsing the adit opening. The WTS is located adjacent to the Paymaster Mine (Figures 3 and 14), but never discharged any water during its years of operation. The WTS operation was officially discontinued in 2003 when ASARCO did not renew the WTS MGWPCS permit (TetraTech, 2013a).

2.3.8 No. 3 Tunnel – EU 10 (1996)

The No. 3 Tunnel was a bulk sample adit driven by the Anaconda Company (ARCO's predecessor) for exploration of the south copper-molybdenum ore zone. ASARCO and ARCO implemented waste rock removal at the No. 3 Tunnel area in 1996 (Figures 3 and 18). Approximately 4,955 yd^3 of mine waste was removed from the No. 3 Tunnel area. All material was fully amended and placed in the Paymaster Repository. The confirmation sampling performed in 1996 was limited to one composite sample (Hydrometrics, 1997; Hydrometrics, 1998). Subsequently, the No. 3 Tunnel area was sampled again during the RI in 2007 and 2008 to assess the effectiveness of the interim actions. Arsenic, copper, iron, manganese, and zinc exceed the SSCLs at least once for each metal. There are no monitoring wells or surface water sampling sites associated with the No. 3 Tunnel area. The No. 3 Tunnel area is on federal land and is not included in this ROD.

2.3.9 EE/CA – includes EU 2 and EU 11 (2013-present)

As previously mentioned in the Regulatory History (Section 2.2), in July 2007, the USFS issued the EE/CA along with an Action Memorandum that selected the cleanup on certain federal lands within the UBMC. The USFS Action Memorandum included: (1) total removal of the Mike

Horse Dam and tailings impoundment with placement of the waste into a within-drainage repository; (2) complete removal of mine waste from Lower Mike Horse Creek and placement of the waste into a within-drainage repository; (3) removal of all concentrated and intermixed tailings from the active floodplain of Beartrap Creek and placement of the waste into a within-drainage repository; and (4) complete mine waste removal (estimated at 45,000 yd^3) from the Upper Blackfoot River and placement of the waste into a within-drainage repository (Hydrometrics, 2007; USFS, 2007; Figure 19). The RI further defined the lateral extent of contamination in the Beartrap Creek floodplain (EU 11) and Blackfoot River floodplain (EU 2), which are within the USFS Action Memorandum (Tetra Tech, 2013a). These two EUs serve to support the extent of removal established by the USFS Action Memorandum. The Paymaster Repository, previously constructed by ASARCO, was identified as the preferred within-drainage repository, subject to further verification that it was a suitable location (USFS, 2007).

Subsequently, several design level investigations of the Paymaster Repository area were conducted and the USFS determined that the Paymaster Repository was not suitable for placement of additional mine waste due to concerns regarding constructability, space, volume, cost, and protectiveness. Based upon those investigations, in July 2012, the USFS issued an amendment to the Action Memorandum and selected a new repository location, often referred to as Section 35. DEQ concurred in the USFS's amendment (DEQ, 2012). The USFS determined that the Section 35 location was the most protective location for a new repository and the most appropriate based upon constructability, space, volume, and cost (USFS, 2012).

The construction of the UBMC (Section 35) Repository began in 2013 and the removals identified in the USFS Action Memorandum began in 2014. Some of those areas slated for removal also contain waste that is not solely located on USFS land. As discussed in Section 2.3.6.3, to minimize the potential for recontamination and to maximize efficiencies and resources, waste in the same drainage (specific parts of the Mike Horse Mine area and repository, Figures 12a and 12b) and near the area that is addressed by the USFS Action Memorandum (Lower Mike Horse Creek, Figure 19) is being removed as an interim action beginning in 2014 (DEQ, 2014b).

3.0 COMMUNITY PARTICIPATION

The Proposed Plan was made available to the public in October 2015. DEQ provided notice of a 30-day public comment period and public meeting/hearing associated with the Proposed Plan via a fact sheet distributed to the mailing list. A legal notice of the public comment period and public meeting/hearing was published on October 11, 2015, in the Helena Independent Record and on DEQ's website. On October 9, 2015, DEQ also sent letters to the Lewis and Clark County Commissioners, Upper Blackfoot Valley Community Council, Helena Mayor and City Commissioners, and Lewis and Clark County Health Department notifying them of the public comment period and public meeting/hearing. In addition, DEQ published display ads announcing the public comment period and public meeting/hearing in the Great Falls Tribune, Blackfoot Valley Dispatch, and the Missoulian. DEQ held a public meeting/hearing on October 28, 2015, to present and discuss the Proposed Plan, answer questions, and to receive oral public comments.

Notice of the issuance of this ROD will be published in accordance with Section 75-10-713, MCA, and copies of the ROD will be available to the public at the information repositories and on DEQ's website. The ROD is accompanied by a discussion of any notable changes to the selected remedy presented in the Proposed Plan along with reasons for the changes. Also included in Part 3 of the ROD is a Responsiveness Summary, which provides responses to the comments received during the comment period.

The administrative record that contains the documents DEQ cited, relied upon, or considered in selecting the final remedy for the non-federal lands at the UBMC Facility (see Section 14.0) is available for review by contacting DEQ at:

Montana Department of Environmental Quality
Remediation Division
1225 Cedar Street
Helena, MT 59620 Telephone: 406-444-6444

A partial compilation of the Facility files can be found on DEQ's website at
http://deq.mt.gov/StateSuperfund/UBMC/default.mcpx and at:

Lincoln Ranger District
1569 Highway 200
Lincoln, MT 59639 Telephone: 406-362-7000

Lincoln Library (Lewis and Clark Library Branch)
102 9th Street
Lincoln, MT 59639 Telephone: 406-362-4300

Lewis and Clark County Library
120 S. Last Chance Gulch
Helena, MT 59601 Telephone: 406-447-1690

4.0 SCOPE AND ROLE OF REMEDIAL ACTION

As described in Section 1, the UBMC covers an area of approximately six square miles and includes a mixture of federal and non-federal land. DEQ has selected the final remedy for the non-federal lands within the UBMC and the USFS will select the final remedy for the federal lands within the UBMC. However, the RI, HHRA, BERA, and FS evaluated the UBMC as a whole.

In general, the purposes of the RI, HHRA, BERA, and FS were to collect data necessary to adequately characterize the UBMC for developing and evaluating effective remedial alternatives that address human health and environmental risks at the Facility. The primary objectives of the RI, HHRA, BERA, and FS for the UBMC include the following:

- Adequately characterize the nature and extent of releases or threatened releases of hazardous or deleterious substances;
- Allow an assessment of health and ecological risks and development of SSCLs; and
- Allow the effective development and evaluation of alternative remedies to be included in the FS to allow selection of a final remedy.

Based on the findings of the RI, HHRA, BERA, and FS, DEQ finds that the data obtained is adequate for DEQ to evaluate and select an appropriate remedy for the UBMC. Any remaining data gaps will be evaluated during remedial design. The ROD contains SSCLs for all known COCs associated with the UBMC and addresses all media contaminated from the hazardous or deleterious substances released from or associated with the former mining operations at the UBMC described herein.

The ROD documents the final remedy for the non-federal lands at the UBMC; addresses the principal threats to public health, safety, and welfare and the environment posed by contaminated media; and selects a remedy that will comply with applicable or relevant state and federal environmental requirements, criteria, and limitations (ERCLs).

DEQ anticipates that remedial design for the remedy will begin shortly after the ROD is issued, and implementation or construction will begin as soon as possible upon completion of remedial design. Institutional controls (ICs) will be implemented during and/or after the construction phase of the remedy, as identified during remedial design.

5.0 FACILITY CHARACTERISTICS

The following summarizes some of the UBMC Facility characteristics.

5.1 SITE CONCEPTUAL MODEL (SCM)

The SCM (Figure 20) is the framework for understanding the contaminant sources and the way those contaminants move in the UBMC environment. The primary sources of contaminants at the UBMC Facility are metal-laden mine waste (mine waste piles, mine tailings, and other mining disturbed areas that are exposed to atmospheric conditions) and acidic, untreated metal-laden mine adit discharge. Elevated levels of metals are present in soil, sediment, groundwater, and surface water at the UBMC due to the leaching of contaminants from mine waste, discharge of groundwater from adits, and exposure to atmospheric conditions in other areas disturbed by mining practices. Areas of naturally occurring high mineralization also contribute to the elevated levels of metals in soil, sediment, groundwater and surface water. The interaction of these primary sources with precipitation, surface water, and groundwater, mobilized the metals from the source materials into surrounding media.

The headwaters area of the upper Blackfoot River contains sources that include the tailings impoundment and a number of waste rock dumps located below the Mike Horse Dam. When the Mike Horse Dam breached in 1975, approximately 200,000 $yd^3$of mine tailings were released from the tailings impoundment and redistributed in the Beartrap Creek floodplain, the Blackfoot River floodplain from Beartrap Creek to the Upper Marsh, and in the eastern portion of the Upper Marsh. This catastrophic event accounts for the majority of soil, sediment, groundwater, and surface water contamination at the UBMC. Other drainage areas that exhibit primary source contamination to soil, sediment, groundwater, and/or surface water include Mike Horse Creek, Stevens Creek, Shave Creek, Paymaster Creek, and Swamp Gulch.

5.2 UBMC OVERVIEW

5.2.1 Climate

Climatic conditions at the UBMC are typical of intermediate to high elevation regions of the Northern Rocky Mountains with long, cold winters and short, moderately hot summers. Based on climatic records from the National Oceanographic and Atmospheric Administration’s weather station at Rogers Pass (approximately two miles north-northeast of the UBMC), average monthly minimum and maximum temperatures recorded at the Rogers Pass Station average 14.0 degrees Fahrenheit (°F) in January, and 81.8 °F in July, respectively (WRCC, 2016). A record cold temperature of –70 °F was recorded on January 20, 1954.

Average monthly precipitation for the period of record ranges from 0.64 inches in February to 2.96 inches in May and June. Annual precipitation for the period is 17.78 inches, with the highest annual precipitation (31.37 inches) occurring in 1975 and the lowest annual precipitation (10.63 inches) occurring in 1973. The greatest one-day storm event recorded since 1964 occurred on June 19, 1975, resulting in 2.98 inches of precipitation (WRCC, 2016), and contributed to a cross-valley embankment failure at the Mike Horse Tailings Impoundment.

Average climatic data from the Lincoln Ranger Station weather station, located about 14 miles west of the UBMC, are similar to that from the Rogers Pass Station. This indicates that weather patterns are relatively uniform throughout the UBMC and are reasonably well represented by the Rogers Pass data (Hydrometrics, 2007).

5.2.2 Geology

5.2.2.1 Regional Geology

In the area between Rogers Pass on the continental divide and the town of Lincoln, the Blackfoot River flows westward in a narrow valley parallel to US Highway 200. Along this stretch, the river has down-cut through a series of resistant bedrock ridges consisting of folded and thrust-faulted red, green and gray sedimentary mudstone units of the Precambrian Belt Formation. These units crop out in a geologic province called the southern Montana Overthrust Belt. The bedrock geologic units of the overthrust belt consist of a series of thick slabs of crustal rocks that have been sheared along low angle fault planes (thrust-faults) that moved the stacked slabs eastward over underlying rocks during the formation of the Rocky Mountains approximately 65 million years ago (Alt and Hyndman, 1986).

In the Rogers Pass area, these Precambrian sedimentary units are cross-cut by granite-like (quartz-monzonitic) intrusives that are several miles in diameter and approximately 35 million years old. A number of these intrusive bodies are associated with metallic ore deposits. The Heddleston District, where the UBMC is located, is associated with one of these intrusive stocks (a stock is a term used to describe an igneous intrusion that is less than 40 square miles in surface exposure). Mineralization in the Heddleston District occurs as two distinct types of deposits including:

- a number of structurally controlled high-grade, lead-zinc–silver-bearing vein-type mineralized fault and fracture structures that were mined from the turn of the century until the early 1950s; and
- a large tonnage, lower-grade disseminated intrusive hosted (porphyry) deposit of copper-molybdenum mineralization that was never developed or brought into production.

The largest and most prominent mine in the Heddleston District was the Mike Horse Mine which occurred as vein-type mineralization associated with the Mike Horse Fault zone (McClernan, 1983).

5.2.2.2 Regional Geology

The geology of the UBMC is characterized by various bedrock units, with unconsolidated materials restricted to relatively thin accumulations of alluvium along drainage bottoms. Numerous reports have been published on the local and regional geology, including Miller, et al (1973), McClave (1998), Pardee and Schrader (1933), Krohn and Weist (1977), and McClernan (1983). The following is a summary of the geology of the UBMC.

Unconsolidated Surficial Units Unconsolidated deposits within the Blackfoot drainage of the UBMC consist of glacial end moraines and stream-reworked outwash materials in the valley bottoms, and colluvial slope-wash sediments on slopes transitional between ridge crests and valley bottoms. Alluvial sediments have been contaminated with mine wastes ranging from rather thick deposits of mine tailings with lateral and vertical continuity in the upper end of the drainage below the Mike Horse tailings dam, to inter-bedded alluvial and tailings deposits, to thinner over-bank deposits in downstream and marsh locations. Ridge crests and upper flanks of ridges tend to be covered with residual, weathered-in place soils (Alt and Hyndman, 1986).

Alluvial material thicknesses in groundwater monitoring wells in the UBMC range from eight to 30 feet thick, and average about 18 feet. The shallower alluvial deposits occur at the upstream end of the valley near the Mike Horse Mine, and the thicker deposits occur near tributary stream junctions along the Blackfoot River. Unconsolidated material thickness in groundwater monitoring wells in the vicinity of the marshes and confluences of Porcupine and Meadow Creeks range from 22 to 42.5 feet thick, and average about 29 feet (Tetra Tech, 2013a).

Bedrock Geologic Units Three general bedrock units are found at the UBMC, including the Belt Series Spokane Formation, a diorite sill (a tabular igneous intrusion), and a series of Tertiary-age igneous intrusive bodies (Figure 17). The Precambrian Spokane Formation includes massive, light to dark gray quartzite and argillite at the bottom, grading upward to maroon to green argillite at the top. The bedding planes dip from 5^0 to 30^0 north. The Spokane Formation is generally devoid of mineralization, except along margins of mineralized veins intruded into fractures within the argillite (Miller, 1973).

The Spokane metasedimentary rocks are intruded by a flat-lying, diorite (gabbro) sill of Proterozoic age (McClave, 1998). The sill is tabular in form and cuts across bedding planes of the Spokane Formation at a slight angle. The sill is well exposed in the northern two thirds of the area (upper Anaconda Creek and Shave Gulch drainages) where it reaches a thickness of 500 feet, but occurs primarily in the subsurface to the south (upper Mike Horse, Stevens, and Paymaster Creek drainages) where the thickness decreases to 200 feet due to vertical displacement by faulting. The top of the sill dips gently northward and strikes southwest-northeast. The diorite sill contains abundant chalcopyrite (copper-iron sulfide) and pyrite (iron sulfide), with the highest copper concentrations in soils within the Heddleston District occurring above sub-crops of the diorite as opposed to above mineralized veins or ore zones (McClave, 1998).

A number of igneous intrusive stocks were emplaced within the older Spokane argillite and diorite sill in the central portion of the Heddleston District (Figure 17). The igneous complex is quartz monzonite porphyry of Tertiary age. The quartz monzonite also forms linear dikes extending radially outward from the central stock, where molten rock intruded along faults and fracture zones within the country rock. Both the mineralized veins and zone of disseminated mineralization extend from south to north across the Blackfoot River drainage bottom (McClernan, 1983; Figure 17).

Structure Two principal fault systems have been identified at the UBMC including the Mike Horse fault system and the Blackfoot fault system (Figure 17). Both systems trend northwest-southeast, and predate emplacement of the porphyry intrusive. The Mike Horse fault system is the southern-most of the two, and extends from east of Mike Horse Creek drainage, westward through Paymaster Creek drainage. The second fault system (the Blackfoot Fault) is located approximately 4,000 feet to the north and trends subparallel to the Blackfoot River drainage bottom (Figure 17). Both of these fault systems exhibit vertical displacements on the order of

400 feet (Miller, 1973). Numerous smaller northwest-trending structures occur within the UBMC, as well as older northeast trending structures (Pardee and Schrader, 1933).

Mineralization Multiple episodes of bedrock mineralization/alteration have occurred at the UBMC, with all mineralization related to the Tertiary-age intrusive complex. Early mineralization includes a network of base and precious metal veins (characterized as quartz/pyrite/chalcopyrite veins), occurring within the porphyry intrusive body and extending radially outward. These radial veins, which are typically fault controlled with considerable bedrock fracturing along vein margins, were the targets of early mine development in the district (McClernan, 1983).

Imprinted upon this fault-controlled vein mineralization and surrounding bedrock are localized, disseminated deposits of supergene (mineral deposit formed near the surface) enriched copper-molybdenum mineralization (the copper-molybdenum ore zones). Two distinct copper-molybdenum ore bodies have been identified within the UBMC, including the "Number 3 Tunnel Ore Zone" located south of the Blackfoot River, and the "North Ore Zone" located north of the river (McClave, 1998; Figure 6 and 17).

Area Seismicity No work has been undertaken to establish recent movement of fault structures in the UBMC. Although many of the high-angle faults shown on the UBMC geologic map (Figure 17) could be considered geologically active, most probably have very long recurrence intervals where the return period of seismic activity is on the order of thousands of years (USGS, 2007).

5.2.3 Groundwater

Groundwater in the UBMC has been studied in areas of known mining impacts, and predominantly along the stream valley bottoms. The general pattern of groundwater flow is from higher elevation areas, where bedrock groundwater is recharged by snowmelt and spring storm events, towards the local drainage bottoms then along the axis of the drainage. Hydrogeology and groundwater quality are variable and appear to be site-specific or locally controlled in many areas of the UBMC. Groundwater occurs within fractured metasediments, igneous bedrock units, and within unconsolidated alluvium in drainage bottoms. Bedrock groundwater discharges to local stream drainages, recharging the alluvial groundwater system and ultimately sustaining base flow in local streams during periods of low precipitation. The recharge area of the UBMC watershed is relatively small, due to topography and proximity to the Continental Divide, and therefore annual precipitation amounts and timing significantly influence base flows in area streams (MSE, 1994).

Based on invariably low yields (a few gpm or less) from bedrock monitoring wells at the UBMC, bedrock permeability is considered to be low with groundwater flow occurring predominantly through secondary fractures, joints, and fault zones. This conclusion is supported by relatively low base flow discharge (35 gpm average (CDM, 2008)) from the Mike Horse Mine adit despite workings that include more than 30,000 lineal feet of tunnels, drifts, raises, and winzes. The alluvium has a much higher permeability than the bedrock due to the predominance of gravel and cobbles in the larger UBMC drainages (Beartrap Creek, Anaconda Creek, and the upper Blackfoot River; MSE, 1994).

Groundwater in the alluvial aquifer and surface water in the Blackfoot River valley and larger tributaries are intimately related, with the streams losing surface water to the alluvial aquifer system in some reaches and gaining water from it in other reaches. An assessment of the significance of this interchange was made by comparing surface water and groundwater quality at locations where both were monitored. In the upper Mike Horse Creek area and in Beartrap Creek, where the stream gains flow from groundwater, high metals concentrations in the shallow alluvial groundwater are an important source for the metal loads in the surface water. Further downstream, near the Mary P Mine and the upper end of the Upper Marsh, the Blackfoot River loses water to the shallow alluvial groundwater system. It appears that the Blackfoot River is a source creating metals concentrations in the groundwater in these reaches (Tetra Tech, 2013a).

Groundwater was initially classified in the RI. In accordance with ARM 17.30.1005, groundwater is classified I through IV based on its beneficial uses, and groundwater is to be classified according to actual quality or use, whichever places the groundwater in a higher class. ARM 17.30.1006 sets the standards for groundwater based upon its natural specific conductance. A review of both field and laboratory specific conductance data for the period of 2007 and 2008 indicates sampled groundwater is classified as Class I groundwater. Two specific areas, the upper Mike Horse waste pile area and the Carbonate mine area, exhibited Class II groundwater characteristics based on specific conductance. However, the groundwater in both of these areas is contaminated by mining-related activities that increase the specific conductance to a level indicative of Class II groundwater (Tetra Tech, 2013a). As the lowest measured specific conductance from unimpacted groundwater determines the classification, the groundwater is Class I.

5.2.4 Surface Water

5.2.4.1 Drainage Network

The drainage network (Figure 21) in the UBMC is characterized by a dendritic pattern. Stream flow originates as snowmelt and as periodic rain events along steep upland slopes. Infiltration from these events provides base flow to streams throughout the remainder of the year. The major tributary streams in the UBMC include, from upstream to downstream, Beartrap Creek, Mike Horse Creek, Anaconda Creek, the Blackfoot River, Stevens Gulch, Shave Creek, Paymaster Creek, Pass Creek, and Swamp Gulch (Figure 16). The Blackfoot River is formed by the confluence of Beartrap Creek and Anaconda Creek. Numerous tributaries of lesser significance join the Blackfoot River downstream of Swamp Gulch. Other significant surface water features include the Mike Horse Tailings Impoundment on Beartrap Creek (which was removed in 2015), and a large marsh system, which begins near the confluence of the Blackfoot River and Pass Creek and extends several miles downstream. All surface waters within the UBMC are classified as B-1 waters (ARM 17.30.607), with certain identified beneficial uses that must be maintained (ARM 17.30.623).

The Blackfoot River (above Landers Fork), Beartrap Creek, and Mike Horse Creek are listed on Montana DEQ’s 303(d) list as having impaired beneficial uses for aquatic life, cold water fish, and drinking water supply. Beneficial uses are identified as impaired due to the following COCs for the Blackfoot River and Beartrap Creek: cadmium, copper, iron, lead, manganese, and zinc; with the addition of aluminum for Mike Horse Creek. These contaminants are primarily released from areas of historic mine activities and may also, in part, be related to natural background conditions (DEQ, 2014a).

5.2.4.2 Marsh Complex and the Upper Marsh

The Upper Marsh, a 62.3-acre wetland at the confluence of Pass Creek with the Blackfoot River (Figure 2), is part of a larger 300-acre marsh that includes the Middle Marsh and Lower Marsh. The Upper Marsh receives its largest water inputs from Pass Creek and the Blackfoot River, but also receives significant inputs from Paymaster Gulch and Swamp Gulch and a significant volume of groundwater discharge from side drainages and other wetland areas. Surface water-groundwater interaction within the Upper Marsh is complex as some portions receive input from the various water sources, while other portions lose water and recharge the aquifer during portions of the year.

Two large fens are located within the Upper Marsh at the inlets of Paymaster Creek and Swamp Gulch (Figure 22), approximately 11 and 12 acres in size, respectively. Ecologically significant because of their unique vegetation and slow rate of peat accumulation, fens require a minimum of 1,000 years for development, indicate geologic and hydrologic stability, and commonly accumulate iron, copper, manganese, and other metals. These iron-rich fen wetlands, which are typically acidic, saturated, and located at low points in the landscape or side-hill areas (Field Guide, 2014), tend to be seepage-fed with an organic peat layer greater than 15 inches deep and an organic carbon content of at least 12 to 18 percent (Colorado Natural Heritage Program, 2005). The fens in the Upper Marsh are located immediately downstream of the Paymaster and Carbonate ore deposits and, given the time required for fens to develop, have been present in their current location well before mining practices at the UBMC. The Army Corps of Engineers, Helena Regulatory Office, considers the fens to be special aquatic sites because of their critical functions, as well as low resilience to disturbance (Geum, 2013).

5.2.5 Water Rights

The Montana State Library's Natural Resource Inventory System (NRIS) database was searched for water rights information. Within the UBMC, 13 surface water right diversions are on file with priority dates ranging from 1892 to 1963. The purpose listed for all 13 rights is "mining." Eleven of the water rights were owned by ASARCO and are now owned by the Trust, one is owned by a private individual, and one is owned by the USFS (for the Mike Horse Dam) (Montana State Library, 2013).

5.3 FACILITY CONTAMINATION

DEQ evaluated data collected prior to the RI, during the RI, and subsequent to the RI to:

- Identify sources of contamination;
- Determine the extent of contamination in soils, groundwater, surface water, and sediment;
- Determine risks to human health and the environment; and
- Develop and evaluate cleanup options.

During the pre-RI, RI, and post-RI investigations, groundwater samples (over 600), soil samples (over 2,000 lab and x-ray fluorescence (XRF) surface and subsurface samples), surface water samples (over 450), and sediment samples (over 200) were collected. The analytical results for these data sets were used to identify contaminants of potential concern (COPCs) in the various medium. Initially, nine out of 23 metals were identified as COPCs: aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc (PTI, 1994). Metals concentrations data for benthic macroinvertebrates, periphyton, vegetation, and small mammals were also collected for the BERA. Further screening of the COPCs resulted in eight COCs being identified in the HHRA and BERA. Mercury was the only COPC, of the original nine COPCs, that was not retained as a COC. The remaining eight metals were either retained as a COC in the HHRA or the BERA, or both.

Prior to the RI, the EE/CA and interim actions identified the majority of the larger areas containing contamination. However, the RI's mine inventory identified an additional 269 mining-related features that included mine waste piles, hand dug exploratory pits and trenches, adits, and exploratory drill pads. Potential locations of mine features were first identified based on historical mining maps. These locations were then visited by field personnel who also identified additional sites while traversing between locations. In particular, areas along active streams (Stevens Creek, Paymaster Creek, Pass Creek, and Shave Creek) were evaluated for the presence of mine wastes (Tetra Tech, 2013a).

Of the 269 features evaluated in the RI, 197 features were assigned a finding of "no significant disturbance" based on the following criteria:

- No Threat to Physical Safety
- No Hazardous Materials or Less Than 100 yd^3 of Excavated Rock Present
- No Discharge to or Contact with Surface Water.

The remaining 72 features were reduced further when several of the features were found to be duplicative of features located within either EU 1B or EU 11. Four other features were combined into two features based on global positioning system (GPS) locations and RI field notes. The reduced list of 63 features (Figure 3) was retained to develop remedial alternatives (Pioneer, 2016). Of the 63 features, 24 are located on non-federal land and addressed in this ROD.

The mining-related features, certain interim action areas that do not comply with CECRA, and EUs with areas exceeding SSCLs were combined into five Evaluation Areas (EAs) to streamline the development of remedial action alternatives in the FS. Details regarding contamination that is specific to the various EUs and mining-related features are discussed in the Selected Remedy section (Section 11.2). The EAs and the affected media are defined as follows:

- Evaluation Area 1 (EA 1) – Soil, associated with specific EUs, is the focus for this EA. It includes all EUs, associated with non-federal land, that have soil contamination located outside the floodplains (Figure 23). These EU areas are collectively referred to as Upland Waste Areas and include the Upper Anaconda Mine Waste Area and Waste Piles (EU 1A and EU 1B), Capital Mine Waste Area (EU 3), Carbonate Mine Waste Area (EU 4), non-federal portions of the Edith Mine Waste Area (EU 5), Consolation Mine Waste Area (EU 6), non-federal portions of the Mary P Mine Waste Area (EU 7), Mike Horse Mine Waste Area (EU 8), and the Paymaster Mine Waste Area Surface and Subsurface (EU 9A and EU 9B). All of these EUs, with the exception of EU 7, were areas where previous interim actions occurred and are described in Section 2.3. The Mary P Mine Waste Area (EU 7) is an upland waste area (waste pile) that was characterized during the RI and exceeds SSCLs for arsenic, copper, lead, manganese, and zinc.

- Evaluation Area 2 (EA 2) – Groundwater, associated with specific EUs, is the focus for this EA (Figure 24). The groundwater features include the Anaconda Mine Adit Discharge (EU 1), Capital Mine Adit Plug (EU 3), Carbonate Mine Groundwater (EU 4), Mike Horse Mine Adit Discharge and Seeps (EU 8), and Upper Mike Horse Bedrock Aquifer (EU 8).
- Evaluation Area 3 (EA 3) – Surface water and sediment associated with specific drainages (including specific EUs) and mining-related features are the focus for this EA (Figure 25). The surface water and sediment features include the Blackfoot River from the inlet of the Upper Marsh downstream to the confluence with Hogum Creek (EU 13). While the reach of the Blackfoot River that runs through the Upper Marsh (EU 12) is part of EU 13, it is included in EA 4 due to the integration of the Blackfoot River channel into the floodplain remedy. Also included in EA 3 are Stevens Creek, Paymaster Creek, and an unnamed tributary to the Blackfoot River located above the WTP. Mining-related features (discharges, seeps, or springs) along the Blackfoot River (BR-14) and Stevens Gulch (SG-71, SG-94) are also included, as well as the historical Paymaster Adit discharge.
- Evaluation Area 4 (EA 4) – Surface water and sediment, floodplain sediment, and groundwater within the boundaries of the Upper Marsh are the focus for this EA (Figure 26). The Upper Marsh is divided into eastern and western sections.
- Evaluation Area 5 (EA 5) – Soil and physical hazards associated with the mining-related features are the focus for this EA (Figure 27). Detailed descriptions of the 24 mining-related features (BR-14, BR-29, BR-39, PC-01, PC-06, PM-04, PM-06, JM-01, SH-13, SH-14, SH-29, SH-37, SG-13/14, SG-16, SG-41, SG-43, SG-47, SG-48, SG-49/50, SG-51, SG-71, SG-93, SG-94, SWG-02) are found in Appendix E.

Contamination found in the various media within the EAs is summarized below.

5.3.1 Soil (EA 1 and EA 5)

Surface soil (0-2 feet bgs) samples were collected at known discrete upland mine waste locations that had previously undergone interim action removals (EA 1); at select mining-related features inventoried during the RI (EA 5); and at 30 locations to establish background metals concentrations for the Facility (Tetra Tech, 2013a).

All eight of the EUs in EA 1 (Section 11.2.1; Figure 23) had soil metal concentrations that exceeded at least one SSCL. The most frequent human health exceedances were arsenic and lead. The most frequent ecological exceedances were arsenic, copper, lead, and zinc (Tetra Tech, 2013a).

In EA 5, soil samples were collected from waste areas at four of the 24 mining-related features (BR-39, PC-01, SG-93, SG-94; Figures 27) that are located on non-federal land. Only BR-39 had soil metal concentrations that exceeded at least one SSCL. The human health exceedances were arsenic and lead. The ecological exceedances were lead and zinc (Tetra Tech, 2013a; Pioneer, 2016).

Background samples were collected from 15 areas expected to be less mineralized and from 15 areas anticipated to have greater mineralization (Figure 17). Selection of the sampling locations was based on geologic maps for the area. The soil sampling results were used to calculate site-specific soil background levels. The background levels were compared to DEQ screening levels, and soil SPLP screening levels used for comparison to the leachate that is produced during the lab analysis. If the leachate exceeds the SPLP screening levels during lab analysis, it indicates that the metals concentrations in the soil may pose a threat to groundwater. All metals exhibited an exceedance of one or more screening levels for one or more samples, which indicates that some background concentrations of metals in soil may pose potential risks to human health and impair water quality (Tetra Tech, 2013a).

5.3.2 Groundwater (EA 2)

In general, groundwater (EA 2) from the Mike Horse Creek and Beartrap Creek areas (Figure 24) contained higher concentrations and more frequent exceedances of SSCLs for the analyzed metals than did samples from downgradient wells further downstream at the UBMC. SSCLs for cadmium, copper, lead, and zinc were exceeded in samples from the Mike Horse and Carbonate areas. In samples from downgradient wells in the same drainages, SSCLs for cadmium, lead and zinc were also exceeded, but only rarely (Tetra Tech, 2013a).

Groundwater in the alluvial aquifer and surface water in the Blackfoot River valley and larger tributaries are connected, with the streams losing surface water to the alluvial aquifer system in some reaches and gaining water from it in other reaches. Water quality comparisons were made at five locations: upper Mike Horse Creek; lower Beartrap Creek; Blackfoot River near the Mary P Mine area; near the head of the Upper Marsh; and near the downstream end of the Upper Marsh (Figure 3), with field measurements showing higher pH and dissolved oxygen concentrations in the surface water samples. Total dissolved solids and sulfate concentrations were usually higher in the groundwater samples; in the cases where this was not true, differences in concentrations were very small (Tetra Tech, 2013a).

In the upper Mike Horse Creek area, where the stream gains flow from groundwater, high metals concentrations in the groundwater are a source for the metals loads in the surface water. Cadmium, lead, and zinc exceeded SSCLs in both surface water and groundwater. For all the metals, groundwater from at least two of the four wells contained concentrations greater than those in the surface water. Near the downstream end of Beartrap Creek, also a gaining stream reach, concentrations of total dissolved solids, sulfate, and metals are substantially higher in the groundwater than in surface water, and groundwater discharges to the stream increase metals concentrations and contribute to the surface water metals load. However, comparison of bedrock groundwater quality to alluvial groundwater quality slightly upstream of this location indicates that the bedrock groundwater does not contribute to degradation of the alluvial groundwater or surface water (Tetra Tech, 2013a).

At the next two locations downstream, near the Mary P Mine and the upper end of the Upper Marsh, the Blackfoot River loses water to the shallow alluvial groundwater system. In both of those areas, the surface water contains higher concentrations of cadmium and zinc than groundwater in both the alluvium and the bedrock. Near the Mary P Mine, the surface water also contains higher concentrations of lead than either source of groundwater. Near the Upper Marsh, lead concentrations in the surface water are higher than in the groundwater and copper concentrations are higher in the surface water than in one of the alluvial wells. Concentrations of cadmium and zinc in the surface water exceed SSCLs, as does lead on occasions in the shallow groundwater. Based on this information, it appears that the Blackfoot River is a source for the higher cadmium, lead, and zinc concentrations in the groundwater in these reaches (Tetra Tech, 2013a).

At the most downstream location, near the lower end of the Upper Marsh, the relative concentrations between groundwater and surface water change as flow conditions change. During the fall, with low streamflow, surface water concentrations of copper, lead, and zinc were higher than in the alluvial and bedrock groundwater, but lower concentrations in the surface water during the June high streamflow reversed that trend (Tetra Tech, 2013a).

Springs and seeps occur in the upper Mike Horse Creek area, in the vicinity of the Mike Horse Tailings Impoundment, and from mine adits, springs, and seeps in the UBMC. Discharge of contaminated groundwater to surface water occurs along many reaches of the Blackfoot River and its tributaries in the UBMC (Tetra Tech, 2013a).

Seventeen water supply wells are listed on the Montana Bureau of Mines and Geology Ground Water Information Center database in the vicinity of the UBMC. Three domestic wells downstream of the Upper Marsh area and within immediate proximity of the Blackfoot River have been sampled by DEQ twice per year since March 2009. Metals concentrations in these three domestic wells are less than SSCLs or below laboratory detection limits (Tetra Tech, 2013a).

Two other domestic wells located closer to the Upper Marsh area in the vicinity of Surveyors Gulch are hydraulically connected to the Blackfoot River valley fill deposits (Tetra Tech, 2013a). One well has been sampled four times, while the other well was only sampled once so far due to well operational issues. Metals concentrations in these two domestic wells are less than SSCLs or below laboratory detection limits (Portage, 2014).

5.3.3 Surface Water (EA 3)

In general, when seasonal (spring and fall) stream flows increased, metals concentrations decreased from upstream to downstream. Measured flows in October 2007 ranged from 0.0105 cubic feet per second (cfs) at location BRSW-4 on upper Mike Horse Creek to 5.85 cfs at location BRSW-17 downstream of the Lower Marsh, and in June 2008 from 1.1 cfs at BRSW-4 to 92.48 cfs at BRSW-17 (Figure 16). October 2007 base flow conditions showed reaches where streamflow was lost to the shallow groundwater system near the Mary P Mine, between Stevens Gulch, Shave Gulch and the Upper Marsh, and reaches downstream of the Upper Marsh. Flow in November 2011 on the Blackfoot River along the reach between BRSW-206 and BRSW-201 ranged from 3.57 cfs at the most upstream location to 19.63 cfs at the most downstream location of the reach. Alice Creek, Hardscrabble Creek, Horsefly Creek, and Hogum Creek enter the Blackfoot River within this reach accounting for the increase in flow (Tetra Tech, 2013a).

With the exception of BRSW-6 (Anaconda Creek background sample), BRSW-11 (Pass Creek background sample), BRSW-103 (Blackfoot River channel through the Lower Marsh), and BRSW-201 through BRSW-206 (between Highway 279 crossing and Hogum Creek), surface water samples exceeded at least one human health or aquatic life SSCL. The most frequent human health exceedances were cadmium, lead, and zinc. All of the human health exceedances occurred above the Upper Marsh. The most frequent aquatic life exceedances were cadmium and zinc. Ecological indicators, such as diversity within the macroinvertebrate community, macroinvertebrate bioassays, and improvement in water quality from upstream to downstream, suggest that the Blackfoot River is recovering below the Upper Marsh (Pioneer, 2016).

The RI identified three mining-related features (BR-14, SG-71, SG-94; Figures 27), located on non-federal land, that have seeps or springs. No flow or water quality data were collected for two of the features (BR-14, SG-71). At SG-94, water emanates from an iron precipitate cone-forming spring. The metal concentrations in the spring water exceeded human health SSCLs for arsenic and iron and aquatic SSCLs for iron and zinc (Tetra Tech, 2013a).

5.3.4 Sediment

Two different types of sediment samples were collected at the UBMC. Streambed sediment samples (i.e. sediments located beneath flowing water within active stream channels) were collocated with surface water samples and collected at 27 of 36 surface water locations sampled on the Blackfoot River and its tributaries. Marsh sediments were collected beginning from the top of the mineralized marsh sediment interface (i.e. beginning at the base of the present/existing vegetative root layer) to 2 inches, 2- to 6 inches, and 6- to 12 inches below the root layer. A total of 293 marsh sediment samples were collected from all three marsh areas (Upper, Middle, and Lower) at the UBMC.

5.3.4.1 Streambed Sediments (EA 3)

Streambed sediments (Figure 16) in the main stem of the Blackfoot River, lower Paymaster Creek, and Stevens Creek have elevated metal concentrations. The streambed data shows metal concentrations that decrease with downstream distance to the outlet of the Upper Marsh. While fluctuations in metal concentrations do occur between locations below the Upper Marsh, these concentrations are relatively constant compared to locations above the marsh. A notable exception to this observation is a distinct spike in aluminum, cadmium, copper, and manganese concentrations measured at BRSW-104 during the 2008 spring/summer sampling between the Middle and Lower Marsh, above the confluence of the Blackfoot River and Cadotte Creek. The metal concentrations in the sample taken the previous fall are much lower than the 2008 spring/summer metal concentrations and the fall sample metal concentrations are within the range of metals concentrations found upstream of BRSW-104 to BRSW-31, just below the Upper Marsh at the Meadow Creek Bridge. According to the field notes, the BRSW-104 sampling location is characterized by swift, shallow water that flows over sand, small gravel, and cobbles. Sediment samples were difficult to collect due to the lack of fine sediment at this location. The contamination at locations below BRSW-104 continues to decrease with downstream distance, which suggests that this one sample may be anomalous as it relates to metal concentrations at the other sampling locations below the Upper Marsh (TetraTech, 2013a).

Sediment samples were collected at three of the 24 mine features (PC-01, SG-93, and SG-94; Figure 27) located on non-federal land. Two (SG-93 and SG-94) of those three mine features had sediment metal concentrations that exceeded at least one SSCL. The most frequent human health exceedances were arsenic and lead. The most frequent ecological exceedances were arsenic, cadmium, copper, lead, and zinc (Tetra Tech, 2013a; Pioneer, 2016).

5.3.4.2 Marsh Sediments (EA 4)

The Upper Marsh has been divided into two areas: the eastern (upstream) portion at 28.0 acres and the western (downstream) portion at 34.3 acres. This division, also used in the BERA, is based on the location of an old drill road constructed within the area prior to the 1975 breach of the Mike Horse Tailings Impoundment (Figure 26). The drill road provided a containment feature for initial deposition of the tailings and sediment materials in the eastern portion of the marsh. Over time, the finer materials have been transported downstream into the western portion (Pioneer, 2016).

Natural weathering of the quartz monzonite porphyry and diorite ore bodies in the mineralized areas within Pass Creek, Paymaster Gulch, and Swamp Gulch drainages (Figure 17) also contributes to the elevated COC concentrations in sediment in the Upper Marsh. The bioavailability parameters assessed in the BERA (grain size, pH, total organic carbon, and solubility) indicate with a high likelihood that lethal and sub-lethal effects to aquatic life could occur in the Upper Marsh. The pH data suggests that the metals may be bioavailable throughout the wetland, and grain size and solubility indicate that the bioavailability may be higher in the eastern (upstream) portion. Fine-grained sediment, found more commonly in the western portion of the marsh, tends to carry more organic carbon and better supports the binding of metals to the sediments. Metals in the marsh are generally more mobile and bioavailable in the eastern portion of the Upper Marsh because of the presence of medium-grained sand that has lower particle surface area (Tetra Tech, 2013b).

Analytical results from sediment collected from the Upper Marsh, Middle Marsh, and Lower Marsh (Figure 26) indicate most metals analyzed exceed SSCLs. SPLP results indicate that some of these metals have the potential to migrate to adjoining sediments, surface water, and groundwater. Acid-base accounting (ABA) is an analysis that is often used, along with metals analysis and SPLP, to determine if a soil or sediment has the potential to mobilize or leach metals into other soils or nearby surface water or groundwater. ABA results indicated that the eastern side of the Upper Marsh has sediment that is potentially acid generating as well as the sediment in the western portion of the marsh where Swamp Gulch enters. The eastern portion of the marsh is an area where much of the tailings from the 1975 breach were deposited, and, therefore, would be expected to exhibit greater concentrations of metals, while high metal concentrations near Swamp Gulch may be a result of historical mining activities within the gulch (Tetra Tech, 2013a; Tetra Tech, 2013b; Pioneer, 2016). The remainder of the sediment in the Upper Marsh has either an uncertain acid generating potential or is unlikely to generate acid. No ABA analysis was performed on the Middle and Lower Marsh sediments.

The Middle Marsh and Lower Marsh sediments exhibit exceedances of SSCLs. SPLP results indicate that lead may have the potential to migrate to adjoining sediments, surface water, and groundwater. Overall, the Middle Marsh and Lower Marsh sediments exhibit lower COC concentrations than the Upper Marsh with the Lower Marsh exhibiting further decreases in metal concentrations. This would be expected if much of the tailings from the 1975 breach settled within the eastern portion of the Upper Marsh (Tetra Tech, 2013a).

The ability of these marsh sediments to generate acid and mobilize metals may be inhibited by reducing chemical conditions and overlying organic mats within the Upper Marsh. Areas that are better drained and have greater contact with atmospheric conditions have a higher potential to leach metals than those areas that are consistently saturated and have less exposure to atmospheric conditions. Organic matter within the marsh, like the peat found in the fen areas, also acts to bind the metals to the sediments, further reducing metals mobility in the environment (Pioneer, 2016).

5.3.5 Flora and Fauna

Environmental sampling was also performed to better evaluate the ecological risks posed by potential uptake of the contaminants into the food chain. Environmental sampling included terrestrial and marsh habitats where plants, invertebrates (terrestrial and aquatic insects), and small mammal tissues were collected to evaluate contaminant transfer from one organism to another. The data was evaluated in a food chain analysis that considered the potential for transfer of metals from sediments, soils, plants, invertebrates, and small mammals to higher organisms, such as fish, predatory birds, waterfowl, and mammals (Tetra Tech, 2013b).

Metal concentrations in plants, small mammals, and invertebrates were determined through laboratory analysis across three transects (high risk, moderate to low risk, and a background area) in both terrestrial and marsh habitats. For some metals, concentration levels were not detected above the laboratory method minimum detection limit. Most notably, mercury was not detected above the laboratory detection limit in any receptor in any location. Cadmium was not measured above the detection limit in any small mammal sample in the terrestrial habitat and arsenic was not detected in any small mammal or vegetation sample in the marsh habitat. For those metals that were detected, concentrations in each receptor were generally highest in the high risk transects, were at intermediate levels in the moderate to low risk transects, and were lowest in the background transects in both terrestrial and marsh habitats (Tetra Tech, 2013b).

Environmental sampling was also performed in the streams to better evaluate the ecological risks posed by potential uptake of contaminants into the food chain and the overall health of the aquatic environment. Macroinvertebrate (insects living in water bodies) population and diversity analysis indicated that some sampling locations had drastic changes in macroinvertebrate populations from the two sampling periods performed during the RI. Despite the change in abundance, the calculated scores used to determine ecological health, a simple unimpaired or impaired determination, remained similar with each sampling site retaining its original determination from the first sampling event to the second event (Tetra Tech, 2013a).

Metal concentrations in macroinvertebrate tissue samples were determined through laboratory analysis. Most samples from the UBMC had greater metals concentrations than from the upstream background location, suggesting that invertebrates are exposed to bioavailable forms of metals in the stream and that the invertebrates are bioaccumulating metals. Based on qualitative interpretation of published tissue levels, it appears that neither cadmium nor copper tissue concentrations are high enough to exert an adverse effect on the invertebrate community. The data for lead are not adequate to support a qualitative statement of risk. However, zinc concentrations in invertebrates at the UBMC are higher than those shown to cause adverse effects in other studies (Tetra Tech, 2013b).

5.3.6 Physical Hazards

Physical hazards that may pose a safety risk were also found during the RI and are primarily related to open adits (Appendix E). Review of field notes and available photos indicate that these features could allow human entry or present other safety hazards (Pioneer, 2016).

6.0 CURRENT AND REASONABLY ANTICIPATED FUTURE USES

Current land use and a variety of potential future land uses were evaluated as part of the HHRA and SSCLs protective of those uses were calculated. The current land use at the UBMC is primarily recreational, with industrial use at the WTP.

As part of selecting the final remedy, Section 75-10-721(2)(c), MCA, requires that DEQ consider the reasonably anticipated future use of the Facility. DEQ determines the reasonably anticipated future use by assessing the four factors found in Section 75-10-701(18), MCA: 1) local land and resource use regulations, ordinances, restriction, or covenants; 2) historical and anticipated uses of the Facility; 3) patterns of development in the immediate area; and 4) relevant indications of anticipated land use from the owner of the Facility and local planning officials. (As stated earlier, this ROD does not address any of the federal lands within the UBMC for which the USFS already determined the remedy. For those federal lands within the UBMC that were not included in the USFS Action Memorandum, as amended, the USFS will issue a separate decision. Therefore, DEQ did not determine the reasonably anticipated future use of federal lands as part of this evaluation.)

1. Local land and resource use regulations, ordinances, restriction, or covenants: The Lincoln Planning Area Growth Policy (Policy) (Lewis and Clark County, 2005) discusses the UBMC. It recognizes “that the Blackfoot River is one of the Lincoln Planning Area’s significant environmental resources” and encourages its protection by “cooperating … in the clean-up and remediation” of the Facility.
2. Historical and anticipated uses of the Facility: Historically, the UBMC has been used for industrial (mining) and residential (housing for workers) purposes. The majority of the UBMC is open space and is currently being used for recreation. The exceptions would be industrial use at the WTP and its infrastructure, and the Carbonate, Paymaster, and UBMC Repositories.
3. Patterns of development in the immediate area: There has been no active development in the area and the non-federal property is surrounded by federal lands. As part of the ASARCO bankruptcy, ownership of the non-federal land at the UBMC was transferred to the Trust.
4. Relevant indications of anticipated land use from the owner of the Facility and local planning officials: DEQ sent a letter to the Trust asking for its future plans for the property. The Trust indicated that it owns 12 tracts of property and that, for tax purposes, 10 of the parcels are classified as agricultural rural, one is classified as vacant land rural, and one is classified as farmstead rural. The Trust also indicated that there are three reasonably foreseeable land use categories: parcels being used in relation to the WTP and its infrastructure or existing repositories (industrial); parcels abutting federal land that should remain forest land (recreational); and parcels abutting privately owned homestead and farmstead land that could be homestead land (recreational or residential) (METG, 2015). Of the four parcels identified by the Trust as having potential residential use, one of them is not within the UBMC and one of them is within the UBMC only because the Blackfoot River (which is impacted) flows through the property. Portions of the other two parcels are within the UBMC. For that portion of property owned by DEQ upon which the UBMC Repository is located, the repository will remain in perpetuity and no development of the property upon which the repository sits will be allowed. To evaluate

relevant indications of anticipated land use from local planning officials, DEQ reviewed the Policy. It encourages the maintenance of open space for wildlife and promotion of existing and future recreational uses. DEQ also reviewed county zoning and determined that the UBMC is not currently subject to any county zoning (Lewis and Clark County, 2015).

With the exception of the existing industrial use at the WTP and its infrastructure and the existing repositories, the other portions of the UBMC addressed by this ROD are currently being used as open space/recreational. Based upon evaluation of the four statutory factors, DEQ has determined the reasonably anticipated future uses of the non-federal lands within the UBMC as primarily open space/recreational, with the exception of the WTP and its infrastructure and existing repositories, which is industrial. Because there is no zoning to prohibit residential use and the Trust has indicated the potential for some of its property to be used as residential in the future, the reasonably anticipated future use of three parcels is recreational or residential. This is not inconsistent with the Policy and also recognizes some potential future part-time or full-time residential use. However, any sale, lease, or disposition of Trust land is subject to the approval of the State of Montana and the USFS (US Bankruptcy Court, 2009).

7.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

DEQ evaluated risks to humans and wildlife in the HHRA (Tetra Tech, 2014) and BERA (Tetra Tech, 2013b) to evaluate if there was any unacceptable risk for current or potential future uses. The following presents a summary of the risks and the SSCLs. The HHRA and BERA identified COCs, exposure pathways, exposure assumptions, toxicity values, and calculated SSCLs protective of human health and the environment at the UBMC. Thirteen separate EUs were identified for the UBMC based on physical location, habitat type, and waste sources, as listed below:

- EU 1 – Upper Anaconda Mine Waste Removal Areas and Waste Piles
  - EU 1A – Upper Anaconda Mine Waste Removal Areas
  - EU 1B – Upper Anaconda Mine Waste Piles
- EU 2 – Blackfoot River Dispersed Tailings Associated with EE/CA Removal Action Area and Overbank Deposits
- EU 3 – Capital Mine Waste Area
- EU 4 – Carbonate Mine Waste Area
- EU 5 – Edith Mine Waste Areas
- EU 6 – Consolation Mine Waste Area
- EU 7 – Mary P. Mine Waste Pile
- EU 8 – Mike Horse Mine Waste Piles
- EU 9 – Paymaster Mine Waste Areas
  - EU 9A – Paymaster Mine Waste Areas (Surface)
  - EU 9B – Paymaster Mine Waste Area (Subsurface)
- EU 10 – Number 3 Tunnel Waste Area
- EU 11 – Beartrap Creek Dispersed Tailings Deposits Associated with EE/CA Removal Action Area, Overbank Tailings Deposits, and Flossie Louise Mine Waste Piles
- EU 12 – Marsh
- EU 13 – Stream Sediments

In addition, the HHRA compared contaminant concentrations in groundwater and surface water with DEQ-7 standards for protection of human health. The BERA compared concentrations in surface water with DEQ-7 standards for protection of aquatic life. Human health and aquatic life risks were not quantified for groundwater and/or surface water. Instead, for those compounds that have them, DEQ-7 standards are the groundwater and surface water SSCLs, unless site-specific background exceeds the DEQ-7 standards in a particular location, in which case background becomes the SSCL for that location. For those compounds in groundwater and surface water for which no DEQ-7 human health standard exists (aluminum, iron, and manganese), DEQ calculated SSCLs or used site-specific background levels (Tables 4A and 4B; Tetra Tech, 2014).

7.1 HUMAN HEALTH RISKS

The HHRA refers to areas directly associated with UBMC contaminant sources (that is, historical mining areas where contaminants originated) as onsite EUs (EUs 1, 3, 4, 5, 6, 7, 8, 9, and 10). Affected areas located downstream from historical mining areas are referred to as offsite exposure units (EUs 2, 11, 12, and 13). This distinction was made only to assist DEQ in developing SSCLs for different EUs within the UBMC and its use is limited to this purpose because, under CECRA, the “facility” includes “any site or area where a hazardous or deleterious substance has been deposited, stored, disposed of, placed, or otherwise come to be located.” For all other purposes, the term “onsite” includes all suitable areas in close proximity to the contamination necessary to implement the remedial action.

When evaluating receptors for risk assessment purposes only, a distinction is made for those areas where contamination may have originated (onsite) and those areas where contamination has migrated from those sources (offsite). In the HHRA, it was assumed that land use at the UBMC consisted of recreational (current/future on and offsite fishermen, hunters, rock hounds, all-terrain vehicle/motorcycle riders), commercial/industrial (current/future onsite and future offsite), construction/utility worker (current/future on and offsite) and residential (future onsite and current/future offsite). Although residential land use was limited to offsite areas in the HHRA, potential future onsite residential use was also evaluated in the HHRA because there are no current restrictions at the Facility limiting residential use.

Populations that could potentially be exposed to contamination at UBMC include future residents, current and future commercial/industrial workers, current and future construction workers, current and future recreators, and current and future ecological receptors. Trespassers were not evaluated separately as the recreator evaluation would be protective of any potential trespassers because the recreator assumptions consider more potential contact with contaminants than trespasser assumptions.

In the HHRA, DEQ calculated exposure scenario- and exposure pathway-specific risks. Potentially complete exposure pathways for soil and sediment at the UBMC are incidental ingestion, dermal contact, and inhalation of COCs released to outdoor air. The HHRA evaluated these pathways for all receptors (Table 12; Tetra Tech, 2014). In addition, the HHRA evaluated exposure to COCs from ingestion of fish for the recreational fisherman. The risk equations used in the HHRA incorporated chemical-specific exposure point concentrations, exposure scenario- and pathway-specific assumptions, and chemical-specific toxicity criteria to calculate cancer risks and noncancer hazards. To ensure protection of human health, DEQ developed cleanup levels based on cumulative risk levels less than or equal to a total excess cancer risk of one in 100,000 ($1X10^{-5}$) for carcinogens (cancer causing COCs) and a total hazard index less than or equal to 1 for non-carcinogens.

Lead was identified as a COC in surface soil, subsurface soil, or sediment at EUs 1, 2, 3, 4, 5, 6, 7, 8, 11, and 12. Health effects from exposure to lead, particularly in children, may occur at such low blood lead levels that use of threshold-based toxicity criteria to evaluate potential risks from exposure to lead is not preferred. Rather, SSCLs for lead were developed using blood lead modeling with a blood lead level of 10 micrograms per deciliter (µg/dL). DEQ also included a SSCL for lead based on 5 µg/dL because the U.S. Centers for Disease Control and Prevention (CDC) recently indicated that adverse health effects are documented at blood lead levels of 5 µg/dL. This provides two separate lead SSCLs based on both current EPA and new CDC guidance on lead effects. Detailed discussion of the blood lead modeling methodology is included in Appendix E of the HHRA (Tetra Tech, 2014). See Section 7.7 for a discussion of the SSCL selection process. All of the SSCLs for the UBMC are found in Tables 4A, 5A, and 5B.

DEQ also identified applicable background soil and sediment concentrations for the COCs. Background soil samples were collected from locations within the Facility and away from known or suspected areas where mining activities took place. Samples were collected from 15 locations expected to be less mineralized and from 15 locations anticipated to have greater mineralization. Selection of the sampling locations was based on geologic maps for the area.

DEQ collected background marsh sediment samples from three locations in Pass Creek Marsh. The purpose was to evaluate metal concentrations in the Pass Creek Marsh, for comparison with the Upper Marsh sediment data, and to provide data for use in the BERA. DEQ also collected background streambed sediment samples from two locations, Anaconda Creek and Pass Creek.

The purpose of collecting the background soil and sediment samples was to evaluate background baseline values of metals in several drainages for comparison with metals concentrations in impacted areas of the facility. ABA and SPLP were analyzed to evaluate natural conditions related to acid generation and metal mobility from the soil and sediments. ProUCL (EPA, 2009) was used to calculate background soil and sediment cleanup values for comparison with analytical results. These data were used for developing SSCLs, when appropriate, as presented in Tables 5A and 5B.

Finally, DEQ developed SSCLs that are protective of groundwater. Site-specific dilution attenuation factors (DAFs) and SPLP results from each EU were used to develop SSCLs that are protective for the conditions found in the specific EU. Initially, the DAFs for each EU were obtained from the RI (Tetra Tech, 2013a). However, after reviewing the leaching-to-groundwater SSCLs, EU soil metals concentrations, and EU groundwater data, it was noted that while the metals concentrations in groundwater were often below SSCLs, the soil metals concentrations often exceeded the leaching-to-groundwater SSCLs. This review suggested that some of the leaching-to-groundwater SSCLs developed using the RI DAFs may be too conservative. Using DEQ guidance for developing SSCLs, site-specific DAFs were determined for each EU. A decision key was then developed that used a four-step progression that moved from the simplest to the most complex process for identifying a leaching-to-groundwater SSCL. Additional discussion regarding this process is found in Section 7.6. The development of the soil leaching-to-groundwater SSCLs is discussed in detail in Section 10.4 in the HHRA (Tetra Tech, 2014).

7.2 ECOLOGICAL RISKS

The UBMC BERA characterizes ecological risks posed to plants, invertebrates, fish, birds, and mammals within the UBMC. Comparisons of soil, sediment, and surface water concentrations with screening criteria are supplemented by additional lines of evidence in the BERA. Because ecological receptors are not exposed to groundwater until it is discharged to surface water or sediment, groundwater is not evaluated in the BERA. Risk estimates are based on food chain models, toxicity information in the literature, benthic community assessment data, and consideration of the frequency and magnitude of chemical detections at the UBMC.

Risk-based remedial ecological goals are concentrations in environmental media that correspond to a specific, allowable target risk or hazard level when an ecological receptor contacts the contaminated medium according to a defined exposure scenario (Table 13; Tetra Tech, 2013b). The following present the methodology used to develop the risk-based remedial ecological goals for plants, terrestrial invertebrates, fish and aquatic invertebrates, and birds and mammals.

Risk-based remedial ecological goals for EUs 1 through 13 were calculated for all birds and mammals evaluated in the BERA using methods consistent with EPA guidance (EPA, 1997).

Instead of inputting a sample soil concentration and calculating a dose, the risk-based remedial goal was calculated by setting the hazard quotient equal to 1.0 and then solving for the soil concentration. This process is known as back-calculating.

Thirteen vertebrate (birds and mammals) receptors were selected as representative of the taxonomic groups and feeding guilds expected to occur in the EUs. The 13 vertebrate receptors and their feeding guilds are American Dipper (insectivore), Great Blue Heron (carnivore), Morning Dove (herbivore), Red-Tailed Hawk (carnivore), American Kestrel (insectivore), Meadow Vole (herbivore), White-Tailed Deer (herbivore), Red Fox (carnivore), Masked Shrew (insectivore), Canada Goose (herbivore), Mallard (omnivore), Muskrat (herbivore), and Mink (carnivore). Other receptor groups included plants, terrestrial invertebrates, and fish and aquatic invertebrates. Representative receptors were based on species known to occur in Lewis and Clark County and on recommendations of local wildlife and fisheries experts from Montana Department of Fish, Wildlife, and Parks. The development of these risk-based remedial ecological goals is discussed in detail in the BERA (Tetra Tech, 2013b).

7.3 DETERMINATION OF COCs

DEQ determined which COCs should be retained from the list of COPCs presented in the RI Report. Because metals are typically found in soils, DEQ also considered site-specific background concentrations in selecting COCs. The COCs for UBMC include: aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc.

All of the UBMC COCs are metals, which are made available for mobilization as products of sulfide mineral oxidation. The oxidation of sulfide in mine waste and tailings generates acid and releases metals. Once freed from the mineral structure, metals can become mobile, leach from sources (mine wastes, tailings, sediment, and exposed ore deposits), and then be transported via acidic water to receiving streams and to the groundwater system. Infiltration of storm water (including snowmelt) and leaching of contaminants may also contribute to contaminant transport from primary sources into subsurface soils (Tetra Tech, 2014). Health effects of the COCs are discussed below.

7.3.1 Aluminum

The Agency for Toxic Substances and Disease Registry (ATSDR) has indicated that the consumption of foods containing aluminum-containing food additives is a major source of aluminum in the diet. The use of other consumer items such as antiperspirants, cosmetics, internal analgesics (buffered aspirins), anti-ulcerative medications, antidiarrheals, and antacids that also contain aluminum compounds will result in exposure to aluminum. Exposure to aluminum is usually not harmful, but exposure to high levels can affect your health. Breathing large amounts of aluminum dusts can cause lung problems or decreased performance in some tests that measure functions of the nervous system. Some people with kidney disease sometimes develop bone or brain diseases which may be caused by the excess aluminum. It is not known for certain whether aluminum causes Alzheimer's disease. The U.S. Department of Health and Human Services (DHHS) and the EPA have not evaluated the carcinogenic potential of aluminum in humans. Aluminum has not been shown to cause cancer in animals (ATSDR, 2008).

The bioavailability and toxicity of aluminum is associated with pH; aluminum is soluble and biologically available in acidic soils (pH less than 5.5), but is biologically inactive in circumneutral to alkaline (pH 5.5 to 8) conditions. The effects of aluminum on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. A discussion regarding aluminum and its effects on ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.2 Arsenic

ATSDR has indicated that arsenic combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Inorganic arsenic compounds are mainly used to preserve wood. Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting low levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. Ingesting very high levels of arsenic can result in death. DHHS and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans. Long-term exposure to arsenic in children may result in lower IQ scores (ATSDR, 2007a). The bioavailability and toxicity of arsenic depend on the chemical and physical forms of arsenic, the exposure route, and the species of concern. The effects of arsenic on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Arsenic can affect plant and fish growth, increase chick mortality rate in some birds, and increase the mortality rate in some smaller mammals. A more detailed discussion regarding arsenic and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.3 Cadmium

ATSDR has indicated that cadmium used in the United States typically is extracted during the production of other metals like zinc, lead, and copper. It is used in many different applications including batteries, pigments, metal coatings, and plastics. Breathing high levels of cadmium can severely damage lungs. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones. The DHHS and IARC have determined that cadmium and cadmium compounds are human carcinogens. Cadmium may also affect children during periods when organs are developing (ATSDR, 2012a).

The bioavailability and toxicity of cadmium depend on the exposure route and the species of concern. The effects of cadmium on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Cadmium can bioaccumulate in plants, negatively affect growth and reproduction in macroinvertebrates, increase mortality in some fish, and lead to increased birth defects in some smaller mammals. A more detailed discussion regarding cadmium and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.4 Copper

ATSDR has indicated that copper is used to make many different kinds of products like wire, plumbing pipes, and sheet metal. Copper is also combined with other metals to make brass and bronze pipes and faucets. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach cramps, nausea, and even death. It is not known whether copper can cause cancer in humans (ATSDR, 2004).

Copper is an essential trace mineral nutrient and is a dietary requirement for most animals in daily doses between eight and 17 mg/kg perday. However, it becomes toxic to all organisms at higher doses (ATSDR, 2004). The effects of copper on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Copper can cause increased aquatic plant mortality, bioaccumulate in plants, and increase mortality in macroinvertebrates and fish. A detailed discussion regarding copper and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.5 Iron

Iron is naturally occurring and the most abundant metal present in the Earth's crust and core. Iron is mined in the United States and is used to make steel, wrought iron, and other metal alloy products. The production and use of iron compounds for use as catalysts, pigments, and drugs, and for use in agriculture, nutrition, metallurgy, and leather tanning, can result in releases to the environment from human activities. Iron is necessary for good health and can be absorbed by the oral, inhalation, and dermal routes of exposure. Very large doses, however, can be harmful. In humans, ingestion of milligram to gram quantities may cause gastrointestinal effects with symptoms such as nausea, diarrhea, vomiting, constipation, heartburn, bloating, abdominal pain, and epigastric pain. Acute doses in the range of 200 to 400 mg/kg may be fatal (EPA, 2006). No suitable bioassays or epidemiological studies are available to assess the carcinogenicity of iron. EPA, therefore, has not assigned iron a weight-of-evidence cancer guideline description for human carcinogenicity (EPA, 2006).

Iron was not evaluated in the BERA because no ecological toxicity benchmarks are available for iron (Tetra Tech, 2013b).

7.3.6 Lead

ATSDR has indicated that lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. The

IARC has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans (ATSDR, 2007b).

Lead is neither essential nor beneficial to living organisms, and all data show that its metabolic effects are adverse. Lead is a mutagen (causes mutations that are often cancerous) and a teratogen (causes birth defects). The effects of lead on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Lead can negatively affect growth in some plants, increase mortality in macroinvertebrates and fish, and produce a variety of toxic effects – including increased mortality – on birds and mammals. A detailed discussion regarding lead and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.7 Manganese

ATSDR has indicated that manganese occurs naturally in most foods and may be added to some foods. It is used principally in steel production to improve hardness, stiffness, and strength. It may also be used as an additive in gasoline to improve the octane rating of the gas. Exposure to excess levels of manganese may occur from breathing air, particularly where manganese is used in manufacturing, and from drinking water and eating food. At high levels, it can cause damage to the brain. The EPA concluded that existing scientific information cannot determine whether or not excess manganese can cause cancer (ATSDR, 2012b).

Manganese is an essential element and ecological receptors' responses to manganese differ widely. The effects of manganese on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Manganese can negatively affect growth in some aquatic and terrestrial plants, and extremely high concentrations of manganese can increase mortality rates in fish and mammals. A detailed discussion regarding manganese and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.3.8 Zinc

ATSDR has indicated that zinc is found in air, soil, and water, and is present in all foods. Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. Low levels of zinc are essential for maintaining good health. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. The DHHS and the IARC have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity (ATSDR, 2005).

Zinc is an essential trace element for all living organisms, and zinc deficiency can be a problem for both plants and animals. Ecological receptors' responses to zinc toxicity differ widely. The effects of zinc on aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, fish, birds and mammals were assessed in the BERA. Zinc can increase toxic effects – including increased mortality – on aquatic and terrestrial plants, increase mortality in macroinvertebrates and fish, and extremely high concentrations of zinc can increase mortality rates in mammals. A detailed discussion regarding zinc and its effects on specific ecological receptors is found in the BERA (Tetra Tech, 2013b).

7.4 HUMAN HEALTH COCs

Arsenic and lead were identified in the HHRA as the only soil or sediment human health COCs at the UBMC. The soil leaching-to-groundwater COCs are aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc. However, the background soil concentrations for some metals in EUs 1-11 are higher than some of the human health and leaching-to-groundwater SSCLs. When the background concentrations are higher, they will be used as SSCLs (Tables 5A and 5B).

The DEQ-7 human health water quality standards are the applicable cleanup levels for groundwater and surface water, unless site-specific background concentrations exceed the DEQ-7 numeric water quality standards in a particular location, in which case background becomes the SSCL for that location. For COCs without a DEQ-7 human health standard available (aluminum, iron, and manganese), the HHRA evaluated and established SSCLs. The groundwater and surface water SSCLs are provided in Tables 4A and 4B.

In the groundwater, the alluvial water-bearing-zone (WBZ) COCs are aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc. The deeper bedrock WBZ COCs are aluminum, cadmium, copper, iron, lead, manganese, and zinc. In the surface water, the COCs are cadmium, lead, manganese, and zinc.

Finally, three areas – Swamp Gulch (Carbonate Mine) surface water, Edith groundwater, and Paymaster groundwater – are identified as having highly mineralized background conditions. In Swamp Gulch the background station (BRSW-14) indicates that the creek in Swamp Gulch may be a source of highly mineralized water (Table 8). Background was calculated, based on 15 sampling events and is reflective of the highly mineralized background conditions discussed in Section 2.3.3.1. The area-specific background concentrations found in Swamp Gulch are the SSCLs for the surface water in that creek (Table 4B).

In the Edith Mine Area all groundwater metals concentrations, except iron and manganese, are lower than the groundwater SSCLs. The groundwater iron and manganese concentrations appear to be a result of highly mineralized background conditions (Table 9). Portions of the Edith Mine Area also contain fen and forested emergent wetland environments as discussed in Section 2.3.4. The area-specific background concentrations found in the Edith Mine Area groundwater are the SSCLs for the groundwater in that area (Table 4A).

Based on the metal concentrations found in the Paymaster Mine area wells, the shallow and bedrock aquifer groundwater quality in the Paymaster Mine area is similar to the groundwater quality found in the shallow and bedrock Paymaster background wells (Table 11). This similarity in water quality suggests that the Paymaster Mine area groundwater is reflective of the highly mineralized background conditions (Table 4A) discussed in Section 2.3.7.1. The area-specific background concentrations found in the Paymaster Mine Area groundwater are the SSCLs for the groundwater in that area.

7.5 ECOLOGICAL COCs

In the BERA, arsenic, cadmium, copper, lead, manganese, and zinc were evaluated for all receptors in all EUs. The remaining COCs were addressed as follows:

- Aluminum was assumed to pose an unacceptable risk wherever soil pH was less than 5.5.
- Iron was not evaluated because no ecological screening benchmarks are available for soil, sediment, or the food chain model.

The risk-based remedial ecological goals are included in the BERA for birds, mammals, plants, terrestrial invertebrates, fish and aquatic invertebrates. The ecological receptor with the lowest risk-based remedial ecological goal at a given EU is the most sensitive receptor. Remedial goals for the most sensitive receptors are expected to be protective of all ecological receptors exposed to soils or sediments within an EU. The masked shrew was identified as the most sensitive receptor to all soils and sediments COCs in EUs 1-12. However, the background soil concentrations that apply to EUs 1-11 are greater than the risk-based remedial ecological goals. Therefore, none of the risk-based remedial ecological goals will be used as SSCLs (Table 5A). For the sediment in EU12, cadmium, copper, and zinc are the COCs that has a risk-based remedial ecological goal for an SSCL; the remaining SSCLs are derived from background concentrations (Table 5B). In EU13 the arsenic, cadmium, copper, lead, and zinc risk-based remedial ecological goals are the SSCLs (Table 5B) for streambed sediment.

The more conservative of the DEQ-7 aquatic acute or chronic water quality standards are the applicable cleanup levels for surface water (which, in most cases, are more conservative than the human health water quality standards), unless site-specific background concentrations exceed the DEQ-7 aquatic water quality standards in a particular location, in which case background becomes the SSCL for that location. Manganese does not have an aquatic standard and iron only has a chronic aquatic standard. Cadmium, copper, lead, and zinc aquatic standards are expressed as a function of total hardness (mg/L as calcium carbonate). Because these metals require a total hardness analysis to calculate the aquatic standard, hardness data will need to be collected at the time of sampling to demonstrate compliance with aquatic surface water SSCLs. The surface water SSCLs are provided in Table 4B.

In the surface water, the COCs are cadmium, copper, iron, lead, and zinc.

7.6 CHEMICAL FATE AND TRANSPORT MODEL

As part of the HHRA, DEQ performed chemical fate and transport modeling to develop SSCLs for the soil leaching-to-groundwater pathway. Leaching-to-groundwater SSCLs for each EU were derived using site-specific DAFs and SPLP results from each EU.

As a result of the complexity of the behavior of metals, leaching tests are used to quantify the partitioning and mobility of metals in soils. DEQ developed the leaching-to-groundwater SSCLs based on the availability and characteristics of the SPLP results for each EU. The site-specific DAF can be applied to several potential methods for developing a groundwater SSCL (Tetra Tech, 2014). The availability and characteristics of the SPLP results for each EU determined which method was used to identify the leaching-to-groundwater SSCL. First, EU soil metal concentrations were compared to background metal concentrations. If all EU soil metal concentrations are less than the background soil metal concentration, then background becomes the leaching-to-groundwater SSCL. Background is also the SSCL if an EU does not have any

SPLP results. If EU soil metal concentrations exceed background, then the SPLP data is arranged in a tabular format and compared to the soil metals concentrations in that EU. If all the EU soil metal concentrations are less than or equal to the highest result that is protective of groundwater (also known as a qualifying soil concentration (QSC)), then the QSC becomes the leaching-to-groundwater SSCL. Finally, if the soil metal concentrations are greater than site-specific background and greater than the QSC, then the leaching-to-groundwater SSCL is determined by using a site-specific distribution coefficient value. The leaching-to-groundwater SSCLs are identified in Table 5A.

The development of leaching-to-groundwater SSCLs is documented in Section 10.4 and Appendix G of the HHRA (Tetra Tech, 2014).

7.7 SITE-SPECIFIC CLEANUP LEVELS

Once the human health risk-based concentrations were calculated for HHRA COCs and the risk-based remedial ecological goals were calculated for the BERA COCs, they were compared to the site or area-specific background concentrations for the UBMC. Some portions of the UBMC are located in highly mineralized ore bodies where the area-specific background concentrations for surface water and groundwater differ from the site-wide background concentrations. If the site or area-specific background concentrations exceeded the human health risk-based concentrations and the risk-based remedial ecological goals, then the background concentrations were selected as the SSCLs. Tables 4A and 4B provide the SSCLs and their origins (DEQ-7 standard, site-specific calculation, or background concentration) for groundwater and surface water. Tables 5A and 5B provide the SSCLs and their origins (risk-based concentration, risk-based remedial ecological goal, soil leaching-to-groundwater, or background concentration) for soil and sediment. All of the SSCLs in Tables 5A and 5B are based upon either site or area-specific background concentrations or leaching-to-groundwater and are not risk-based concentrations. Because site or area-specific background levels were higher, in most cases, than the human health risk-based concentrations and the risk-based remedial ecological goals, the site or area-specific background levels were selected as the SSCLs. Site or area-specific background levels were chosen because it is not necessary to remediate soils, groundwater, or surface water to a level that is lower than the background concentration.

8.0 REMEDIAL ACTION OBJECTIVES

DEQ established remedial action objectives (RAOs) for each contaminated medium. RAOs are general descriptions of what the remediation must accomplish in order to protect public health, safety, and welfare and the environment against unacceptable risk identified in the BERA and HHRA, consistent with reasonably anticipated future land use, background concentrations, and beneficial use of groundwater. Using the RAOs, DEQ identified and screened remedial alternatives that will achieve protection of public health, safety, and welfare and the environment consistent with reasonably anticipated future land use, background concentrations, and beneficial use of groundwater.

8.1 MINE WASTE, TAILINGS, SOIL AND SEDIMENT

The RAOs for solid media (mine waste, tailings, soil, and sediment) include:

- Prevent exposure of humans to COCs in solid media at concentrations greater than SSCLs.
- Prevent exposure of ecological receptors to COCs in solid media at concentrations greater than SSCLs.
- Reduce ecological risks to levels that will result in the recovery and maintenance of healthy local populations and communities of plants and animals.
- Prevent migration of COCs from solid media to groundwater and surface water that would result in exceedances of SSCLs.
- Meet SSCLs for COCs in soil and sediment.
- Comply with ERCLs.

8.2 GROUNDWATER AND SURFACE WATER

The RAOs for water media (surface and groundwater) include:

- Meet groundwater and surface water SSCLs for COCs.
- Reduce potential future migration of contaminated groundwater.
- Prevent exposure of humans or ecological receptors to COCs in groundwater or surface water at concentrations greater than SSCLs.
- Comply with ERCLs.

9.0 DESCRIPTION OF FS ALTERNATIVES

The FS (Pioneer, 2016) describes the alternatives evaluated to cleanup soil and sediment, groundwater, and surface water at the UBMC. Section 9.0 summarizes the alternatives evaluated in the FS. These alternatives are summarized and evaluated in the following sections using the remedy selection criteria provided in Section 75-10-721, MCA:

> **Protectiveness** Overall protection of public health, safety, and welfare and the environment addresses whether an alternative provides adequate protection in both the short-term and the long-term from unacceptable risks posed by hazardous or deleterious substances by eliminating, reducing, or controlling exposure to protective levels.
>
> **Compliance with ERCLs** This criterion evaluates whether each alternative will meet applicable or relevant state and federal ERCLs. Preliminary ERCLs are included in the FS (Pioneer, 2016). Final ERCLs are identified and located in Appendix A.
>
> **Mitigation of Risk** This criterion evaluates mitigation of exposure to risks to public health, safety, and welfare and the environment to acceptable levels.
>
> **Effectiveness and Reliability** Each alternative is evaluated, in the short-term and the long-term, based on whether acceptable risk levels are maintained and further releases are prevented.
>
> **Practicability and Implementability** Under this criterion, alternatives are evaluated with respect to whether the technology and approach could be applied at the UBMC.
>
> **Treatment or Resource Recovery Technologies** This criterion addresses use of treatment technologies or resource recovery technologies, if practicable, giving due consideration to engineering controls. These technologies are generally preferred to simple disposal options.
>
> **Cost Effectiveness** Cost effectiveness is evaluated through an analysis of incremental costs and incremental risk reduction and other benefits of the alternatives considered. This analysis includes taking into account the total anticipated short-term and long-term costs, including operation and maintenance (O&M) activities.

The first two criteria, protectiveness and compliance with ERCLs, are threshold criteria that must be met in order for DEQ to select a remedy. The next five criteria are balancing criteria that DEQ evaluated to obtain the best balance in selecting the remedy. These criteria also consider present and reasonably anticipated future uses of the UBMC as well as ICs. In addition to these criteria, DEQ considered the acceptability of the preferred alternative to the affected community, as indicated by community members and local government, during the public comment period on the Proposed Plan.

The cost estimate for each alternative evaluated in the FS was based on present worth estimates of capital and O&M costs for a specific time period. The costs were developed using environmental costing software and vendor information. The types of costs that were assessed include the following:

- Capital costs, including both direct and indirect costs
- Annual O&M costs, including long-term effectiveness monitoring cost
- Periodic costs

- Implementation of ICs
- Net present worth of capital, O&M costs, periodic costs, and implementation of ICs

Detailed cost estimates for each alternative are included in the FS and the costs are summarized in Appendix C (Table C-1). The FS cost estimates include both federal and non-federal lands not already addressed in the USFS Action Memorandum, as amended, at the UBMC. However, the ROD contains only the cost for the selected remedy on non-federal lands.

When groundwater modeling predictions or experience related to a specific alternative was available, that information was considered in estimating cleanup timeframes and is discussed in each alternative description below. The cost estimates are based on the assumption that the alternatives will meet the estimated cleanup timeframes and these are preliminary estimates only. They are used to ensure that the costs of each alternative are compared and evaluated based upon consistent information. Actual costs and cleanup timeframes may vary and cost estimates will be further refined during remedial design.

Two of the alternatives originally retained for consideration in the FS were not considered for further analysis:

- Physical Hazards/Solid Media – Ex situ Treatment - Blending and Co-Disposal. Initially this alternative was considered most applicable as a design consideration for the blending of waste within an onsite or offsite repository (Pioneer, 2013). However, further analysis of this alternative indicated that there were no locations where it would be advantageous to blend and co-dispose of wastes (Pioneer, 2016).
- Groundwater/Surface Water – Engineering Controls – Detention. This alternative would involve temporarily storing water in a pond and releasing it slowly, with the goal of removing suspended sediment to improve water quality. Further analysis of this alternative suggested that, for groundwater, this technology would offer no benefit for water quality since there is no effect on dissolved COCs. For small surface water flows (i.e., adit discharges) it would not be desirable to release the flow downstream from a detention area. For larger surface water flows (i.e., streams) the size of a pond required to offer any benefit to water quality would not fit within the UBMC topographic constraints. Therefore, there were no locations where it would be advantageous to use detention (Pioneer, 2016).

9.1 FS ALTERNATIVES EVALUATION

EUs, as discussed in Section 2.3, were combined into five EAs to streamline the development of remedial action alternatives in the FS. DEQ's final remedy reflects only the actions and costs associated with non-federal land and is further described in Section 11. Also, as discussed earlier, EU2 and EU11 are within the USFS Action Memorandum, as amended, and, therefore, the USFS has already selected the remedy for those areas and they are not evaluated further here. EU10, portions of EU 5 and EU 7, and several abandoned mine features are on federal land and the USFS will select the remedy for those areas. Again, the EAs and the affected media are:

- EA 1 – Upland Waste Areas (soil associated with specific EUs)
- EA 2 – Groundwater (adit discharge and groundwater associated with specific EUs)
- EA 3 – Streams (sediment and surface water associated with specific drainages, also includes three mining-related features and the Paymaster adit)

- EA 4 – Upper Marsh (sediment, surface water, and groundwater)
- EA 5 – Mining-related Features (physical hazards and soil)

9.2 SITE-WIDE ELEMENTS

In the FS, all remedial alternatives, except No Action, have common elements. These common elements are described here and are not repeated in the description of alternatives that follow. These include:

- ICs – Deed Restrictions, Easements, Covenants, Reservations or a Controlled Groundwater Area
- Engineering Controls
- Long-term Monitoring and Maintenance

ICs – Deed Restrictions, Easements, Covenants, Reservations or a Controlled Groundwater Area

ICs are defined in Section 75-10-701(11), MCA, as restrictions placed upon real property to mitigate the risk to public health, safety and welfare, and the environment. They include such things as: a) deed restrictions; b) easements; c) reservations; d) covenants, either restrictive or affirmative; and e) other mechanisms or restrictions for controlling present and future land use, such as a controlled groundwater area. ICs do not remediate the contamination, but can be effective for managing human exposure to contaminants. The effectiveness of ICs depends on the mechanism used and the durability of the IC. ICs may be layered to improve effectiveness. They are considered easy to implement and inexpensive to implement and maintain, although long-term enforcement may increase costs. At the UBMC, ICs could include a restrictive covenant prohibiting residential use, limiting groundwater use until it meets SSCLs, or prohibiting excavation in areas of capped or contained waste. It could also include a controlled groundwater area limiting groundwater use until it meets SSCLs.

For purposes of the FS, the estimated cost of implementing an IC was approximately $5,000, including attorney and filing fees, and it assumed that five ICs will be necessary for a total cost of $25,000. This estimate does not include the cost of enforcing violations of the IC, reporting compliance with ICs, or the cost of additional remediation that may be necessitated by a violation of an IC.

Engineering Controls

Engineering controls are measures that help manage environmental and health risks by reducing contamination levels or limiting exposure pathways. Engineering controls encompass a variety of engineered remedies such as fencing to contain and/or reduce exposure to contamination and/or physical barriers intended to limit access to property. Although engineering controls do nothing to remediate the contamination, they can be effective for managing exposure to contaminants. The effectiveness of engineering controls depends on the mechanisms used and the durability of the engineering control. The initial cost of some engineering controls can be high, and generally engineering controls require some long-term maintenance. Engineering controls at the UBMC may include access restrictions such as the installation of fencing, gates, and posting of signage.

Fencing and gates provide some short-term protection from unacceptable risks for public health and safety by limiting physical access to contaminated soil or physical hazards, such as subsidence. Protection would depend on the durability of the control and compliance from the general public, regular monitoring, and maintenance. Access restrictions would be most effective for areas with contaminated solid media. Fencing and signage is less effective for surface water due to the dynamic nature of the streams and difficulty in fencing a floodplain.

For purposes of the FS, the estimated cost of the engineering controls was $507,514.

Long-term Monitoring and Maintenance

Monitoring is a common element to all remedial alternatives except No Action. However, the monitoring requirements may vary for each remedial alternative. The general objectives of monitoring are to evaluate the effectiveness of the remedy, to determine when SSCLs are achieved, and to ensure the ongoing protection of public health, safety and welfare and of the environment. Long-term monitoring has two key components: long-term monitoring and performance monitoring. Long-term monitoring is independent of remedial alternatives and is used to evaluate the nature and extent of the groundwater plumes. Performance monitoring is specific to individual remedial alternatives and is used to evaluate the effectiveness of the remedy. Details of the required long-term monitoring will be developed after the ROD is issued.

At present, a long-term monitoring program for the UBMC includes semiannual sampling of an existing groundwater monitoring well network of seven wells and inspections at the Paymaster and Carbonate Repositories (which include but are not limited to vegetative cover and integrity inspections). The long-term monitoring program will also include semiannual sampling of an existing groundwater monitoring well network of four wells and inspection of the UBMC Repository. Other performance monitoring costs are included in the costs of the individual remedies.

For purposes of the FS, the estimated cost of long-term monitoring and maintenance was $1,979,427.

Costs associated with these common elements are provided in Appendix C, Table C-1. The net present value for the site-wide elements is $2,511,941.

9.3 REMEDIAL ALTERNATIVES

In the FS, the remedial alternatives were evaluated by solid media (which includes soil, sediment, and physical hazards) and liquid media (which includes groundwater and surface water). The FS included an initial screening of alternatives, which included an analysis of known alternatives for each media (Pioneer, 2013). As part of the FS, remedial alternatives that could reasonably be expected to work at the UBMC were evaluated. Additional screening of these alternatives in the FS resulted in further evaluation of one baseline alternative (no action) that may be applied to both solid and liquid media, seven alternatives for solid media, and seven alternatives for liquid media, which include:

Solid Media and Liquid Media:

- Alternative 1: No Action

Solid Media:

- Alternative 2: Monitored Natural Recovery (MNR)
- Alternative 3: Physical Barriers
- Alternative 4: Containment

- Alternative 5: Removal and Onsite Disposal
- Alternative 6: Removal and Offsite Disposal
- Alternative 7: In Situ Neutralization with Alkaline Amendment
- Alternative 8: Ex situ Neutralization with Alkaline Amendment

Liquid Media:

- Alternative 9: Monitored Natural Attenuation (MNA)
- Alternative 10: Containment (Retention Pond)
- Alternative 11: Hydrologic and Hydraulic Control
- Alternative 12: Inundation
- Alternative 13: Active Chemical Reagent
- Alternative 14: Active Physical/Mechanical Treatment
- Alternative 15: Passive Chemical Reagent: Permeable Reactive Barrier (PRB)

These technologies are discussed in detail in the FS and are summarized below.

9.3.1 No Action

Under the no action alternative for both solid and liquid media, all identified contamination remains at the UBMC and continues to impact soil, groundwater and surface water quality, and environmental receptors. This alternative assumes no remediation work would be conducted, no institutional controls implemented, and no engineering controls put in place. Operation of the WTP is discontinued and there is no further monitoring of the existing repositories. Contaminants could become more mobile under hydrological changes such as flood events, changes in the stream channel, or drying of the currently flooded areas due to loss of beaver activity. COCs would remain mobile in the environment with potential accumulations in the food chain.

Protectiveness – This alternative does not provide any protection from unacceptable risks in either the short-term or long-term for human health or the environment. All contaminated media remains in place and SSCLs would continue to be exceeded. Although the saturated conditions that currently exist have reduced the mobility of metals in the marsh, the COCs would continue to be taken up within the food chain and contaminated sediments could be subject to erosion if a large flood occurs or beaver activity is significantly reduced.

Compliance with ERCLs – Since all contamination remains in place under this alternative and taking into account the nature of the contamination, contaminated soil and sediment would continue to impact groundwater and surface water. Groundwater and surface water would not comply with applicable ERCLs and compliance with ERCLs would not be achievable within any timeframe.

Mitigation of Risk – There is no mitigation of exposures to risk under this alternative. SSCLs continue to be exceeded site-wide.

Effectiveness and Reliability – There is no short-term or long-term effectiveness or reliability in maintaining acceptable risk levels under this alternative.

Practicability and Implementability – This alternative could be easily implemented site-wide at the UBMC.

Treatment or Resource Recovery Technologies – This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $0 (Appendix C, Table C-1).

9.3.2 Alternative 2 – Monitored Natural Recovery (Sediments)

MNR is a remedy for contaminated sediment that typically uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment. Under the MNR alternative, contaminated sediments are regularly monitored to track changes in COC concentrations with time after source removal or upstream control actions. MNR relies on the mixing and isolation of contaminants through natural sedimentation processes without active treatment (EPA, 2005) and is applicable to areas within EA 3 (Table 14-3), and EA 4 (Table 14-4). For marsh sediments, present inundated conditions have helped to immobilize the metals; however, the COCs are still being taken up within the food chain and are subject to mobilization under high flow events. Loss of beaver activity could result in dewatering of the inundated areas and result in increased contaminant mobility and availability throughout the Upper Marsh. Although surface water concentrations meet DEQ-7 standards for humans, concentrations upstream of State Highway 279 would continue to exceed standards for aquatic life until natural recovery reduces levels to SSCLs. Performance monitoring of sediment and surface water would be conducted to measure the success of upstream source removals.

Protectiveness – This alternative provides no protection from unacceptable risks in the short-term for public health and safety or welfare or the environment, but may become protective over the long-term. SSCLs will continue to be exceeded within sediment until concentrations decrease through natural recovery processes. The effectiveness of MNR would largely be dependent upon the success of source removal or upstream control actions. Monitoring would be needed to evaluate the effectiveness of this alternative.

Compliance with ERCLs – Under this alternative, contamination remains in place at concentrations exceeding SSCLs and may serve as a continuing source of contamination to groundwater, surface water and other receptors in the short-term. However, combined with successful upstream removal actions, and based on experience at other similar sites such as Silver Bow Creek near Butte, Montana, compliance with surface water ERCLs may be achieved within 30 to 40 years. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination.

Mitigation of Risk – There is little to no immediate mitigation of exposures to risk under this alternative. Contaminants left in place at concentrations exceeding the SSCLs may become more mobile under hydrological changes such as flood events, channel erosion, or dewatering of the currently flooded marsh areas due to loss of beaver activity. COCs would remain mobile within the food chain as well until concentrations are naturally reduced over time. Monitoring could be used to identify areas that have recovered sufficiently.

Effectiveness and Reliability – This alternative by itself is not an effective remedy for limiting human exposure. There is no effectiveness or reliability in protection of the environment, nor protection of human health downstream. This alternative can be effective and reliable when combined with other source control or removal actions.

Practicability and Implementability – This alternative could be easily implemented at the UBMC in areas where adequate upstream source control or removal was performed. Access to the existing monitoring points would remain the same or similar to current conditions. This alternative is practicable and implementable at the UBMC.

Treatment or Resource Recovery Technologies – This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $2,545,823 (Appendix C, Table C-1). .

9.3.3 Alternative 3 – Physical Barriers (Physical Hazards)

Under this alternative, adit openings or related physical safety hazards associated with mining-related features (EA 5) would be closed using a physical barrier to prevent human entry. Installation of a bat gate, plugging with foam or a bulkhead, or backfilling would eliminate the open adit hazard at PC-01. This alternative only addresses the physical safety hazards associated with open adits.

Protectiveness –This alternative is protective of public safety associated with open adits because the openings would be closed to prevent human entry.

Compliance with ERCLs – This alternative only addresses the physical safety hazards associated with open adits. There are no ERCLs applicable to this alternative. The remedy would be designed to ensure adequate revegetation, cover materials, and maintenance of any structures used to prevent entry.

Mitigation of Risk – By eliminating purposeful or accidental access to the adit opening or related physical safety hazards, risks to public safety would be mitigated under this alternative.

Effectiveness and Reliability – This alternative involves proven technology that is effective and reliable in the short- and long-term for eliminating access to open adits or other related physical safety hazards. Adit closure has been used to limit access at other mining-related features at the UBMC and other mining sites with success.

Practicability and Implementability - Adit closure is a standard mining construction practice. A physical barrier could be easily implemented at the PC-01 mining-related feature under this alternative.

Treatment or Resource Recovery Technologies – This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $193,845 ((Appendix C, Table C-1).

9.3.4 Alternative 4 – Containment (Soil and Marsh Sediment)

Under this alternative, solid media (soil and marsh sediment) would be contained by covering with vegetated cover or rock to eliminate risk of direct exposure, reduce sediment migration and limit water infiltration. Containment is applicable to areas within EA 1 (Table 14-1), EA 4 (Table 14-4), and EA 5 (Table 14-5).

Protectiveness – This alternative would eliminate the potential for direct contact with contamination, stabilize the exposed surfaces of waste rock or impacted soil with respect to migration of impacted sediment to surface water, and slow or reduce the infiltration of precipitation. This alternative would significantly reduce direct exposure to contamination and would reduce to some extent the leaching of contamination to groundwater. However, it may not be protective of human health and the environment in the short-term and long-term by itself because contamination would remain in place at concentrations exceeding soil leaching to groundwater SSCLs and could serve as a continued source of contamination to groundwater.

Compliance with ERCLs - Under this alternative, contamination remains in place at concentrations exceeding protection of groundwater SSCLs and may serve as a continuing source to groundwater. Depending on conditions at the source area, groundwater and surface water may not achieve applicable ERCLs within any timeframe due to a fluctuating groundwater table or other continuing migration of contamination. In areas where waste is not in contact with surface water or groundwater, compliance with surface water and groundwater ERCLs may be achieved within 30 to 40 years, due to the reduction in infiltration provided, based on experience at other similar sites such as Silver Bow Creek near Butte, Montana. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination. The remedy would be designed to ensure adequate revegetation and cover material that meets reclamation ERCLs.

Mitigation of Risk – Containment provides some mitigation of the risks to human health and the environment. While the risk posed by direct contact with the contamination may be reduced, contamination left in place at concentrations exceeding the soil leaching to groundwater SSCLs may continue to leach to groundwater, and therefore this alternative does not adequately mitigate risk to human health and the environment.

Effectiveness and Reliability – This alternative provides adequate short-term effectiveness and reliability in limiting contact with contamination. Short-term water quality impacts to the surrounding environment could occur at those sites where construction of roads or re-grading of waste occurs close to surface water. Construction best management practices (BMPs) would be employed to effectively reduce adverse short-term impacts on surface water from the construction activities. Containment may be susceptible to weathering and erosion, reducing the long-term effectiveness and reliability of the cover. O&M would be required to maintain the integrity of the cover.

Practicability and Implementability – The grading, placement of soil or cover, and revegetation steps required for containment are considered standard and conventional construction practices. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally. This alternative is practicable and implementable at the UBMC

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $16,064,459 (Appendix C, Table C-1).

9.3.5 Alternative 5 – Removal and Onsite Disposal (Soil and Sediment)

Under this alternative all solid media (soil and sediment) exceeding the SSCLs would be removed, transported, and disposed of at an engineered onsite repository. Removal is applicable to areas within EA 1 (Table 14-1), EA 3 (Table 14-3), EA 4 (Table 14-4), and EA 5 (Table 14-5).

Protectiveness – The removal and disposal of contaminated solid media would eliminate the waste sources and provide protectiveness for human health and the environment. In areas of impacted groundwater and/or surface water, this alternative would eliminate the continuing source, allowing groundwater and/or surface water quality to improve. Removal of marsh sediments will require disturbance of large areas of the sensitive wetland ecosystem.

Compliance with ERCLs – Since the contamination exceeding the SSCLs is removed, there is no continuing waste source that could impact groundwater and surface water. Therefore, in areas where groundwater and surface water standards are currently met, this alternative would achieve ERCLs immediately. In locations of impacted groundwater and/or surface water, compliance with surface water and groundwater ERCLs may be achieved within 30 to 40 years, when combined other alternatives, based on experience at other similar sites such as Silver Bow Creek near Butte, Montana. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination. In addition, the repository would be sited in an area that complies with ERCLs and would be designed and constructed to comply with solid waste ERCLs, including a minimum of 24 inches of cover material. The remedy would be designed to ensure adequate revegetation and cover material that meets relevant reclamation ERCLs.

Mitigation of Risk - Removal and proper disposal of contamination at concentrations exceeding the SSCLs provides mitigation of the risks to human health and the environment.

Effectiveness and Reliability – This alternative is considered highly effective and reliable in both the short-term and long-term. Short-term water quality impacts to the surrounding environment could occur at those sites where construction of roads and excavation of waste occurs close to surface water or in the marsh. Construction BMPs would be employed to effectively reduce adverse short-term impacts on surface water and the marsh from the construction activities.

Practicability and Implementability – The excavation and disposal of wastes and revegetation steps required for removal are considered standard and conventional construction practices. Construction and reclamation of upland wastes and mining-related features could be difficult in some locations at the UBMC because of the steep terrain, remoteness, and inadequate access, and special equipment may be required. Removal of sediment in the marsh and streams is dependent upon dewatering operations and access into wet or saturated areas. Mike Horse Creek Road and an abandoned drill testing road provide the only serviceable access to the Upper Marsh. Certain stream reaches are difficult to access because of steep terrain, remoteness, and inadequate roads in these areas. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally. While this alternative is practicable and implementable at the UBMC, removal would be difficult in certain locations for the reasons stated.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness - The cost estimate assumed that the onsite disposal location is the UBMC (Section 35) repository since the USFS already selected the Section 35 repository in its Action Memorandum, as amended, and that repository has been constructed. Since the USFS already selected that repository and it is currently being constructed under the Action Memorandum, as amended, costs associated with construction of the repository were not included with the onsite repository estimates. For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $23,436,794 (Appendix C, Table C-1).

9.3.6 Alternative 6 – Removal and Offsite Disposal (Soil and Sediment)

Under this alternative all solid media (soil and sediment) exceeding the SSCLs would be removed, transported, and disposed of at an engineered offsite repository. Removal is applicable to areas within EA 1 (Table 14-1), EA 3 (Table 14-3), EA 4 (Table 14-4), and EA 5 (Table 14-5).

Protectiveness –The removal and disposal of contaminated solid media would eliminate the waste sources and provide protectiveness for human health and the environment. In areas of impacted groundwater and/or surface water, this alternative would eliminate the continuing source of contamination, allowing groundwater and/or surface water quality to improve. Removal of marsh sediments will require disturbance of large areas of the sensitive wetland ecosystem.

Compliance with ERCLs – Since the contamination exceeding the SSCLs is removed, there is no continuing waste source that could impact groundwater and surface water. Therefore, in areas where groundwater and surface water standards are currently met, this alternative would achieve ERCLs immediately. In locations of impacted groundwater and/or surface water, compliance with surface water and groundwater ERCLs may be achieved within 30 to 40 years, when combined other alternatives, based on experience at other similar sites such as Silver Bow Creek near Butte, Montana. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination. In addition, the repository would be sited in an area that complies with ERCLs and would be designed and constructed to comply with solid waste ERCLs, including a minimum of 24 inches of cover material. The remedy would be designed to ensure adequate revegetation and cover material that meets relevant reclamation ERCLs.

Mitigation of Risk - Removal and proper disposal of contamination at concentrations exceeding the SSCLs provides mitigation of the risks to human health and the environment.

Effectiveness and Reliability – This alternative is considered highly effective and reliable in both the short-term and long-term. Short-term water quality impacts to the surrounding environment could occur at those sites where construction of roads and excavation of waste occurs close to surface water or in the marsh. Construction BMPs would be employed to effectively reduce adverse short-term impacts on surface water and the marsh from the construction activities.

Practicability and Implementability – The excavation and disposal of wastes and revegetation steps required for removal are considered standard and conventional construction practices. Construction and reclamation of upland wastes and mining-related features could be difficult in some locations at the UBMC because of the steep terrain, remoteness and inadequate access, and special equipment may be required. Removal of sediment in the marsh and streams is dependent upon dewatering operations and access into wet or saturated areas. Mike Horse Creek Road and an abandoned drill testing road provide the only serviceable access to the Upper Marsh. Certain stream reaches are difficult to access because of steep terrain, remoteness, and inadequate roads in these areas. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally. While this alternative is practicable and implementable at the UBMC, removal would be difficult in certain locations for the reasons stated.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness - The cost estimate assumed that the offsite repository location was the State Section 18 site. This site was selected to represent the offsite repository location because it was the nearest, potentially suitable state-owned property (Pioneer, 2011). For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $29,625,091 (Appendix C, Table C-1).

9.3.7 Alternative 7 – In Situ Neutralization with Alkaline Amendment (Soil)

Under this alternative, all solid media exceeding the SSCLs would remain in place, but the pH of the soil would be increased through the application of lime, and the mobility and bio-availability of metals within the soil reduced. Concentrations of metals in the soil are unchanged. In situ neutralization is applicable to waste deposits less than two feet in thickness, or treatment of residual soil contamination in previously reclaimed areas within EA 1 (Table 14-1) and EA 5 (Table 14-5).

Protectiveness – This alternative can be protective for human health and the environment by reducing the bioavailability of the metals to environmental receptors. While this alternative would reduce the leaching of contamination to groundwater, it may not be protective of human health and the environment in the short-term and long-term by itself because contamination would remain in place at concentrations exceeding soil leaching to groundwater SSCLs.

Compliance with ERCLs - Under this alternative, contamination remains in place at concentrations exceeding soil leaching to groundwater SSCLs. In areas of impacted groundwater or surface water, compliance with surface water and groundwater ERCLs may be achieved within 30 to 40 years, when combined with other alternatives, based on experience at other similar sites such as Silver Bow Creek near Butte, Montana. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination below the treatment zone. The remedy would be designed to ensure adequate revegetation and cover material that meets relevant reclamation ERCLs.

Mitigation of Risk – In situ neutralization provides some mitigation of the risks to human health and the environment. While the risk posed by direct contact with the contamination may be reduced, contamination would be left in place at concentrations exceeding the soil leaching to groundwater SSCLs, and therefore this alternative does not adequately mitigate risk to human health and the environment.

Effectiveness and Reliability - This alternative provides adequate short-term effectiveness and reliability in limiting contact with contamination and reduces leaching to groundwater. Short-term water quality impacts to the surrounding environment could occur at those sites where construction of roads, re-grading of waste, and treatment occurs close to surface water. Construction BMPs would be employed to effectively reduce adverse short-term impacts on surface water from the construction activities.

Practicability and Implementability - The grading, lime incorporation and revegetation steps required for in situ neutralization are considered standard and conventional construction practices. Construction may be moderately difficult because of the steep terrain and remoteness of some locations and may require special equipment. Incorporation of lime requires specialized equipment and expertise and will require additional sampling and investigation to determine proper liming rates at each location. A suitable offsite source of lime is required and will involve hauling of this material on public roads. This alternative is practicable and implementable at the UBMC to waste deposits less than two feet in thickness, or treatment of residual soil contamination in previously reclaimed areas. While this alternative is practicable and implementable at the UBMC, neutralization would be difficult in certain locations for the reasons stated. This technology was used during interim remedial actions at the UBMC, in combination with containment.

Treatment or Resource Recovery Technologies - This alternative relies on the treatment technology of alkaline amendment of soil, which raises the pH of the amended material, thus reducing the mobility of the metals.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $4,311,101 (Appendix C, Table C-1).

9.3.8 Alternative 8 – Ex Situ Neutralization with Alkaline Amendment (Soil)

Under this alternative, all soil exceeding the SSCLs would be excavated, mixed with lime, and returned to the original excavation site. Ex situ neutralization is applicable to areas within EA 1 (Table 14-1) and EA 5 (Table 14-5).

Protectiveness – This alternative can be protective of human health and the environment by reducing the bioavailability of the metals to environmental receptors. While this alternative would reduce the leaching of contamination to groundwater, it may not be protective of human health and the environment in the short-term and long-term by itself because the contamination would remain in place at concentrations exceeding soil leaching to groundwater SSCLs.

Compliance with ERCLs - Under this alternative, contamination remains in place at concentrations exceeding soil leaching to groundwater SSCLs. In areas of impacted groundwater or surface water, compliance with surface water and groundwater ERCLs may be achieved within 30 to 40 years, when combined other alternatives. Although not used at similar sites such as Silver Bow Creek near Butte, Montana, the technology supporting this alternative is the same as in situ neutralization and similar results in achieving ERCLs are expected. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination. The remedy would be designed to ensure adequate revegetation and cover material that meets relevant reclamation ERCLs.

Mitigation of Risk – Ex situ neutralization provides some mitigation of the risks to human health and the environment. While the risk posed by direct contact with the contamination may be reduced, contamination would be left in place at concentrations exceeding the soil leaching to groundwater SSCLs, and therefore this alternative does not adequately mitigate risk to human health and the environment.

Effectiveness and Reliability - This alternative provides some short-term effectiveness and reliability in reducing leaching to groundwater. Short-term water quality impacts to the surrounding environment could occur at those sites where construction of roads, excavating, mixing, and handling of waste occurs close to surface water. Construction BMPs would be employed to effectively reduce adverse short-term impacts on surface water from the construction activities. This alternative may be more effective when combined with other alternatives.

Practicability and Implementability - The excavation, lime incorporation, mixing, replacing, and revegetation steps required for ex situ neutralization are considered standard and conventional construction practices. Construction may be moderately difficult because of the steep terrain and remoteness of some locations and may require special equipment. Incorporation of lime requires specialized equipment and expertise and will require additional sampling and investigation to determine proper liming rates at each location. A suitable source of lime is required and will involve hauling of this material on public roads. This alternative is practicable and implementable at the UBMC to large areas of previous interim actions that exceed SSCLs. In small areas were treatment cannot be contained within the footprint of the identified area exceeding SSCLs, removal of waste and mixing of lime may possibly impact surrounding areas, increasing the volume of material requiring treatment. In larger areas, removal and mixing could be performed within the footprint of the identified area exceeding SSCLs, minimizing impacts.

Treatment or Resource Recovery Technologies - This alternative relies on the treatment technology of alkaline amendment of soil, which raises the pH of the amended material, thus reducing the mobility of the metals.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $2,317,210 (Appendix C, Table C-1).

9.3.9 Alternative 9 – Monitored Natural Attenuation (Groundwater)

Under the MNA alternative, groundwater is regularly monitored to track changes in COC concentrations with time after source removal. MNA relies on dilution, sorption, and/or dispersion without active treatment and is applicable to areas within EA 2 (Table 14-2) and EA 4 (Table 14-4). The site-wide monitoring element tracks the overall effectiveness of remediation and does not include the monitoring for MNA at specific locations that may vary with time depending on the success of source removal and other site-specific factors. For purposes of developing cost estimates, it was assumed that MNA monitoring would include the existing wells at each of the groundwater locations plus an additional five wells. MNA monitoring would last for approximately 30 years. The monitoring would begin on a semi-annual basis and continue for 10 years. It would finish with annual monitoring for the final 20 years. Monitoring for this alternative could be effectively combined with the site-wide long-term monitoring to reduce costs.

Protectiveness -This alternative provides no protection from unacceptable risks in the short-term for human health or the environment. When combined with other alternatives, it can provide long-term protection for public health, safety, and welfare and the environment, although it is a slow natural process. The effectiveness of MNA would largely be dependent on the success of source removal or control actions.

Compliance with ERCLs - Based on experience at other similar sites such as Silver Bow Creek in Butte, Montana, compliance with groundwater ERCLs through natural attenuation may be achieved within 30 to 40 years, when combined with source removal. This timeframe could vary due to a fluctuating groundwater table or other continuing migration of contamination. However, based on this experience and engineering judgment, and depending on conditions at the source area and successful removal of source materials, compliance with applicable ERCLs for groundwater may not be achieved for 50 years at certain areas of the facility due to mineralized geology in the bedrock aquifer, presence of mine workings, a fluctuating groundwater table or other continuing migration of contamination. Natural attenuation processes, in association with source removal, will act to reduce mass, toxicity, mobility, volume, or concentrations of COCs in groundwater.

Mitigation of Risk - There is little to no immediate mitigation of exposures to risk under this alternative alone. Contaminated groundwater remains in place, untreated, and may continue to migrate offsite. Depending on subsurface geology and geochemistry, the mechanisms for reducing concentrations of the inorganic COCs are complex and difficult to predict with any certainty.

Effectiveness and Reliability – This alternative by itself is not an effective remedy for limiting human exposure. There is no effectiveness or reliability in protection of the environment, or protection of human health at or downgradient of contaminated groundwater. This alternative can be effective and reliable when combined with other source control or removal actions.

Practicability and Implementability - This alternative could be easily implemented at the UBMC. Access to the existing monitoring points would remain the same or similar to current conditions. This alternative is practicable and implementable at the UBMC.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $2,311,332 (Appendix C, Table C-1).

9.3.10 Alternative 10 – Containment (Retention Pond – Seeps and Springs)

Under the containment (retention pond) alternative, seeps and springs (surface water) associated with certain mining-related features would be captured and stored in a retention pond. Retention relies on evaporation and infiltration without active treatment and is applicable to mining-related features areas within EA 3 (Table 14-3) because of the limited volume of contaminated water associated with the mining-related features. It would not apply to contaminated streams and rivers because the volume of contaminated water is too great and the space to construct a retention pond to contain large volumes of water is limited.

Protectiveness - This alternative would provide a means of containing impacted surface water and preventing migration beyond the area of the retention pond. This alternative would significantly reduce direct exposure to contamination downstream of the retention pond. However, it may not be protective of human health and the environment in the short-term and long-term by itself because contamination would remain in place at concentrations exceeding SSCLs and could serve as a source of exposure to human health and the environment in the retention area.

Compliance with ERCLs – Under this alternative, contamination remains in place at concentrations exceeding SSCLs. Depending on conditions at the source area, surface water from the source area (e.g., seep or adit discharge) and the retention pond may not achieve applicable ERCLs because of continuing inputs of contamination. Based on engineering judgment and review of guidance from the "National Menu of Stormwater Best Management Practices" (EPA, 2015), surface water downstream of the retention pond may comply with ERCLs following implementation of the remedy in combination with other alternatives, such as upstream source removal and natural attenuation.

Mitigation of Risk – Exposures to risk in the vicinity of the surface water discharge would not be mitigated by retention as the water at concentrations exceeding the SSCLs may remain on the surface and become concentrated within the retention pond. Downstream of the pond, however, risk exposure would be mitigated through the containment of the contaminated seep or spring (surface water).

Effectiveness and Reliability – Containment of water in a retention pond will reduce the extent of impacts causing human and ecological exposure to the contaminants. Retention must retain the entire volume of water to be effective, and therefore higher flow rates require larger areas. Retention ponds may be susceptible to erosion and other damage, reducing the long-term effectiveness and reliability of the alternative. O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.

Practicability and Implementability –The excavation, filling, lining, grading, and revegetation steps required to construct a retention basin are considered standard and conventional construction practices. Construction at some of the mining-related features could be difficult in some locations at the UBMC because of the steep terrain, remoteness and inadequate access, and special equipment may be required. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally. While this alternative is practicable and implementable at the UBMC, retention would be difficult in certain locations for the reasons stated.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness - For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $1,116,380 (Appendix C, Table C-1).

9.3.11 Alternative 11 – Hydrologic and Hydraulic Control (Groundwater and Surface Water)

Under this alternative, clean upgradient groundwater and surface water at the Carbonate Mine site (EA 2; Table 14-2) would be captured and diverted around the waste removal area. While this alternative would reduce the quantity of groundwater impacted by metals, it would not reduce the quantity of metals leaving the Carbonate Mine site, and therefore is not anticipated to reduce the impact of the Carbonate Mine site on downgradient groundwater and surface water quality. If used in conjunction with other alternatives, this alternative could reduce the volume of contaminated water requiring treatment, thereby reducing long-term costs.

Protectiveness – This alternative would not significantly reduce the contribution of metals from the Carbonate Mine site and does not provide protectiveness for the short-term and long-term for human health or the environment. Protectiveness may be met if combined with other alternatives.

Compliance with ERCLs –Since mine workings would continue to generate groundwater with concentrations exceeding SSCLs that would continue to migrate downgradient of the Carbonate Mine site, contaminant sources to groundwater would remain in place. With this alternative alone, it is reasonable to assume compliance with groundwater ERCLs will not be achievable in any timeframe in downgradient groundwater based on engineering judgment. However, when combined with other treatment alternatives, such as a PRB at the Carbonate site, compliance with ERCLs for downgradient groundwater would be achievable following implementation of the PRB within five to ten years.

Mitigation of Risk - There is no mitigation of exposures to risk to human health and the environment under this alternative.

Effectiveness and Reliability – This alternative does not reduce contamination and has no short-term and long-term effectiveness or reliability in maintaining acceptable risk levels for exposure risks to groundwater exceeding SSCLs. In conjunction with passive or active treatment with chemical reagent, this alternative could provide a significant increase in effectiveness and reliability by reducing the quantity of groundwater that would need to be treated. O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.

Practicability and Implementability – The capture and diversion of water are considered standard and conventional construction practices. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally. This alternative is practicable and implementable at the UBMC.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $464,514 (Appendix C, Table C-1).

9.3.12 Alternative 12 – Inundation (Groundwater in Mine Workings)

Under this alternative, an inundation control (bulkhead/wet mine seal or plug) is installed to raise the water level within the mine workings to reduce acid mine drainage through the reduction of oxygen available to the ore body.

Protectiveness – This alternative would eliminate the potential for direct contact with contamination at the adit and is protective of human health and the environment in the short-term and long-term. The increased hydraulic head behind the plug may cause groundwater to create new seeps or increase groundwater gradients in the area, which may create additional O&M requirements such as retention basins.

Compliance with ERCLs - Under this alternative, potentially impacted groundwater remains within the mine workings. Groundwater that exceeds SSCLs would not be remediated although it would be contained, assuming no seeps occurred as a result of increased hydraulic head behind the plug.

Mitigation of Risk – Inundation of an adit with discharge concentrations exceeding the SSCLs provides complete mitigation of the risks to human health and the environment related to the adit discharge. Continued risk may be present if new uncontrolled seeps develop.

Effectiveness and Reliability – This alternative is considered highly effective and reliable in both the short-term and long-term when installed and maintained properly. The alternative can be very effective if combined with water collection and treatment alternatives. O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.

Practicability and Implementability – The sealing of an adit and resultant inundation are considered standard and conventional mining practices. This alternative is practicable and implementable at the UBMC. Adit sealing and inundation has been used at other locations within the UBMC with success.

Treatment or Resource Recovery Technologies - This alternative does not rely on treatment or resource recovery technologies.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $10,124 (Appendix C, Table C-1).

9.3.13 Alternative 13 – Active Chemical Reagent (Groundwater)

This alternative involves adding a neutralizing agent, such as lime (calcium oxide or calcium hydroxide) to impacted water, followed by a settling pond for metals precipitation. The addition of sodium hydroxide or calcium hydroxide directly to water promotes the precipitation of metal hydroxides, thus reducing the amount of metals in the water. This alternative is applicable to the groundwater areas listed in EA 2 (Table 14-2). The process is being used as part of the existing WTP system and when combined with ceramic microfiltration has proven effective. By itself, the alternative will not effectively remediate COCs to SSCLs. Because of the complexity and unknowns associated with the underground workings at the Carbonate, Paymaster, and Upper Mike Horse bedrock aquifer sites, it may not be feasible to capture all of the groundwater at each of these sites. Additional data collection and bench-scale tests would be necessary as part of remedial design.

Implementation of the alternative requires a capture and conveyance system to either a common treatment plant for all sources, or to individual treatment plants. For the purpose of developing costs, it was assumed that waters would be conveyed to the WTP for treatment and the WTP would be expanded accordingly to accommodate the increased flows. There is currently a capture and conveyance system in place for the Mike Horse adit discharge and seep water and for the Anaconda adit water. A new capture and conveyance system would be required at the Carbonate, Paymaster, and Upper Mike Horse bedrock aquifer sites. At each of these sites, the system would involve an interception trench and/or series of wells to capture the water, and a pumping station and pipeline to convey flows to the WTP. Design of the capture systems would require the collection of additional data on the aquifer properties (e.g., extent of contamination geology, hydraulic conductivity).

<u>Protectiveness</u> – This alternative by itself is not protective of human health and the environment because contamination would remain in place at concentrations exceeding SSCLs. However, if combined with other alternatives, active chemical reagent could provide protection from elevated metals within groundwater migrating offsite. A combination of the alternatives would minimize exposure risks for metals within downgradient groundwater and surface water for the short-term and long-term for public health, safety or welfare or the environment.

<u>Compliance with ERCLs</u> - Under this alternative, groundwater would be intercepted and treated at a centralized location. Contaminated groundwater exceeding SSCLs would remain at each location prior to interception and without removal of the contamination source, would not comply with ERCLs within any timeframe based on engineering judgment. Compliance with ERCLs may be achieved at the outflow of the WTP when combined with other active treatment alternatives based on the operation of the existing WTP.

<u>Mitigation of Risk</u> – There would be no mitigation of risk from exposure to contaminated groundwater with this alternative, but if combined with other alternatives, some mitigation of risk may be achieved.

<u>Effectiveness and Reliability</u> – Because this alternative by itself would not remove COCs to standards, it is not effective or reliable in either the short-term or long-term, unless combined with active physical/mechanical treatment. This alternative, combined with ceramic microfiltration, has proven to be effective and reliable at the existing WTP. O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.

<u>Practicability and Implementability</u> – This alternative has proven practicable and implementable for the Anaconda Adit water and the Mike Horse Adit discharge and seep water. Because of the complexity and unknowns associated with the underground workings at the Carbonate, Paymaster, and Upper Mike Horse bedrock aquifer, it is likely not feasible to capture all of the groundwater at each of the sites. It is also uncertain whether or not the existing WTP location could accommodate the expansion necessary to treat these waters.

<u>Treatment or Resource Recovery Technologies</u> - This alternative does rely on treatment technologies. The treatment may produce sludges or byproducts that require disposal.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $20,394,855 (Appendix C, Table C-1). Given the current design of the WTP, it is difficult to segregate chemical treatment costs from physical/mechanical treatment costs; therefore, for cost estimation purposes, the overall costs were allocated equally.

9.3.14 Alternative 14 – Active Physical/Mechanical Treatment (Groundwater)

This alternative involves the use of ceramic microfiltration to filter contaminants out of the water by pumping through a ceramic membrane. This alternative is applicable to the groundwater areas listed in EA 2 (Table 14-2). The process is currently being used as part of the existing WTP system and is effective when combined with pretreatment with a chemical reagent. By itself, the alternative will not effectively remove COCs to SSCLs. Determining the effectiveness for groundwater will require additional data collection and bench-scale tests as part of remedial design.

Implementation of the alternative requires a capture and conveyance system to either a common treatment plant for all sources, or to individual treatment plants. For the purpose of developing costs, it was assumed that all waters would be conveyed to the WTP for treatment and the WTP would be expanded accordingly to accommodate the increased flows. There is currently a capture and conveyance system in place for the Mike Horse adit discharge and seep water and for the Anaconda adit water; a new capture and conveyance system would be required at the Carbonate, Paymaster, and Upper Mike Horse bedrock aquifer sites. At each of these locations, the system would involve an interception trench and/or series of wells to capture the water, and a pumping station and pipeline to convey flows to the WTP. Design of the capture systems would require the collection of additional data on the aquifer properties (e.g., extent of contamination, geology, hydraulic conductivity).

Protectiveness – This alternative by itself is not protective of human health and the environment. However, if combined with other alternatives, active physical/mechanical treatment could provide protection in certain areas from elevated metals within groundwater. These actions together would minimize exposure risks for metals within downgradient groundwater and surface water for the short-term and long-term for public health, safety or welfare or the environment.

Compliance with ERCLs - Under this alternative, groundwater would be intercepted and treated at a centralized location. Contaminated groundwater exceeding SSCLs would remain at each location prior to interception and, without removal of the contamination source, would not comply with ERCLs within any timeframe based on engineering judgment. Compliance with ERCLs may be achieved at the outflow of the WTP when combined with other active treatment alternatives based on the operation of the existing WTP.

Mitigation of Risk – There would be no mitigation of risk from exposure to contaminated groundwater with this alternative, but if combined with other alternatives, partial or complete mitigation of risk outside of the source area may be achieved.

Effectiveness and Reliability – Because this alternative by itself would not remove COCs to standards, it is not effective or reliable in either the short-term or long-term, unless combined with active chemical treatment. This alternative, combined with alkaline amendment (active chemical treatment), has proven to be effective and reliable at the existing WTP. O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.

Practicability and Implementability – This alternative has proven practicable and implementable for the Anaconda Adit water and the Mike Horse Adit discharge and seep water. Because of the complexity and unknowns associated with the underground workings, it is likely not feasible to capture all of the groundwater at each of the locations. It is also uncertain whether or not the existing WTP location could accommodate the expansion necessary to treat these waters.

Treatment or Resource Recovery Technologies - This alternative does rely on treatment technologies. The treatment may produce sludges or byproducts that require disposal.

Cost Effectiveness – For purposes of the FS, the estimated total present worth cost for implementing this alternative at the UBMC was $20,394,855 (Appendix C, Table C-1). Given the current design of the WTP, it is difficult to segregate chemical treatment costs from physical treatment costs; therefore, for cost estimation purposes, the overall costs were allocated equally.

9.3.15 Alternative 15 – Passive Chemical Reagent: Permeable Reactive Barrier (Groundwater)

This alternative consists of installing a PRB and cutoff wall to remove metals from contaminated groundwater. This technology is potentially applicable to sites requiring treatment of near-surface groundwater. Treatment of the Upper Mike Horse bedrock aquifer groundwater with this technology is not practicable because of the depth to water and the difficulties in intercepting water in a complex bedrock environment. Therefore, it is potentially applicable to the Anaconda adit discharge, the Carbonate Mine, the Mike Horse adit discharge and seeps, and the Paymaster alluvial aquifer in EA 2 (Table 14-2). Because this alternative requires interception of all contaminated water, the use of this alternative at each of these locations will require additional investigation and data to characterize the extent of contamination, water quality chemistry, and the aquifer properties at each location to maximize effectiveness. The CSM for the Carbonate Mine groundwater suggests that PRB may be a viable alternative at that location if near-surface groundwater requires treatment. During design, further monitoring will need to be performed to determine whether near-surface contaminated groundwater may be emanating from the Carbonate Mine and potentially affecting the Blackfoot River.

Protectiveness – This alternative could provide protection from elevated metals within groundwater migrating beyond the source area and could therefore minimize exposure risks for metals within downgradient groundwater and surface water for the short-term and long-term for human health and the environment.

Compliance with ERCLs – Under this alternative, near-surface contaminated groundwater, if leaving the Carbonate Mine site, may comply with DEQ-7 standards and compliance with ERCLs could be expected to be achieved within five to ten years. The compliance timeframe is based on performance at sites such as the Success Mine and Mill site in Idaho, where a PRB utilizing phosphate-induced metal stabilization successfully reduced concentrations of lead, cadmium, nitrate, and sulfate to below detection levels and lead to near background levels within two years (Conca, 2003). Compliance with ERCLs through implementation of this alternative for the other locations will require additional data to maximize effectiveness of the remedy. It is unlikely that this alternative would meet ERCLs in these areas unless combined with source removal.

Mitigation of Risk – The Carbonate Mine site CSM estimates that there is the potential to contribute enough cadmium to the Blackfoot River during base flow to increase in-stream concentrations to more than twice the applicable DEQ-7 standard. There would be significant mitigation of exposures to risk under this alternative for near-surface contaminated groundwater leaving the Carbonate Mine site because any concentrations of cadmium and other metals in the groundwater leaving the Carbonate Mine site would be significantly reduced. Potential mitigation of risk within the Anaconda adit discharge, the Carbonate Mine, the Mike Horse adit discharge and seeps, and the Paymaster alluvial aquifer is unknown, due to lack of data to characterize the extent of contamination, water quality chemistry, and the aquifer properties at each location to maximize effectiveness.

Effectiveness and Reliability – This alternative could have significant short-term and long-term effectiveness or reliability in maintaining acceptable risk levels for exposure risks to downstream groundwater and surface water at the Carbonate Mine site, should monitoring demonstrate a potential for near-surface contaminated groundwater to affect the Blackfoot River. Effectiveness and reliability for the Anaconda adit discharge, the Carbonate Mine, the Mike Horse adit discharge and seeps, and the Paymaster alluvial aquifer is unknown, due to lack of data to characterize the extent of contamination, water quality chemistry, and the aquifer properties at each location to maximize effectiveness. Because of the complexity and unknowns associated with the underground workings, it is likely not feasible to capture all of the groundwater at each of the sites. Periodic replacement of the PRB substrate will be required to ensure long-term effectiveness.

Practicability and Implementability – PRB is an understood water treatment technology; however, all of the installation equipment may not be locally available. This alternative would require additional site investigations and pilot studies to ensure optimization of the designs.

Treatment or Resource Recovery Technologies - This alternative does rely on the use of PRB, a treatment technology.

Cost Effectiveness – For the purposes of the FS, the estimated total present worth cost for implementation at the UBMC was $7,827,027 (Appendix C, Table C-1).

9.4 SHARED AND DISTINGUISHING FEATURES

9.4.1 ERCLs

Appendix A contains the final list of ERCLs DEQ has identified for the UBMC Facility which must be met during implementation of the final remedy. None of the individual alternatives are expected to meet all applicable or relevant federal and state ERCLs individually. However, various combinations of the alternatives will comply with all ERCLs.

9.4.2 Long-Term Reliability of Remedy

With the exception of Alternative 1 (No Action), Alternatives 2-15 and Site-wide Elements would be reliable in the long-term. Some alternatives would require some form of O&M to maintain the integrity of the remedy and ensure continued performance as designed. Additionally, some alternatives would require institutional controls to help mitigate risk to human health at the UBMC Facility. Institutional controls are considered moderately reliable because they rely on human actions. All technology options being considered in the alternatives are considered reliable over the long term, but each depends upon proper design, implementation, and maintenance.

9.4.3 Estimated Time of Design and Construction

Each component within each alternative could be designed within one year or less and could be constructed within two years or less.

9.4.4 Estimated Time to Reach Cleanup Levels

With the exception of Alternative 5, 6, 13, and 14, cleanup levels would not be met in the short-term or long-term for soil, sediment, surface water, or groundwater under any of the alternatives individually. However, in various combinations, it is possible to meet cleanup levels for soil, sediment, surface water, and groundwater in the long-term at the UBMC Facility. In locations of impacted groundwater, surface water, or sediments compliance with surface water, groundwater, and sediment SSCLs may be achieved within 30 to 40 years, when combined with other alternatives.

9.4.5 Cost

The cost estimate for each alternative is based on estimates of capital costs as well as operation and maintenance costs. These are initial cost estimates only and are subject to further refinement once remedial design is complete. Section 10.7 details the comparison of alternative costs. Table C-1 (Appendix C) details the estimated costs associated with each alternative. A three percent discount rate is used in the cost estimates (Pioneer, 2016).

9.4.6 Use of Presumptive Remedies

A presumptive remedy is a technology that EPA has determined, based upon its experience, generally will be an appropriate remedy for a specified type of site. EPA's presumptive remedy guidance for metals-in-soils is intended to accelerate site-specific analysis of remedies by focusing FS efforts (EPA, 1999). Use of presumptive remedies can reduce the need for site-specific pilot or treatability testing as EPA's identification of presumptive remedies for types of contaminants or sites is based on performance data for other similar sites where the technology was used with successful results. Although the UBMC Facility is being addressed by DEQ under CECRA, DEQ considered the presumptive remedy guidance during the alternatives analysis.

Containment (Alternative 4) is a presumptive remedy for remediation of metals-in-soils and may be appropriate for low-hazard wastes, such as those that do not exhibit leaching potential or are near the applicable SSCL (EPA, 1999). Immobilization (Alternatives 7 and 8) is a presumptive remedy of metals-in-soils and may be appropriate for source materials, soils containing high levels of contaminants, and highly mobile contaminants (EPA, 1999). In addition, pump and treat is a presumptive remedy for contaminated groundwater (EPA, 1996).

9.5 EXPECTED OUTCOMES

Direct contact with contaminated soils exceeding SSCLs is considered a risk to human health and/or ecological receptors. Most contaminated soils will be removed to SSCLs and placed in the UBMC Repository. In EU 8 and the mining-related features, where contaminated soils can't be removed to SSCLs due to safety or accessibility constraints, containment and/or site-wide elements will be used to ensure protectiveness. Where necessary, use will be restricted through the establishment of ICs. SSCLs for direct contact with contaminated subsurface soils are based on a construction worker scenario and apply to EU 9B – Paymaster Mine Waste Area. Due to concerns regarding geochemistry and the potential release of contamination into the groundwater, site-wide elements will be used to ensure protectiveness. In addition to direct contact, DEQ also evaluated soils to identify concentrations in soil that are protective of the soil leaching to groundwater pathway. The soil SSCLs are based upon either site or area-specific background concentrations or leaching-to-groundwater and are not human health risk-based concentrations. Because site or area-specific background levels were higher, in most cases, than the human health risk-based concentrations and the risk-based remedial ecological goals, the site or area-specific background levels were selected as the SSCLs. Site or area-specific background levels were chosen because it is not necessary to remediate soils to a level that is lower than the background concentration.

Direct contact with contaminated sediments exceeding SSCLs is considered a risk to human health and/or ecological receptors. Most contaminated sediments will be removed to SSCLs and placed in the UBMC Repository. In areas with low level SSCL exceedances, MNR will be used in applicable areas until sediments are remediated to SSCLs for all COCs. In ecologically sensitive areas within the Upper Marsh, site-wide elements, including ICs to restrict use, will be used to ensure protectiveness. The current plant community health suggests that these areas continue to thrive. Other conditions, including submersion (reduces metals mobility) and high organic content (binds metals making them less bioavailable), in the fens and forested emergent wetlands also help reduce exposure risk to ecological receptors. Therefore, the protection of these sensitive areas will also protect the flora and fauna that are unique to metals rich environments such as these.

Ingestion and direct contact with contaminated groundwater pose current and future risks to human health. None of the alternatives will allow groundwater to be restored immediately to SSCLs for the COCs. In addition, some groundwater areas have background concentrations that exceed the groundwater SSCLs. These areas will be excluded from remediation because it is not necessary to remediate groundwater to a level that is lower than the background concentration. Where necessary, groundwater use will be regulated through the establishment of institutional controls in the form of a restrictive covenant or a controlled groundwater area (or both) to prohibit installation of wells, except for those used for remediation or monitoring purposes, at the

Facility until groundwater is remediated to SSCLs for all COCs. Once DEQ determines SSCLs have been met for groundwater, the institutional controls associated with groundwater may be modified or removed if appropriate.

Ingestion and direct contact with contaminated surface water and/or seeps and springs exceeding SSCLs is considered a risk to human health and/or ecological receptors. The surface water SSCLs (including those based on DEQ-7 standards) are based upon levels that are protective for aquatic invertebrates and fish, human health, or a site-specific background concentration. DEQ did not select any alternatives that solely address UBMC surface water. Achieving the SSCLs for surface water will come from successful implementation of the selected remedies for soil, sediment, and groundwater that surround the UBMC surface water bodies. At the mining-related features that have seeps or springs, containment and/or site-wide elements will be used to ensure protectiveness. Where necessary, use will be restricted through the establishment of ICs.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives were evaluated and compared against the seven cleanup criteria identified in § 75-10-721, MCA. Protectiveness and compliance with ERCLs are threshold criteria that must be met for any remedy. In the comparative analysis, the remaining criteria are weighed and evaluated to identify the best overall alternatives for each media, and include considerations of present and reasonably anticipated future uses of the UBMC and the use of ICs. Each criterion is listed individually below. A list of the alternatives and their corresponding numbers is also provided to aid in this analysis.

Solid Media and Liquid Media Alternative

- Alternative 1 – No Action

Solid Media and Physical Hazard Alternatives

- Alternative 2 – MNR
- Alternative 3 – Physical Barriers
- Alternative 4 – Containment
- Alternative 5 – Removal and Onsite Disposal
- Alternative 6 – Removal and Offsite Disposal
- Alternative 7 – In Situ Neutralization with Alkaline Amendment
- Alternative 8 – Ex Situ Neutralization with Alkaline Amendment

Groundwater and Surface Water Alternatives

- Alternative 9 – MNA
- Alternative 10 – Containment (Retention Pond)
- Alternative 11 – Hydrologic and Hydraulic Control
- Alternative 12 – Inundation
- Alternative 13 – Active Chemical Reagent
- Alternative 14 – Active Physical/Mechanical Treatment
- Alternative 15 – PRB

None of these alternatives alone will clean up the UBMC to SSCLs and the most appropriate remedy may consist of a combination of different alternatives. Due to the size of the UBMC, the extent of contamination, and the affected media, some of the remedial alternatives listed above are specific to affected material and areas. Alternatives 2 through 8 address soil, sediment, and physical hazards. Alternatives 9 through 15 address groundwater, including adit discharge. Alternatives 10 through 14 address surface water. Alternatives 2 through 8 were compared to each other. Alternatives 9 through 15 were compared to each other for groundwater, while Alternatives 10 through 14 were compared to each other for surface water. All the alternatives were compared to Alternative 1 (No Action).

10.1 PROTECTIVENESS

Alternative 1 provides no protection to human health and the environment. Alternative 2 provides no protection from unacceptable risks in the short-term for public health, safety or welfare or the environment, but may become protective in the long-term. Alternative 3 does provide protection from unacceptable risks in the short-term and long-term for public health, safety or welfare or the environment by addressing the physical safety hazards associated with mine adits. Alternatives 4, 7, and 8 provide some protectiveness by covering or reducing the mobility of COCs in solid media. However, because the contaminated media remains in place, there will continue to be a risk of exposure. If Alternative 4 were combined with Alternative 7 or 8, the protectiveness would be increased. Alternatives 5 and 6 provide the greatest level of protectiveness for the solid media options because all waste material exceeding SSCLs would be removed. Alternative 9 provides no protection from unacceptable risks in the short-term for public health, safety or welfare or the environment, but may become protective in the long-term. Alternative 10 is protective downstream of the remedy, but not within the retention area. Alternative 11 provides no protection from risks in either the short-term or long-term for public health, safety, and welfare or the environment. Alternative 12 is protective, provided the adit plug remains intact and no new seeps form as a result of the adit plug. Alternatives 13 and 14, by themselves are not fully protective, but, if combined, could provide protectiveness by treating water to meet standards before it leaves the source area. Alternative 15 could provide protectiveness downgradient by preventing contaminated groundwater from migrating beyond the source area.

10.2 COMPLIANCE WITH ERCLs

Alternative 1 does not comply with ERCLs. Alternative 2 would not meet surface water ERCLs in the short-term, but may in the long-term. Alternative 3 only addresses safety hazards so it does not comply with ERCLs by itself. Under Alternatives 4, 7, and 8, contaminated soils remain in place and could continue to leach COCs to groundwater so compliance with ERCLs would not be achieved. Alternatives 5 and 6 would achieve ERCLs compliance within a short period in some areas through removal of contaminated soils that leach to groundwater or impact surface water, and placement in a repository that complies with ERCLs, although removal may result in an adverse impact to wetlands in EA4. However, other areas would not achieve ERCLs in the short term because groundwater would not be immediately addressed. Alternative 9 would not meet groundwater ERCLs in the short-term, but with source removal, ERCLs compliance would be achieved in the long-term. Alternative 10 would not achieve compliance with ERCLs, but may achieve compliance with ERCLs when combined with other alternatives. Alternative 11 would not improve the quality of surface water or groundwater and would not comply with ERCLs. Alternative 12 does not meet groundwater ERCLs although it does meet surface water ERCLs by controlling groundwater within the adit. Alternatives 13 and 14, if combined, would meet DEQ-7 standards at the point of discharge. Alternative 15 could comply with groundwater ERCLs downgradient of the system at the Carbonate site and improve the compliance of surface water in the downgradient Blackfoot River for any exceedances of SSCLs.

10.3 MITIGATION OF RISK

Alternative 1 does not mitigate risk. Mitigation of risk may be achieved through Alternative 2 over a long period as natural recovery processes occur within stream sediments, although the success of this remedy is dependent on source removal and control. Alternative 3 provides mitigation of safety risks through the use of physical barriers. Alternative 4 provides mitigation of the risk presented by direct contact, but may not completely mitigate the risks to surface water or groundwater because contamination is left in place. Alternatives 5 and 6 provide the greatest level of risk mitigation for the solid media alternatives through removal of the waste sources to meet SSCLs. Alternatives 7 and 8 provide some mitigation of risk through the reduction of metals mobility in the soils. Alternative 9 does not mitigate risk in the short-term, but there would be some mitigation of risk in the long-term as COC concentrations decrease over time after source removal. There is no mitigation of exposures to risk under Alternatives 10 and 11, although Alternative 10 provides mitigation downstream (below the retention pond) of the seep or spring, but not for the water contained in the retention pond. Alternative 12 provides mitigation of risk through maintaining an effective seal on the adit thereby limiting direct contact with contaminated water near the adit. Alternatives 13, 14, and 15 mitigate risk by treating contaminated groundwater to meet SSCLs.

10.4 EFFECTIVENESS AND RELIABILITY

Alternative 1 provides no short-term or long-term effectiveness or reliability. Alternatives 2 and 9 are not effective or reliable in the short-term, but are effective and reliable in the long-term when combined with source removal and control. Alternative 3 has proven to be effective and reliable for addressing physical hazards at the UBMC and other mining sites. Alternative 4 is effective and reliable in the short-term by limiting contact with contamination, but is less effective and reliable in the long-term due to weathering and erosion. Alternatives 5 and 6 provide the most effectiveness and reliability because waste materials are removed and placed in an engineered repository. Alternatives 7 and 8 may be effective and reliable in limiting contact with contamination and reducing leaching to groundwater. Alternative 9 is effective and reliable in the long-term provided there is adequate source removal and control. There is significant short-term and long-term effectiveness and reliability in maintaining acceptable risk levels under Alternatives 10 and 12; however, Alternative 12 has limited use. Alternatives 13 and 14, if combined, have proven to be effective and reliable at reducing COC levels to SSCLs at the existing WTP. By itself, Alternative 11 has no short-term or long-term effectiveness or reliability in maintaining acceptable risk levels; however, when combined with other alternatives, it can be effective at reducing the quantity of groundwater that would need to be treated. Alternative 15 may be effective in the long-term, but has limited use.

10.5 PRACTICABILITY AND IMPLEMENTABILITY

Alternative 1 is easily implementable. Alternatives 2 and 9 are technically practicable and implementable utilizing and expanding the existing monitoring network. Alternatives 3, 4, 5, and 6 are each technically practicable and implementable. Alternatives 7 and 8 are technically practicable at some sites within EA 1 and EA 5 provided that a suitable source of lime is available. Alternatives 10, 11, and 12 only address groundwater and surface water, and are practicable and implementable at sites within EA 2 (groundwater) and EA 3 (surface water). Alternatives 13 and 14 have proven to be technically practicable and implementable at the existing WTP for treating water from the Anaconda Mine adit and Mike Horse Mine adit and seeps. Implementation of Alternative 15 is practicable and implementable at the Carbonate Mine site should monitoring demonstrate a potential for near-surface contaminated groundwater to affect the Blackfoot River.

10.6 TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES

Alternatives 1, 2, 3, 4, 5, 6, 9, 10, 11, and 12 do not rely on treatment or resource recovery technologies. Alternatives 7 and 8 rely on soil amendment with lime treatment. Alternative 13 relies on a suite of neutralizing chemical reagents for treatment. Alternative 14 relies on proven filtration treatment technology. Alternative 15 relies on PRB technology.

10.7 COST EFFECTIVENESS

All costs are estimated and actual costs may vary. Alternative 1 is the least expensive alternative, but provides no risk reduction for soil, sediment, groundwater, or surface water at the UBMC. Alternative 3 provides no risk reduction for soil, sediment, groundwater, or surface water, but does reduce risk where physical hazards are a concern.

Soil/sediment alternatives 2, 4, 7, and 8 provide some risk reduction, but do not address all contamination because at least a portion of the contamination is left in place for each of the alternatives. Soil/sediment alternatives 5 and 6 provide the same risk reduction, but Alternative 6 is more expensive than Alternative 5 with no additional risk reduction. Alternative 9 provides long-term risk reduction, but is only effective when combined with a removal and source control alternative.

Groundwater/surface water alternatives 10, 11, and 12 provide some risk reduction and are less expensive than other groundwater treatment alternatives, but do not address all contamination. Alternatives 13 and 14 provide risk reduction and have similar costs. Alternative 15 is less expensive than Alternatives 13 and 14, but due to limiting facility characteristics is only applicable to specific areas within the UBMC.

11.0 SELECTED REMEDY

As described earlier, for those federal lands within the UBMC that were not included in the USFS Action Memorandum, as amended, the USFS will issue a separate decision. This ROD identifies DEQ's selected remedy for the non-federal land within the UBMC. Work will be performed in coordination with NRDP restoration efforts.

11.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

DEQ's selected remedy for the non-federal UBMC lands is a combination of alternatives set forth below.

- No action (Alternative 1): No action is the selected remedy for portions of EA1 (EU5) because recalculation of exposure point concentrations demonstrated compliance with SSCLs or there were only slight exceedances of one SSCL (EU9A) that is based on protecting ecological receptors and the area is small and not appealing habitat.
- Monitored natural recovery (MNR) (Alternative 2): MNR is the selected remedy for the sediments in portions of EAs 3, 4, and 5 and will reduce contaminant concentrations of metals in sediments. MNR utilizes natural sedimentation processes to contain and reduce the bioavailability or toxicity of contaminants in sediment. Because the selected remedy also includes removal or containment of contaminant sources to reduce the movement of COCs into surface water bodies, contaminated sediment concentrations will decrease over time. Other alternatives, such as sediment removal or containment of all contaminated sediments would result in several miles of disturbance in active streams with significant negative short-term ecological affects. Surface water and sediment concentrations will be monitored to demonstrate that MNR is effective and that SSCLs are met.
- Physical barriers (Alternative 3): A physical barrier is the selected remedy for the physical hazard identified in EA 5 and it will prevent human entry. One of the mining-related features is only a physical safety hazard and does not impact soils, sediments or surface water. The selected remedy is a physical barrier to reduce or prohibit entry by humans and large mammals at the open adit. Physical barriers to prevent human entry can be as complex as a bat gate (only allows entry to bats and other small mammals) or plugging with foam or a bulkhead, or as simple as backfilling the opening. Any of these choices will sufficiently address the hazardous open adit. An IC will be needed to provide for inspection and maintenance of the barrier.
- Containment (Alternative 4): Containment is the selected remedy for soils in portions of EU 8 in EA 1 and will reduce direct contact, rain-drop impact energy with soils exceeding SSCLs, and the associated erosion and transport of those soils. Because removal is not feasible, due to the near-surface mine workings that pose potential subsidence issues, and the slopes are too steep (greater than 3:1 horizontal:vertical) to establish a vegetative cover, an angular rock cover will be applied. The rock cover will also be used to break up long slope lengths to reduce soil erosion and aid in establishing vegetation on portions of the slope. Containment does not fully isolate or eliminate metal loads in acid-generating rock and, therefore, does not eliminate infiltration into

groundwater. Also, it may require a high level of maintenance for erosion and weed control. Contaminated groundwater in this area will be captured and treated at the WTP. EU 8 will require an IC to restrict use to ensure protectiveness.

- Removal and onsite disposal (Alternative 5): Removal and onsite disposal at the UBMC Repository is the selected remedy for the soils in portions of EAs 1 and 5, and sediments in portions of EAs 3 and 4. Removal involves excavating (and typically drying) mine wastes and placing them within an engineered repository. Removal of soils and sediments to respective SSCLs at the UBMC Facility will effectively eliminate human and environmental exposures.

- Monitored natural attenuation (MNA) (Alternative 9): MNA is the selected remedy for groundwater in portions of EA 4 and will reduce contaminant concentrations of metals in groundwater. MNA utilizes natural processes to reduce groundwater concentrations of COCs through time. Because the selected remedy also includes removal of contaminant sources to reduce the movement of COCs into groundwater, contaminated groundwater concentrations will decrease. Groundwater COC concentrations will be monitored to demonstrate that MNA is effective and that SSCLs are met.

- Containment (Retention Pond) (Alternative 10): Containment, in the form of lined retention ponds, constructed near drainage, seepage, or spring sources to capture and retain contaminated water is the selected remedy for portions of EA 3. Because this remedy relies on evaporation, it is applicable only to low flows and not applicable to surface runoff flows with highly variable seasonal flows. In areas where water treatment is not an option due to low flows, lack of infrastructure required for a treatment system, and remoteness resulting in decreased cost effectiveness, retention ponds will provide a means of containing impacted surface water and preventing migration beyond the area of the pond, thus significantly reducing direct exposure to contamination downstream of the retention pond. Evaporation of the water concentrates the metals in the water and leaves behind a residue of soluble metal salts. Periodic cleaning of the pond will be required to remove the residues. For those areas where high contaminant concentrations and low pH of the water in the ponds may present high exposure risks to birds and other receptors; fencing, netting, or other engineering controls will be needed to minimize receptors coming into direct contact with the water in the retention pond. The retention ponds will require ICs to restrict use to ensure protectiveness.

- Hydrologic and hydraulic control (Alternative 11): Hydrologic and hydraulic control is the selected remedy for capturing and rerouting surface water and groundwater around an area of contaminated groundwater in a portion of EA 2. Hydrologic and hydraulic controls (diversion, fracture/fault grouting, piping, and stream alignment) are used to intercept surface and/or groundwater and to divert water away from mine workings, around wastes, and/or to specific discharge points. Under this remedy, upgradient groundwater and surface water at the Carbonate Mine site would be captured and diverted around the waste removal area. While this remedy would reduce the quantity of groundwater impacted by metals, it would not reduce the quantity of metals leaving the Carbonate Mine site, and therefore is not anticipated to reduce the impact of the Carbonate Mine site on downgradient groundwater and surface water quality. Hydrologic and hydraulic control will be used in conjunction with a permeable reactive barrier (PRB;

passive treatment with a chemical reagent). Routine inspection and maintenance will ensure that the hydrologic and hydraulic controls are functioning as designed.

- Inundation (Alternative 12): Inundation (bulkhead/wet mine seal and plug) is the selected remedy to control adit discharge in a portion of EA 3. A bulkhead/wet mine seal, a wall installed in a mine opening that allows water to leave a flooded adit but prevents air from entering, will be used to collect, equalize, and convey adit water to a retention pond at the Paymaster Mine. While this remedy would collect and control the adit discharge, it would not reduce the quantity of metals leaving the Paymaster Mine adit, and therefore is not anticipated to reduce the potential impact on downgradient groundwater and surface water quality. Inundation will be used in conjunction with containment – a lined retention pond. Inundation will provide an optimization for the collection, equalization, and conveyance of adit discharge to the retention pond. Currently, this technology is a part of interim actions being used at the UBMC to control adit discharges (Capital Mine adit – grout-seal plug) as well as to collect, store, mix, and equalize mine water in the mine workings (Mike Horse and Anaconda adits – flow-through bulkhead plugs) before routing to the WTP. Routine inspections, monitoring, and maintenance of the controls will be required to ensure that they continue to function as intended.

- Active chemical reagent (Chemical Treatment) (Alternative 13): Active chemical treatment is the selected remedy for treating adit discharge in portions of EA 2. The Anaconda Mine adit discharge and the Mike Horse Mine adit discharge and seeps are currently being treated at the WTP with active chemical treatment (sodium hydroxide) as part of the overall treatment of the adit discharges and seeps. This treatment is already a part of an interim action that combines active chemical treatment with ceramic microfiltration and has proven to be effective in meeting groundwater SSCLs prior to discharge into the Blackfoot River. Proper operation and maintenance of the WTP is essential to ensuring that it continues to operate efficiently and effectively. WTP effluent concentrations will be monitored to demonstrate that the WTP process is effective and that SSCLs are met.

- Active physical/mechanical treatment (Alternative 14): Active mechanical treatment is the selected remedy for treating adit discharge in portions of EA 2. The Anaconda Mine adit discharge and the Mike Horse Mine adit discharge and seeps are currently being treated at the WTP with active mechanical treatment (ceramic microfiltration) as part of the overall treatment of the adit discharges and seeps. This treatment is already a part of an interim action that combines active mechanical treatment with chemical treatment and has proven to be effective in meeting groundwater SSCLs prior to discharge into the Blackfoot River. Proper operation and maintenance of the WTP is essential to ensuring that it continues to operate efficiently and effectively. WTP effluent concentrations will be monitored to demonstrate that the WTP process is effective and that SSCLs are met.

- Passive chemical reagent: permeable reactive barrier (PRB) (Alternative 15): A PRB is the selected remedy for reducing metals in contaminated groundwater in a portion of EA 2. A PRB utilizes a flow-through barrier that is usually filled with organic matter that interacts with dissolved COCs in the groundwater. The barriers are usually installed underground to treat near-surface groundwater as it flows through the barrier. Other alternatives, such as pumping and conveying the water to the WTP would result in the same reduction of metals in the groundwater, but would be more expensive to construct and maintain. Groundwater concentrations will be monitored to demonstrate that the PRB is effective and that SSCLs are met.

- Site-wide elements – Institutional controls (ICs): The selected remedy relies on ICs in the form of land use and groundwater use restrictions (restrictive covenants or controlled groundwater area or both) at the UBMC Facility. The following State and Trust property use must be restricted with a DEQ-approved restrictive covenant in substantially the same form as the models included in Appendix B: UBMC Repository (Section 35; State owned), Carbonate Repository (Trust owned), and the Paymaster Repository (Trust owned). The water treatment plant area (Trust owned) must be restricted to commercial/industrial use. Mine waste areas (mining-related features and exposure units (EUs)) associated with Trust owned property at the Anaconda Mine area (EU 1A/1B), Capital Mine area (SG-13/14, SG-16, SG-41, SG-43, SG-47, SG-48, SG-49/50, SG-51, SG-71, SG-93, SG-94, EU 3), Carbonate Mine area (SWG-02), Consolation Mine area (BR-14, SH-37), Mary P Mine area (BR-29), Midnight/Daylight Mine area (PC-01, PC-06, SH-14, SH-37), Mike Horse Mine area (upper seep – WTP operation, EU 8), Paymaster Mine area (PM-06, JM-01, EU 9B), and the Upper Marsh sensitive areas (containing mine wastes) must be restricted to limit access (signs and/or fencing), provide for inspection and maintenance of barriers, and warn recreators of waste or physical hazards in remote or sensitive areas. To address groundwater use restrictions at the UBMC Facility, DEQ may also elect to petition for a controlled groundwater area or similar restriction for groundwater associated with the Carbonate Mine area, the Mike Horse Mine area, and the Upper Marsh area (eastern portion). ICs will also be applied to the adits (Anaconda, Capital, Mike Horse, and Paymaster mine areas) and seep capture systems at the Anaconda and Mike Horse mine areas.
- Site-wide elements – Engineering controls: Engineering controls such as fencing and/or signage will be necessary during implementation of the remedy to restrict access to restricted areas (repositories) and mine waste areas.
- Site-wide elements – Long-term monitoring: Monitoring is necessary to evaluate the effectiveness of the remedy, to determine when SSCLs are achieved, and to ensure the ongoing protection of public health, safety and welfare and of the environment. It will include monitoring sediment, surface water, and groundwater, and will be further identified during remedial design and ROD implementation.

DEQ did not select any alternatives that solely address UBMC surface water. Achieving the SSCLs for surface water will come from successful implementation of the selected remedies for soil, sediment, and groundwater that surround the UBMC surface water bodies. The effectiveness of this approach is demonstrated by past interim actions. For example, soil and sediment waste removal in Swamp Gulch improved the surface water quality (Table 8) as it exited the Carbonate Mine area and emptied into the Upper Marsh. Soil waste removal (Capital Mine) in Stevens Gulch improved the surface water as it reached the lower end of Stevens Creek (Table 7). The other interim actions conducted in the 1990s (see Section 2.3) also improved water quality through soil and sediment waste source removal (Tetra Tech, 2007). Adit discharge and seep captures (Mike Horse adit and seeps, Anaconda adit) conveyed to the WTP for treatment have improved the Blackfoot River water quality. This has been demonstrated in the decreasing trend of metals concentrations in the surface water (Tetra Tech, 2013a; Pioneer 2015).

More recent interim actions further improve surface water quality. For example, the EE/CA and Mike Horse interim actions, are removing 800,000 yd^3 of soil and sediment source, and will improve surface water quality throughout the Mike Horse, Beartrap, and Blackfoot floodplain reaches. Likewise, the remedy selected in this ROD will improve water quality and over time is predicted to meet the surface water SSCLs. Surface water monitoring will evaluate the effectiveness (performance) of the remedies for the other media and confirm that SSCLs are met in surface water.

Some interim actions have been conducted, as discussed previously**,** which helped reduce the threat to public health, safety, and welfare and the environment. While not all of the interim actions have been completely effective, they contributed to the selected remedy because they reduced metals concentrations in soils and sediments and/or the potential for acid mine drainage from soils, or treated metals in adit discharge in some areas.

Interim actions that have been effective and incorporated into the selected remedy include the Carbonate and Paymaster repositories, the adit plugs, and the WTP. The Carbonate repository design considered stability, drainage, potential settlement, mine shaft remediation, infiltration/water balance (HELP modeling), acid/leachate production, erosion control, floodplain protection, and revegetation. Construction was completed in 1994. The Paymaster repository design considered stability, drainage, potential settlement, mine shaft remediation, infiltration/water balance (HELP modeling), acid/leachate production, erosion control, floodplain protection, and revegetation. Construction was completed in 1997. Also in 1997, a grout seal was placed in the Capital Mine adit effectively inundating the Capital Mine workings with the groundwater discharge, while eliminating the seasonal discharge of water from the adit. That seal will be inspected and maintained as part of long-term monitoring and maintenance at the UBMC. This O&M will ensure that the adit plug integrity is maintained to reduce any future potential of adit plug failure. Constructed in 2008, the WTP combines ceramic microfiltration technology with active chemical reagent treatment to effectively treat adit water from the Mike Horse and Anaconda mines. It also captures seeps from the upper and lower Mike Horse mine areas and Anaconda mine area.

As part of evaluating the success of interim actions, DEQ found that ASARCO and ARCO constructed the Mike Horse Repository within the 100-year floodplain, which does not comply with ERCLs. The sampling conducted during the RI indicated that repository seeps were impacting groundwater and surface water. In addition, the sludge-drying beds located on top of the repository did not meet cap requirements for a solid waste repository. Therefore, this repository was removed and the contents placed in the UBMC Repository as part of an interim action, which is consistent with the final remedy for the UBMC. Completion of this interim action, along with confirmation sampling to confirm SSCLs are met, will be completed in 2016.

The interim action to remove the Mike Horse Repository began in 2014 and was completed in 2015. This interim action included removal of the Mike Horse Repository, along with the floodplain waste running the length of the mine site. It also included construction of an upgrade to the seep capture systems at the Mike Horse mine.

11.2 DETAILED DESCRIPTION OF THE SELECTED REMEDY

The following describes DEQ's selected remedy for the non-federal land within the UBMC. Engineering and design details for the selected remedy will be specified in the remedial design documents to be issued after the ROD. The selected remedy includes the site-wide elements: ICs, engineering controls, and long-term monitoring and maintenance. The selected ICs will be in the form of restrictive covenants in substantially the same form as the documents found in Appendix B. In addition, areas within EA1 or EA5 that are not removed to meet SSCLs due to accessibility concerns, as described in Sections 11.2.2 and 11.2.6, will be surveyed and use of those surveyed areas will also be restricted.

Engineering controls will include the construction of fences, placement of signs, or both in those areas where SSCLs are exceeded and access is limited or disturbance of the mineral rich soils would result in mobilizing additional contaminants into the environment. These areas include: portions of EA 1 (Section 11.2.2), portions of EA 3 (Section 11.2.4), portions of EA 4 (Section 11.2.5) and portions of EA5 (Section 11.2.6).

Monitoring will include sampling and analysis to confirm the satisfactory performance of the remedy, ensure protection of public health, safety, and welfare, and the environment during remedy implementation, verify attainment of SSCLs, confirm achievement of RAOs, and verify compliance with ERCLs. Long-term monitoring and maintenance will include sampling some, or all, of the existing monitoring well network that now includes 15 wells or additional wells that may be installed as part of remedial design. Monitoring will also include the existing WTP well. DEQ anticipates that, at a minimum, select wells will be monitored semi-annually during high and low groundwater elevations for the first five years following completion of the cleanup to monitor contaminant levels for dissolved metals and evaluate the effectiveness of the cleanup. The monitoring frequency will then be re-evaluated and may be changed to another frequency that DEQ determines appropriate until cleanup levels are achieve. Water levels in monitoring wells will also be measured at the same time that sampling occurs. Finally, the remedy includes long-term monitoring and maintenance of the Anaconda, Capital, Paymaster, and Mike Horse adit plugs, existing repositories, and engineering controls to ensure their integrity.

Surface water and sediment monitoring will include the WTP influent and effluent, and sample locations that will be determined during or after remedial design for those portions of the site where monitored natural recovery or sediment removal is the selected remedy, including but not limited to: the eastern portion of the Upper Marsh, the Blackfoot River from the start of the western portion of the Upper Marsh to Hogum Creek, Stevens Creek, Paymaster Creek, the unnamed tributary above the WTP. At a minimum, the monitoring will include contaminant levels for total metals for both surface water and sediments, and hardness for surface water. The monitoring schedule (excluding the WTP, which follows the operations monitoring schedule per the WTP O&M plan) will consist of an annual high flow – spring runoff – and low flow monitoring event for at least a period of 10 years before reassessing the monitoring frequency.

The total cost for the selected remedy, including the site-wide elements, is $22,020,895. This cost does not include federal land cleanup costs. This cost estimate was based on the information presented in the FS (Pioneer, 2016). However, the FS cost estimates included both federal and non-federal lands. Therefore, the cost tables for the ROD found in Appendix C, Table C-2, have been adjusted to only reflect remedial action costs for the selected remedy on non-federal lands within the UBMC. Changes in the cost estimates are likely to occur as a result of new information and data collected during the engineering design of the selected remedy. This is a feasibility-level engineering cost estimate expected to be within plus 50 to minus 30 percent of the actual project cost.

11.2.1 COST UNCERTAINTIES

Remedial design will play a critical role in determining final costs for the UBMC remedy and will be more reflective of actual costs than the estimated costs presented in this ROD. Uncertainties that may affect the costs of the selected remedy include but are not limited to:

- The time required for monitoring to confirm that SSCLs are met may increase or decrease the costs of monitoring.
- Increases or decreases in the number of wells to be monitored as part of long-term groundwater monitoring may increase or decrease the costs of monitoring.
- Increases or decreases in the number of sample locations to be monitored as part of long-term monitoring associated with MNR may increase or decrease the costs of monitoring.
- Increases or decreases in the volume of contaminated media that is encountered during implementation of the remedy may increase or decrease the costs estimates.
- Costs associated with confirmation sampling were not included in the cost estimates. Costs associated with these samples will increase the cost of the selected remedy.
- Costs associated with a major repair or part replacement at the WTP are included in the O&M cost estimates, but may be underestimated based on cost of specialty parts such as ceramic microfiltration filters.
- Costs associated with a major repair of a repository or adit plug were not included in the cost estimates. Any major repairs for these items will increase the cost of the selected remedy.
- Costs associated with enforcing a violation of an IC were not included in the cost estimates. Cost of the selected remedy will increase if there is a violation of an IC.
- Costs associated with DEQ's oversight of the remedial action were not included in the cost estimates for the selected remedy. Cost associated with DEQ's oversight of the remedial action will increase the cost of the selected remedy.

11.2.2 EA 1 – UPLAND WASTE AREAS

The selected remedy will address impacted soils in EA 1 at the UBMC in one of three ways, and also includes the use of site-wide elements.

Soil exceeding SSCLs in EU4, EU6, and in that portion of EU7 not on federal land will be removed and placed in the UBMC Repository (Alternative 5). Removal of impacted soils will significantly reduce metals concentrations in EA 1, which will improve surface water by reducing or eliminating runoff and erosion and the leaching of metals to groundwater. When possible, contaminated wastes and soils will be excavated to meet SSCLs. There are areas, such as certain portions of EU8 (that are not already addressed by the interim action), where removal to this level is not possible because of the physical constraints (exposed ore body, steep slopes, proximity of mine workings, etc.) of the area. In that case, removal to a physical/visual indicator like groundwater, underlying native lithologic unit, pre-determined over-excavation depth, or bedrock may be used and will be determined during remedial design. Removal will be applied to any soil-like material at the UBMC including, but not limited to, waste rock, tailings, metals laden overburden, spoils, or contaminated underlying soils. Upland Waste Areas EU4 (iron, lead, and manganese), EU6 (arsenic and lead), and EU7 (arsenic and lead) will require removal to SSCLs, while at EU8 (arsenic, cadmium, copper, lead, manganese, and zinc) the accessibility concerns, including proximity to mine workings and steep slopes, may only allow for removal in certain discrete areas.

For EU8, where complete removal to SSCLs may not be possible, containment (Alternative 4) will also be used to address the EU8 soils that cannot be removed. Establishing a vegetative cover under these circumstances may not be feasible and has already been unsuccessful in two prior interim actions. Therefore, containment under these circumstances will include use of angular rock cover. This will reduce direct contact and the erosion and transport of contaminated media associated with rainfall, which will assist in improving the surface water quality in Mike Horse Creek. Containment does not fully isolate or eliminate contaminants leaching to groundwater, but contaminated groundwater in EU8 will be mitigated by the Upper Mike Horse seep capture system that is already in place as part of the existing WTP. Details of the containment will be further defined as part of remedial design.

For EU1A, EU1B, and EU3, engineering controls such as fencing and warning signs will be used. These EUs are difficult to access due to steep slopes that are sometimes heavily timbered with either unmaintained roads or no roads at all. These conditions make removal or containment difficult. These same conditions also make human foot travel difficult, which greatly limits recreationalists in these areas. Therefore, fencing and warning signs will limit human exposure to these EUs. In addition, these areas will be surveyed and use of these surveyed areas will also be restricted through ICs.

For EU5 and EU9A, No Action is the selected remedy. In EU5 there were slight exceedances of arsenic and lead. However, when assessed using ProUCL (Appendix D, Section D2), the average (95 percentile) arsenic (18.5 mg/kg) and lead (249 mg/kg) concentrations in EU5 are well below the surface soil SSCLs. In EU9A, there are slight exceedances of the copper SSCL that are based on protecting ecological receptors; however, the physical condition of the waste area habitat is poor and it is unlikely to be used by wildlife. Small (< 0.15 acres at EU9A), sparsely vegetated or bare waste piles are not appealing habitat when the vast majority of surrounding area is undisturbed, suitable habitat (TetraTech, 2013b). Therefore, the ecological receptors' preference for the undisturbed habitat will provide adequate protection. As described in Section 7.4, copper does not pose an unacceptable risk to human health.

For EU9B, maintaining the current subsurface geochemical/oxidation state conditions in the vicinity of the Paymaster constructed wetland system will limit widespread deposition of ferrous iron and increased metal mobility of at least arsenic and possibly other metals (see Section 2.3.7). In addition, this area will be surveyed and use of this surveyed area will also be restricted through an IC (site-wide elements) to prohibit excavation and construction in this area to be protective of human health.

11.2.3 EA 2 – GROUNDWATER

There are three distinct groundwater areas in EA 2: Anaconda Mine and Mike Horse Mine adit discharges and seeps, Carbonate Mine groundwater, and the Upper Mike Horse Mine bedrock groundwater aquifer. The impacted groundwater in EA 2 will be addressed through active chemical reagent treatment combined with active physical/mechanical treatment, or inundation as an engineering control, or hydrologic and hydraulic control combined with a passive chemical reagent PRB and through the use of site-wide elements.

Anaconda and Mike Horse Adit Discharges and Seeps

The Anaconda Mine adit discharge and the Mike Horse Mine adit discharge and seeps, which include the upper Mike Horse Mine alluvial groundwater, are currently being treated at the WTP, and continuing that treatment is the selected remedy (Alternatives 13 and 14). The Upper Mike Horse Mine bedrock groundwater aquifer is also currently addressed through the WTP, and that will continue as part of the selected remedy. Seep capture systems were included during interim actions to treat seeps at the upper Mike Horse waste piles area and next to Cell 4 from the old wetland treatment system and will continue to be treated. If sampling as part of remedial design indicates that the seep associated with the former Mike Horse Repository exceeds SSCLs, then water from it will continue to be captured and treated. The WTP incorporates ceramic microfiltration technology with active chemical reagent to treat the discharges from the two mines, which includes the Upper Mike Horse Mine bedrock groundwater that infiltrates into the Mike Horse mine workings. After treatment in the WTP, water meets SSCLs at its discharge point into the Blackfoot River, which serves to improve the surface water quality by treating the adit discharges and seeps that once contributed to surface water contamination.

Carbonate Mine Groundwater

For the Carbonate Mine groundwater, the selected remedy is hydrologic and hydraulic controls combined with a PRB (Alternatives 11 and 15) to treat the contaminated groundwater should monitoring conducted as part of remedial design demonstrate a potential for near-surface contaminated groundwater to affect the Blackfoot River. Because this remedy requires interception of all contaminated water, additional investigation is required as part of remedial design to better define the extent of contamination, water quality chemistry, and the aquifer properties to maximize effectiveness. In order to limit exposure to groundwater in the Carbonate area, the selected remedy will also require ICs (site-wide elements).

Upper Mike Horse Mine Bedrock Groundwater Aquifer

The Upper Mike Horse Mine Bedrock Groundwater Aquifer is currently addressed through the WTP, which has been selected as the final remedy (Alternatives 13 and 14). The cleanup at the Mike Horse Mine Area will address the alluvial aquifer through the removal of waste sources and reconstruction of the Mike Horse Creek channel and floodplain, and enhancement and incorporation of the Upper Mike Horse seep capture system into the designed cleanup. However, the bedrock aquifer will likely continue to flood the mine workings in this area. In order to limit exposure to groundwater in the alluvial and bedrock aquifer, the selected remedy will also require ICs (site-wide elements).

11.2.4 EA 3 – SURFACE WATER AND SEDIMENT

Blackfoot River (EU12 and EU13)

The selected remedy for the streambed sediments in the active Blackfoot River channel from the start of the western Upper Marsh to Hogum Creek is MNR (Alternative 2). The remedy for the active Blackfoot River channel within the eastern Upper Marsh is addressed in Section 11.2.5. Stream sediments were sampled below the Upper Marsh to Highway 279 during the RI in 2007 and 2008 and from Highway 279 to Hogum Creek during the RI in 2011. Although stream sediment samples were not collected from below the Upper Marsh to Hogum Creek during the same time period, the surface water data indicate that COC concentrations generally decreased downstream from below the Upper Marsh to Hogum Creek, and at the confluence of the Blackfoot River with Alice Creek at BRSW-205 no SSCL exceedances were noted. Sampling location BRSW-104 will be included in the MNR monitoring plan (see Section 5.3.4.1) to assure that the spring/summer sample was anomalous and that MNR is occurring in that area. MNR does not disturb large areas of active river channel through sensitive ecosystems. When combined with the source removals at and above the Upper Marsh, MNR is a long-term protective remedy through a reach of the Blackfoot River that is already showing decreased metals concentrations from upstream to downstream. As the streambed sediments continue to recover, the surface water quality will improve and will be monitored as part of the long-term monitoring plan. Monitoring of sediments and surface water at a minimum of six stations along the Blackfoot River below the Upper Marsh will be included in the long-term monitoring plan.

Stevens Creek (Gulch)

The furthest downstream water quality conditions, near the confluence of Stevens Creek and the Blackfoot River in Stevens Creek, do not meet aquatic standards for cadmium, copper, lead, and zinc and sediment exceeds arsenic, copper, and lead. However, it would be difficult to implement an active sediment remedy in this remote, highly mineralized area where runoff across the copper-molybdenum ore body may continue to affect sediment and surface water quality (Figure 8). In addition, the seasonal flows are small (0.0004 to 1.07 cfs), while Blackfoot River flows at the confluence with Stevens Gulch are much larger (8.76 to 36.5 cfs), and Stevens Creek does not flow into the Blackfoot River during drier precipitation periods. It is important to note that the waste removal at the Capital Mine (see Section 2.3.2), the largest waste pile sitting in Stevens Creek, improved the water quality below the mine. Stream sediment metal concentrations also decrease steadily from the Capital Mine downstream to sediment sample BRSW-8, approximately 500 feet south of the confluence with the Blackfoot River (Table 6, Figure 16). The selected remedy for Stevens Creek sediments for non-federal land is MNR (Alternative 2) and monitoring of sediments and surface water at approximately two stations will confirm that SSCLs are met. When combined with the Capital Mine source removal, MNR is a protective remedy for Stevens Creek.

Paymaster Creek

The selected remedy for the Paymaster Creek streambed sediments is removal and disposal at the UBMC Repository (Alternative 5). The BRSW-13 sediment sample, located immediately downstream of the Paymaster Mine area, is the only one of the four samples collected that shows exceedances of SSCLs. Arsenic exceeds the sediment SSCL at 0 to 2 inches, 2 to 6 inches, and 6 to 12 inches; lead exceeds the SSCL at 2 to 6 inches and 6 to 12 inches; and copper exceeds the SSCL at 6 to 12 inches. Paymaster Creek was rerouted and reconstructed around the passive wetland treatment system. The extent of sediment contamination in this area is a data gap that will be addressed during remedial design.

Unnamed Tributary above WTP

The selected remedy for the unnamed tributary streambed sediments is MNR (Alternative 2), combined with source removal at mining-related feature BR-39 as addressed in EA5. This unnamed tributary located west of the Upper Anaconda Mine Waste Piles (EU 1B) has a drainage area of approximately 75 acres and drains south to the WTP. Flow in the tributary was sampled during the RI immediately downgradient from mining-related feature BR-39 a collapsed adit and waste rock pile situated approximately 700 feet uphill from the WTP. The sampled water at BTSW-101 exceeded DEQ-7 aquatic life standards for chronic cadmium (0.00099 mg/L, standard is 0.00025 mg/L) and chronic and acute zinc (0.16 mg/L, standard for chronic and acute zinc is 0.112 mg/L). The flow rate was measured in the RI at less than 0.039 cfs. No sediment samples were collected. The unnamed tributary is located in a steep, highly mineralized area and its flows are generally low and intermittent. MNR was selected as the remedy and monitoring of surface water and sediments at a minimum of two stations will confirm that SSCLs are met.

Mining-related Feature Discharge, Seep, or Spring

The final remedy for features located in areas with easy to moderate access is containment (Alternative 10). The final remedy for features located in areas with difficult access is engineering controls in the form of fencing and institutional controls in the form of access restrictions (site-wide elements). These areas are characterized by very steep and often heavily timbered slopes with very few established roads for access. Stevens Gulch (site for two of the three features) is also located in a highly mineralized copper-molybdenum ore body (Figure 7). Road construction in this area would be extremely difficult and would be compounded by the likelihood of exposing the ore body or highly mineralized soil, which could potentially cause more environmental damage by releasing heavy metals. These access conditions make containment very difficult. These very same conditions also make human foot travel extremely difficult, which greatly limits recreational use in these areas. Fencing will minimize wildlife use of these areas, but will not completely eliminate potential use by ecological receptors. However, there are other nearby areas that provide better habitat and are likely to be preferred by wildlife. Therefore, fencing and warning signs, used as access restrictions, are effective remedies for these remote features. In addition, these areas will be surveyed and use of these surveyed areas will also be restricted through ICs.

The selected remedy for mining-related feature BR-14 (difficult access) is fencing and signage to restrict access (site-wide elements) if SSCLs are exceeded in samples collected during remedial design. Feature BR-14 is a collapsed adit with leaking water that was pooled near the adit entrance and supporting vegetation. No flow or water quality data were collected and these data gaps will be addressed during remedial design.

The selected remedy for mining-related feature SG-71 (difficult access) is fencing and signage to restrict access (site-wide elements) if SSCLs are exceeded in samples collected during remedial design. SG-71 is a spring at a possible adit location approximately 70 feet from Stevens Creek. Water had pooled from the spring to a depth of 6 inches. No flow or water quality data were collected. Lack of flow and water quality data are data gaps that will be addressed during remedial design.

The selected remedy for mining-related feature SG-94 (difficult access) is fencing and signage to restrict access (site-wide elements). SG-94 is an iron precipitate, cone-forming spring. During the RI, the flow rate was estimated at two to five gpm and sediment deposition was observed.

Surface water sampled in 2008 during the RI at SGSW-104 exceeded the DEQ-7 human health standards for arsenic and iron, and the aquatic standards (chronic and/or acute) for iron and zinc. The distance from the spring to Stevens Creek was not noted in the RI, an indication that the creek was not within eye sight to make a reasonable estimate of distance.

The selected remedy for the historical Paymaster Adit discharge (easy access) is containment (Alternative 10) if SSCLs are exceeded in samples collected during remedial design. The adit was collapsed and an adit discharge collection system (piping and a vault) and wetland treatment system were installed in 1996-1997 with the intent to discharge water into the upper wetlands cell. Water is currently seeping out of the slope toe and into the road next to the plugged adit. ASARCO abandoned the wetland system by plugging the pipe that flowed between the upper and lower cells. The upper cell could be used as a retention pond if the water quality proves to be poor. Lack of flow and water quality data are data gaps that will be addressed during remedial design. Monitoring and maintenance of the adit plug will occur to assure long-term protectiveness to reduce the future potential of adit plug failure. The wetland cells solid media (EU9B) is addressed as Paymaster Mine Waste Areas in EA 1.

11.2.5 EA 4 – UPPER MARSH

The Upper Marsh has been divided into two areas: the eastern (upstream) portion at 28 acres and the western (downstream) portion at 34 acres. This division, also used in the BERA, is based on the location of an old drill road constructed within the area prior to the 1975 breach of the Mike Horse tailings impoundment (Figure 26). The marsh is also divided into an eastern area and a western area for the purpose of remedy selection. The active Blackfoot River streambed sediments in the Upper Marsh are addressed in EA3. The selected remedy only applies to that portion of the marsh on non-federal land.

Upper Marsh (EU12) Eastern Area

Except for the sensitive areas, the Eastern Marsh selected remedy includes removal of tailings and contaminated sediments/soil throughout the eastern marsh floodplain area with disposal at the UBMC Repository (Alternative 5, Figure 26). Removals will be based on meeting SSCLs and will be supported by other lines of evidence, including bioavailability parameters, ABA, and SPLP within the marsh area. Removal in the Eastern Marsh area will extend upstream until it connects with the downstream extent of the Blackfoot River designated removal area per the EE/CA (Figure 3 and 19). The lateral extent of contamination will be confirmed during remedial design to further identify the extent of areas exceeding SSCLs. In addition, the locations of the sensitive areas, such as fens and forested emergent wetlands in Figure 22, will be field verified prior to performing cleanup. The selected remedy for these sensitive areas does not include removal of contaminated sediments. These sensitive environments take hundreds of years to form and play a crucial working role in the health of the Upper Marsh. Both sensitive area types accumulate peat layers that act to collect and retain metals that come out of the Paymaster and Swamp Gulch drainages. Due to the length of time that it took to establish these areas, removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The current plant community health suggests that these areas continue to thrive. Other conditions, including submersion (reduces metals mobility) and high organic content (binds metals making them less bioavailable), in the fens and forested emergent wetlands also help reduce exposure risk to ecological receptors.

Therefore, the protection of these sensitive areas will also protect the flora and fauna that are unique to metals rich environments such as these, in addition to the fauna that is more transient and may occasionally visit the area.

The removal of the tailings and contaminated sediments will be followed by MNA for contaminated groundwater within the area of the Eastern Marsh. Under MNA, groundwater will be monitored semiannually to track changes in the groundwater metals concentrations. MNA will continue until the groundwater meets all SSCLs. For cost estimation purposes, it was assumed that the monitoring program will include 10 years of semiannual monitoring followed by 20 years of annual monitoring. However, the timeframe may vary depending on the success of source removal and other site-specific factors such as fluctuating groundwater elevation or continuing migration of contamination.

The selected remedy for the stream sediments in the active Blackfoot River channel within the eastern Upper Marsh includes removal of tailings and sediment with disposal at the UBMC Repository (Alternative 5). The present channel alignment will be preserved as much as possible during remediation. However, that may not be possible if removal of contaminated sediment creates an unstable stream configuration once the floodplain contaminated sediments are removed to meet SSCLs. This will be evaluated as part of remedial design.

The selected remedy for the Eastern Marsh will also contain the necessary site-wide elements (ICs and engineering controls in the form of signs) to limit access and protect humans from contaminants that exceed SSCLs in the sensitive areas (fens, forested emergent wetlands), where removal to SSCLs did not occur. The Upper Marsh naturally limits human access because it is extremely difficult to negotiate on foot due to the uneven terrain and heavy vegetation, both submerged by surface water. However, signs will be posted alerting recreators to the potential health hazards in the area. In addition, those areas will be surveyed and use of those surveyed areas will also be restricted through ICs.

Upper Marsh (EU12) Western Area

The Western Marsh selected remedy for sediment is MNR (Alternative 2, Figure 26). The conditions for this area are conducive to MNR as described in EPA guidance on sediment remediation (EPA, 2005). Total removal of contamination from the Mike Horse Mine/Beartrap Impoundment area down to the Upper Marsh, combined with additional removals in the eastern portion of the Upper Marsh, will eliminate a significant sediment contamination loading source to both the Eastern and Western Upper Marsh.

The Western Marsh remedy also includes site-wide elements (ICs and engineering controls in the form of signs) to limit access and protect humans from contaminants that exceed SSCLs in the sensitive areas (fens, forested emergent wetlands). Signs will be posted alerting recreators to the potential health hazards in the area. In addition, the Upper Marsh naturally limits human access because it is extremely difficult to negotiate on foot due to the uneven terrain and heavy vegetation, both submerged by surface water.

Allowing contaminated sediments to naturally recover will also be ecologically protective in the long-term. The current plant community health suggests that these areas continue to thrive. Other conditions, including submersion (reduces metals mobility) and high organic content (binds metals making them less bioavailable), help reduce exposure risk to ecological receptors in the short-term. Meanwhile, the sensitive areas (fens, forested emergent wetlands) are likely to continue to collect and retain metals. However, the protection of these sensitive areas will also protect the flora and fauna that are unique to metals rich environments such as these, in addition to the fauna that is more transient and may occasionally visit the area. Due to the length of time that it took to establish these areas, removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas.

11.2.6 EA 5 – MINING-RELATED FEATURES

The selected remedy for impacted soils and sediments in EA 5 is either removal and disposal at the UBMC Repository, site-wide elements, or both. In addition, one physical safety hazard is identified in EA 5 that will require some form of physical barrier to eliminate the hazard.

Physical Safety Hazards

The Mining-Related Features (EA 5) on non-federal land within the UBMC include a total of 24 locations (Appendix E). One of the features (PC-01; Figure 27) is only a physical safety hazard and does not impact soils, sediments or surface water. The selected remedy for PC-01 is a physical barrier (Alternative 3) to reduce or prohibit entry by humans at the open adit, along with an IC to provide for inspection and maintenance of the barrier. Installation of a bat gate, plugging with foam or a bulkhead, or backfilling will sufficiently address the hazardous open adit. Once the presence of bats is verified in the adit, the choice of which physical barrier to use will be made during remedial design and will consider size of the hazardous opening, accessibility issues, and ecological protectiveness.

Mining-related Features – Easy or Moderate Access

Of the remaining 23 features (Appendix E), five (BR-14, BR-39, PM-04, SH-13, SH-29; Figure 27) are either easily accessible (close to an existing road) or moderately accessible (close to an old road grade on mild slopes with minimal timber). The selected remedy for waste pile at BR-39 is removal to meet SSCLs and onsite disposal at the UBMC Repository. There are no soils and/or sediment sample data available for the other four locations. This is a data gap that will be addressed during remedial design. If SSCLs are exceeded in samples collected during remedial design, removal to meet SSCLs and disposal at the UBMC Repository is the selected remedy.

Mining-related Features – Difficult Access

The other 18 features (Appendix E) are in difficult areas to access and 6 (SG-47, SG-48, SG-49/50, SG-51, SG-71, SG-93; Figure 27) of the 18 sites are near surface water. All 18 feature locations (BR-29, PC-06, PM-06, JM-01, SH-14, SH-37, SG-13/14, SG-16, SG-41, SG-43, SG-47, SG-48, SG-49/50, SG-51, SG-71, SG-93, SG-94, SWG-02; Figure 27) are characterized by very steep and often heavily timbered slopes with very few established roads for access. Soils and/or sediment sample data is only available for two (SG-93, SG-94) of the 18 locations, and the selected remedy for those two features will be institutional controls and warning signs to limit access. Soils and/or sediment metals data for the other 16 features is a data gap that will be addressed during remedial design to determine if similar access restrictions are necessary. If SSCLs are exceeded in samples collected during remedial design, then the selected remedy is institutional controls and warning signs to limit access. In addition, those areas will be surveyed and use of those surveyed areas will also be restricted through ICs. Due to the small size of these features and their lack of vegetation, wildlife would likely avoid these areas for more desirable habitat in the surrounding areas.

Stevens Gulch (the location of 12 of the 18 features) is also located in a highly mineralized copper-molybdenum ore body (Figure 27). Road construction in this area would be difficult and would be compounded by the likelihood of exposing the ore body or highly mineralized soil (Figure 17), which may cause additional environmental damage by releasing metals to the environment. These access conditions make removal or containment difficult. These same conditions also make human foot travel extremely difficult, which greatly limits recreational use in these areas. The exposure assumption used to calculate SSCLs protective of recreational users (hunter) was 16 days, and it is unlikely that any recreationalist would be exposed for more than one day given the remote location and difficult terrain associated with these 18 features. In addition, the arsenic (530 mg/kg) and lead (2,608 mg/kg based on 5 ug/dL blood lead level) concentrations that are protective for a hunter, based on the 16 day exposure scenario, are higher than the more conservative site-wide SSCLs. Therefore, warning signs and ICs to limit use are the selected remedies at these remote features. In these areas, the physical condition of the waste area habitat is so poor that it is unlikely to be used by wildlife. These areas are small, sparsely vegetated, or bare waste piles and they are not appealing habitat when the vast majority of surrounding area is undisturbed forest habitat (TetraTech, 2013b). Therefore, the ecological receptors' preference for the nearby undisturbed habitat will provide adequate protection for ecological receptors.

11.3 ESTIMATED OUTCOMES OF THE FINAL REMEDY

The selected remedy uses a combination of institutional controls, engineering controls, long-term monitoring, removal and disposal of contaminated soil and sediment, soil containment, groundwater and surface water treatments (retention ponds, hydrologic and hydraulic controls combined with a permeable reactive barrier, inundation, and active chemical treatment combined with active mechanical treatment), MNR for some sediments, and MNA to protect public health, safety, and welfare and the environment over the long term. The remedy will reduce contaminant concentrations through a combination of technologies that cleanup soils and sediments in the source areas and accelerate cleanup of the contaminated groundwater. The technologies selected by DEQ to meet the remedy requirements include a combination of excavation, onsite disposal, containment, PRB, active chemical treatment combined with active mechanical treatment, MNR, and MNA. Successful excavation and disposal of contaminated soil and sediment or containment of contaminated soil will reduce or eliminate the continuing sources of contamination contributing to groundwater and surface water concentrations. Successful treatment of groundwater (adit discharges, seeps, alluvial and bedrock aquifers) and surface water (seeps and springs) will reduce or eliminate the continuing sources contributing to groundwater and surface water contamination. After completion of soil and sediment alternatives, soil and sediment contaminant concentrations will be below SSCLs. Groundwater concentrations are expected to be at or below SSCLs in those areas where sources are removed or contained, and MNA occurs. However, groundwater SSCLs are not expected to be met in those areas where active groundwater treatment will be performed into perpetuity; however, the treated groundwater will be at or below SSCLs prior to discharge. ICs and engineering controls, along with monitoring and maintenance, will prevent or mitigate exposure risks to onsite workers and visitors during remedy implementation, will ensure people are not drinking water that exceeds SSCLs, and will ensure particular uses do not occur on portions of the UBMC Facility where SSCLs are not protective of those uses.

It will take two years for remedial design and construction. The total time of planned construction (not including long-term monitoring) is approximately two years as most of the remedial activities will occur concurrently. Long-term monitoring, including MNR and MNA monitoring, will continue until SSCLs are met.

Some potential future land uses may be limited as a consequence of the remedial action. ICs in the form of restrictive covenants will ensure that the use of the properties is limited to commercial/industrial for the WTP. State property (Section 35) will also have an IC in place to control access and use of the UBMC Repository area, as will those properties containing the Carbonate and Paymaster Repositories. Through ICs, installation of groundwater wells will be limited until SSCLs are met. In areas characterized by very steep and often heavily timbered slopes with very few roads, contaminated soil removals to meet SSCLs may not be feasible. These areas will also require an IC to restrict access and use; there will also be ICs to require maintenance of signs, fencing, and adit plugs.

Groundwater use restrictions are necessary to prevent use of contaminated groundwater. After groundwater SSCLs are achieved, groundwater will again be available for unrestricted use and as allowed by local regulations. The timeframe for achieving groundwater SSCLs at the various portions of the Facility will vary and in some cases is uncertain. In areas where contaminated floodplain soils and sediments are removed, shallow, alluvial groundwater should attenuate to SSCLs more quickly than in areas where metals concentrations in groundwater are higher.

Achieving the SSCLs for surface water quality will come from successful implementation of the selected remedies for soil, sediment, and groundwater that surround the UBMC surface water bodies. Successful implementation of interim actions demonstrates the effectiveness of this approach. The remedy selected in this ROD will improve water quality and over time is predicted to meet the surface water SSCLs. Surface water monitoring will evaluate the effectiveness (performance) of the remedies for the other media and confirm that SSCLs are met in surface water.

12.0 STATUTORY DETERMINATIONS

Under Section 75-10-721, MCA, of CECRA, DEQ must select a remedy that will attain a degree of cleanup of the hazardous and deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety, and welfare and of the environment. In approving or carrying out remedial actions performed under Section 75-10-721, MCA, DEQ must require cleanup consistent with applicable state and federal ERCLs, and may consider substantive state and federal ERCLs that are relevant to site conditions. In addition, DEQ must select a remedy considering present and reasonably anticipated future uses, giving due consideration to institutional controls. The selected remedy must mitigate risk, be effective and reliable in the short- and long-term, be practicable and implementable, and use treatment or resource recovery technologies, if practicable, giving due consideration to engineering controls. DEQ also evaluates the remedy for cost effectiveness. Finally, DEQ considers the acceptability of the remedy to the affected community, as indicated by community members and the local government. DEQ has considered all public comment received during the public comment period on the Proposed Plan, has responded to these comments in Part 3 of the ROD, and addressed those comments in selecting the final remedy.

The selected remedy is protective of public health, safety, and welfare and the environment, complies with ERCLs, mitigates risk, is effective in the short- and long-term, is practicable and implementable, uses treatment and resource recovery technologies, and is cost-effective.

The following sections discuss how the selected remedy meets the CECRA statutory requirements.

12.1 PROTECTION OF PUBLIC HEALTH, SAFETY, AND WELFARE AND THE ENVIRONMENT

CECRA provides that protection of public health, safety, and welfare and the environment is a threshold criterion in selecting a remedy. DEQ has determined that the selected remedy appropriately protects public health, safety, welfare and the environment through the following:

- Excavation of contaminated soils, followed by disposal in the UBMC Repository, to reduce metals concentrations in EA1, which will also improve surface water quality by reducing or eliminating runoff and erosion, and leaching to groundwater.
- Containment in one portion of EA1to reduce direct contact and the erosion and transport of contaminated media associated with rainfall, which will also improve surface water quality.
- Use of engineering controls and ICs in portions of EA1 that are difficult to access due to steep slopes and a lack of roads.
- No action for portions of EA1 (EU5) because recalculation of exposure point concentrations demonstrated compliance with SSCLs or there were only slight exceedances of one SSCL (EU9A) that is based on protecting ecological receptors and the area is small and not appealing habitat.
- Use of ICs to prohibit excavation and construction in the Paymaster area to prohibit mobilization of metals.
- Treatment of contaminated groundwater from the Anaconda Mine adit discharge, the Mike Horse Mine adit discharge and seeps, and the Upper Mike Horse Mine alluvial and

bedrock groundwater aquifers in the WTP along with ICs to restrict groundwater use until SSCLs are met.

- Hydrologic and hydraulic controls combined with PRB to treat the groundwater at the Carbonate Mine, should monitoring demonstrate a potential for near-surface contaminated groundwater to affect the Blackfoot River and ICs to restrict groundwater use until SSCLs are met.
- Removal of sediments in particular surface water bodies along with MNR and long-term monitoring. For mining-related feature discharges, seeps, and springs, containment or engineering controls will be used to limit exposure.
- In the eastern portion of the Upper Marsh, tailings and sediments will be removed to SSCLs and disposed in the UBMC Repository. In areas containing fens and forested emergent wetlands, ICs and engineering controls will limit exposure. In the western portion of the Upper Marsh, MNR will be used along with long-term monitoring, ICs, and engineering controls to limit exposure until SSCLs are met. In areas containing fens and forested emergent wetlands, ICs and engineering controls will limit exposure.
- A physical barrier and ICs, along with inspections and maintenance, will be used at mining-related feature PC-01 to reduce or prohibit entry at the open adit.
- Contamination at other mining-related features will be addressed by removal and disposal at the UBMC Repository or, where access is difficult, through ICs and engineering controls to limit exposure.
- MNA, in combination with source remediation in the Eastern Marsh in EA4, will be protective of human health and the environment by ensuring that contaminants in the groundwater meet SSCLs.
- Long-term monitoring and maintenance of the Anaconda, Capital, Paymaster, and Mike Horse adit plugs, existing repositories, and engineering controls to ensure their integrity.

12.2 COMPLIANCE WITH ERCLS

Remedial actions undertaken pursuant to CECRA must "attain a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety, and welfare and of the environment." Section 75-10-721(1), MCA. Additionally, Sections 75-10-721(2)(a) and (b), MCA, provide that DEQ must require cleanup consistent with applicable state or federal ERCLs. The statute also provides for DEQ consideration of substantive ERCLs that are relevant to the site conditions. In order to assist DEQ in ensuring that the required cleanup is consistent with ERCLs, DEQ identifies those laws or regulations that have been promulgated which are applicable or relevant to the Facility. The final determination of ERCLs is included in Appendix A of this ROD. While some of the selected remedial actions will result in immediate compliance with ERCLs, additional time may be needed for other remedial actions to demonstrate compliance with ERCLs. The selected remedy will comply with all applicable and relevant ERCLs. Some significant ERCLs compliance issues are discussed below.

For the COCs in surface water and groundwater, the contaminant-specific ERCLs for the remedial action are the standards specified in the DEQ-7 standards.

Certain actions (removal of contaminated soil and sediment, and onsite disposal), coupled with MNR and MNA, will lead to compliance with DEQ-7 standards within a reasonable timeframe.

Construction of the UBMC Repository will comply with solid waste ERCLs including installation of a liner, run-on and run-off controls, and a minimum two foot cover.

Reclamation after removals will comply with identified reclamation ERCLs, including revegetation and noxious weed requirements.

Removal of the Mike Horse Repository out of the floodplain ensures compliance with floodplain ERCLs. The UBMC Repository is constructed in an area that complies with location-specific ERCLs.

Removals in the marsh area will not result in destruction or loss of wetlands.

12.3 MITIGATION OF RISK

The selected remedy for soil and sediment was selected over other alternatives because it is expected to achieve substantial and long-term risk reduction through excavation and disposal of contaminated soil and sediment in the UBMC Repository. In those areas where soil or sediment cannot be removed, alternative remedies such as containment and engineering controls were selected to provide protection against direct contact and erosion. Contaminated groundwater in many areas will be treated at the WTP and MNA will also be used following source removal. Risk to surface water is mitigated through source removal of contaminated soil and sediment followed by long-term monitoring of the surface water. These removals will also facilitate MNR, ensuring that sediments are not posing an unacceptable risk. Direct hazards will be addressed through adit closure or addressed through engineering controls. Long-term monitoring of the adit plugs, repositories, sediments, surface water, and groundwater will confirm that risk has been mitigated. Finally, ICs and engineering controls will also be used to prevent access and exposure to a variety of media until SSCLs are met.

12.4 EFFECTIVENESS AND RELIABILITY

The selected remedy is effective in that it reduces the risk to acceptable levels, consistent with background concentrations, and allows the UBMC Facility to be used for the reasonably anticipated future uses, which include commercial/industrial, open space, residential, and assorted recreational opportunities. ICs and long-term monitoring and maintenance will ensure the integrity of the remedy.

The selected remedy will comply with all federal and state safety laws. Short-term effectiveness of the remedy, including consideration of the risks involved to workers, the community, and ecological receptors as the remedy is being implemented, will be mitigated through the use of BMPs, adequate dust control, and other safety measures, as necessary, and will be identified as part of remedial design.

12.5 PRACTICABILITY AND IMPLEMENTABILITY

The selected remedy is technically practicable and implementable at the UBMC Facility because the selected technologies are routinely used successfully in the environmental field and the materials necessary are widely available. The excavation and disposal of wastes and revegetation steps required for removal are considered standard and conventional construction practices.

Removal and reclamation of upland wastes and mining-related features could be difficult in some locations at the UBMC because of the steep terrain, remoteness, and inadequate access, and special equipment may be required. Certain stream reaches are difficult to access because of steep terrain, remoteness, and inadequate roads in these areas; however, engineering and institutional control are implementable in those locations Removal of sediment in the marsh and streams is dependent upon dewatering operations and access into wet or saturated areas. Mike Horse Creek Road and an abandoned drill testing road provide the only serviceable access to the Upper Marsh. Engineering and construction contractors with the experience and equipment necessary to complete the work are available regionally.

12.6 USE OF TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES

The selected remedy is expected to achieve substantial risk reduction through treatment of contaminants in groundwater by using active chemical treatment combined with physical/mechanical treatment, and passive chemical treatment through a PRB.

12.7 COST EFFECTIVENESS

The selected remedy is cost-effective, taking into account the total short- and long-term costs of the actions, including long-term operation and maintenance activities for the entire period during which the activities will be required. The selected remedy provides overall risk reduction proportionate to the costs. To the extent that the estimated cost of the selected remedy exceeds the costs of the other alternatives, the difference in cost is reasonably related to the greater overall reduction in risk provided by the selected remedy and the reliability. The detailed evaluation of the balance of these criteria among the alternatives considered is set forth in the FS and in Section 10, Comparative Analysis of Alternatives, of this ROD.

13.0 DOCUMENTATION OF NOTABLE CHANGES FROM THE PROPOSED PLAN

The Proposed Plan for the UBMC Facility was released for public comment on October 9, 2015. The Proposed Plan identified a combination of Solid Media Alternative 2 (MNR) to address remaining metals-contaminated sediments; Solid Media Alternative 3 (physical barriers) to address physical hazards such as adit openings; Solid Media Alternative 4 (containment) to address contaminated soils that cannot be removed; Solid Media Alternative 5 (removal and onsite disposal) to address contaminated soil and sediment; Liquid Media Alternative 9 (MNA) to address remaining metals in groundwater; Liquid Media Alternative 10 (retention pond) to address small volume seeps, springs, and adit discharge; Liquid Media Alternative 11 (hydrologic and hydraulic control) combined with Liquid Media Alternative 15 (PRB) to address remaining metals in surface water and groundwater; and Liquid Media Alternative 13 (active chemical reagent) combined with Liquid Media Alternative 14 (active physical/mechanical treatment) to reduce COC concentrations in the adit discharges to DEQ-7 surface water standards. The preferred remedy identified in the Proposed Plan also included ICs, engineering controls, and long-term monitoring. DEQ has reviewed and responded to the written comments made during the public comment period (See Part 3). No one provided oral comments during the public hearing for the Proposed Plan.

In this ROD, DEQ made the following specific changes to the selected remedy set forth in the Proposed Plan:

- In response to public comment, DEQ SSCL tables were revised to better explain the origin of the soil and sediment SSCLs. It was clarified that iron is only a COC for groundwater (Section 7.3.5). The SSCL tables also clarify that leaching-to-groundwater SSCLs for all COCs for each EU were derived using site-specific DAF and SPLP results from each EU. These leaching-to-groundwater SSCLs represent the theoretical concentration that it would take for iron to leach from the soil and into the groundwater at the UBMC. Footnotes were also added identifying hardness and pH dependent metals. The origin for each surface water and groundwater SSCL was provided and included background, a site-specific calculation, or a DEQ-7 standard. In addition, SSCLs were identified for Swamp Gulch surface water and Paymaster and Edith groundwater.
- DEQ re-evaluated the Long-Term Monitoring and Maintenance costs for the UBMC and found that those costs were not included in the Proposed Plan cost estimates. These costs were included in the text of the FS, but not included in the FS cost tables that were used to estimate cost in the Proposed Plan. Therefore, the proposed plan costs for the site-wide elements were under estimated. The total site-wide elements cost is approximately $1.7 million versus the estimated $108,488 in the Proposed Plan.
- The Paymaster groundwater aquifers occur in highly mineralized areas. After closer evaluation of the data, DEQ identified the background concentrations for the Paymaster groundwater aquifers as SSCLs for that area (Table 4A). As a result of this evaluation, DEQ determined that the Paymaster Mine area groundwater meets SSCLs that apply to that area and does not require any further action.
- The Edith groundwater area occurs in a highly mineralized area that is located in and influenced by local fen and forested emergent wetland environments. After closer evaluation of the data, DEQ identified the background concentrations for the Edith groundwater area as SSCLs for that area (Table 4A). As a result of this evaluation, DEQ

determined that the Edith Mine area groundwater meets SSCLs that apply to that area and does not require any further action.

- DEQ added background information regarding the nature and function of each of the four adit plugs previously installed as interim actions. The Anaconda and Mike Horse plugs function as part of the conveyance system that transports adit discharge to the WTP. The Capital Mine plug is a grout plug that prevents adit discharge. The Paymaster plug is a conveyance pipe and vault combined with intentionally collapsing the adit.
- While adding land ownership to Figure 26, DEQ discovered that the non-federal land in the Western Marsh was underestimated. The percent of non-federal land in the 34 acre Western Marsh increased from just under 2% (< 1 acre) to approximately 39% (13.3 acres). This adjustment increased the cost for MNR in the Western Marsh to $71,311 versus the $11,885 that was identified in the Proposed Plan.
- At the request of NRDP, DEQ added capital costs to the cost estimate in the FS (Pioneer, 2016) to address water treatment plant replacement costs. Specifically, the following costs were added:
    - $20,000 annually to cover ceramic module costs (replacement every five years at a cost of $100,000);
    - $25,000 annually to cover ceramic filter costs (replacement every five years at a cost of $125,000);
    - $100,000 annually to cover other replacement or repair expenses.

These additional costs increased the annual operating costs to $625,356. Without WTP replacement, this changed the 30 year net present value for annual O&M to $12,257.254. The Trust also has insurance on the WTP for catastrophic replacement in the amount of $3,000,000. This amount was added to the cost estimate at years 15 and 30. With WTP replacement in those years, the 30 year net present value for the WTP is $15,418,800. This increased the estimated cost of the selected remedy to $22,020,895.

14.0 ADMINISTRATIVE RECORD

DEQ cited, relied upon, or considered the following documents in selecting the remedy for the UBMC. It does not include legal citations such as those found in the Montana Code Annotated, Administrative Rules of Montana, United States Code, and Code of Federal Regulations. Any document, model, or other reference identified in the RI (Tetra Tech, 2013a), BERA (Tetra Tech, 2013b), HHRA (Tetra Tech, 2014), or FS (Pioneer, 2016) are also incorporated herein as part of the administrative record.

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1.0 INTRODUCTION

The Montana Department of Environmental Quality (DEQ) solicited public comment on the October 2015 Proposed Plan (DEQ, 2015) for the Upper Blackfoot Mining Complex (UBMC) Facility near Lincoln, Montana, during a public comment period that ran from October 10, 2015, to November 9, 2015. DEQ also held a public meeting and hearing in Lincoln on October 28, 2015. At the public hearing, people were offered the opportunity to submit oral comments but no one provided any oral comments during that hearing. DEQ received one written comment during the public comment period.

1.1 COMMUNITY INVOLVEMENT BACKGROUND

The Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) provides for the public to have input into the DEQ decision-making process with respect to the final cleanup of state Superfund facilities. At the UBMC Facility, DEQ sought public comment on the Proposed Plan, considered that comment, prepared this written responsiveness summary, and made changes, as necessary, to the Feasibility Study (FS) and the Record of Decision (ROD) based on public comment or as otherwise appropriate.

1.1.1 Notification of Public Comment Period

DEQ provided notice of the public comment period and public meeting/hearing associated with the Proposed Plan via postcard mailings and a Site Update distributed to the UBMC Facility mailing list. DEQ also issued press releases to local newspapers and posted the Proposed Plan and Draft Final FS, as well as notice of the public comment period and public meeting, on its website. On October 9, 2015, DEQ sent letters to the Lewis and Clark County Commissioners, the Upper Blackfoot Valley Community Council, the Mayor of Helena and the Helena City Commissioners, and the Lewis and Clark County Health Department notifying them of the public comment period and public meeting. A legal notice of the public comment period and public meeting/hearing was published on October 11, 2015, in the Independent Record and on DEQ's website. In addition, DEQ published display ads announcing the public comment period and public meeting/hearing in the Great Falls Tribune, Blackfoot Valley Dispatch, and the Missoulian. DEQ held a public meeting/hearing in Lincoln on October 28, 2015, to present and discuss the Proposed Plan, answer questions, and to receive oral public comments. No one provided oral comments during the public hearing for the Proposed Plan.

1.1.2 Administrative Record

The administrative record is the set of documents DEQ cited, relied upon, or considered when determining the final remedy for the non-federal lands at the UBMC. References to the administrative record are found in Part 2, Section 14.0 of the ROD. It does not include legal citations such as those found in the Montana Code Annotated, Administrative Rules of Montana, United States Code, and Code of Federal Regulations. Any document, model, or other reference identified in the Final Remedial Investigation Report (Tetra Tech, 2013a), Final Baseline Human Health Risk Assessment (Tetra Tech, 2014), Final Baseline Ecological Risk Assessment (Tetra

Tech, 2013b), and Final Feasibility Study (Pioneer, 2016) are also incorporated herein as part of the administrative record.

1.1.3 Document Repositories

The complete files for the UBMC Facility, including the documents making up the administrative record for the ROD, are available for public review at the DEQ offices in Helena. There is also a partial compilation of these resources at the Lewis and Clark County Library, the Lincoln Ranger Station, the Lincoln Library, and on DEQ's website at http://deq.mt.gov/StateSuperfund/UBMC/default.mcpx.

Montana Department of Environmental Quality 1225 Cedar Street Helena, MT 59601 406-444-6444	Business Hours: Monday – Friday: 8 am – 5 pm
Lincoln Ranger District 1569 Highway 200 Lincoln, MT 59639 406-362-7000	Business Hours: Monday – Friday: 8 am – 5 pm
Lincoln Library (Lewis and Clark Library Branch) 102 9th Street Lincoln, MT 59639 406-362-4300	Business Hours: Sunday – Friday (hours vary); Closed Saturday
Lewis and Clark County Library 120 S. Last Chance Gulch Helena, MT 59601 406-447-1690	Business Hours: Sunday – Saturday (hours vary)

1.1.4 Updates

To keep citizens updated about activities at the UBMC Facility, DEQ publishes informational mailings called the Mike Horse Messenger. These mailings contain information on recently released documents, upcoming activities and meetings, construction activities, and other information. Informational updates were sent to individuals on the mailing list for the UBMC Facility and local media, as well as to City and county officials and other stakeholders. Informational updates will continue during remedial design and implementation, and will be available on DEQ's website listed above.

1.1.5 Toll-free Hotline

DEQ maintains an in-state toll-free number (1-800-246-8198) for people who want to contact DEQ about the UBMC Facility or other Superfund facilities. DEQ Remediation Division personnel direct calls to appropriate project officers. The toll-free number is answered in person during business hours. In addition, DEQ maintains a website at http://deq.mt.gov.

1.1.6 Mailing List

DEQ maintains a mailing list that is periodically updated. DEQ has actively solicited additions to the mailing list in informational updates and at public meetings. In accordance with state law, the mailing list is generally not released to the public.

2.0 RESPONSIVENESS SUMMARY

2.1 EXPLANATION

All comments received by DEQ during the public comment period on the Proposed Plan have been reviewed and considered by DEQ in the decision-making process and are addressed in this Responsiveness Summary. The Lewis and Clark Public Health Department provided comments on the Proposed Plan and those comments are summarized below; they are also part of the administrative record (DEQ, 2015). As stated above, no one provided oral comments during the public hearing for the Proposed Plan; however, the transcript from the public hearing is part of the administrative record (DEQ, 2015).

To assist in developing responses, DEQ added its own numbering to comments where appropriate to add clarity. Comments are numbered and in italics, with DEQ's response following each.

2.2 COMMENTS AND DEQ RESPONSES

Comment 1*: The site-specific cleanup levels (SSCLs) for soils (Table 1A) and sediments (Table 1B), as listed, include some relatively high metals concentrations that do not necessarily seem to be protective of the local ecosystem. For example, the SSCL for iron in EU 7 is listed at 762,136 mg/kg. This reflects a soil that is 76% elemental iron, exceeding the actual concentrations encountered in what is considered high grade iron ore. While this is the highest listed concentration, the SSCLs seem higher than they should be. For example, the SSCL for lead at 1,109 mg/kg, which would be a soil concentration of 0.1% lead. The SSCL concentrations for soil and sediment should be realistic to maintain the local ecologic functions for these lands.*

Response: These tables, which are Tables 5A and 5B in the ROD, have been revised with footnotes to better explain the origin of the soil and sediment SSCLs. Iron is only a contaminant of concern (COC) for groundwater (Section 7.3.5). Leaching-to-groundwater SSCLs for all COCs for each exposure unit (EU) were derived using site-specific dilution attenuation factor and synthetic precipitation leaching procedure results from each EU. The development of leaching-to-groundwater SSCLs (see Section 7.6 of the ROD) is documented in Section 10.4 and Appendix G of the HHRA (Tetra Tech, 2014). These leaching-to-groundwater SSCLs represent the theoretical concentration that it would take for iron to leach from the soil and into the groundwater at the UBMC.

All of the site-wide surface soil SSCLs are based on the UBMC background soil concentrations (see Section 7.7 of the ROD). Once the human health risk-based concentrations were calculated for HHRA COCs and the risk-based remedial ecological goals were calculated for the BERA COCs, they were compared to the site-specific background concentrations for the UBMC. If the site-specific background concentrations exceeded the human health risk-based concentrations and the risk-based remedial ecological goals, then the background concentrations were selected as the SSCLs. The reason site-specific background levels were chosen is because it is not necessary to cleanup to a soil metals concentration that is lower than the background concentration. This has been clarified in the ROD in response to this comment.

Comment 2: *The SSCLs for groundwater and surface water are presented in Table 2 represent the human health standards from DEQ-7, and not the aquatic life standards. The proposed standards are significantly higher than those described in the Proposed Plan as derived from aquatic life standards and necessary for ecosystem protection. The wrong standards were used in the calculations for the SSCLs. Recharging waters at concentrations meeting the listed concentrations in Table 2 could significantly impact the local ecosystem. Aquatic standards should be used for several reasons. Background conditions may result in localized areas with elevated concentrations of contaminants of concern. Depending on the magnitude of the contamination, the total cost for the cleanup activities, compared with available funding, may not be practical to meet the lower standards immediately proximal to the sites. Mixing zones may be used accounting for dilution and natural attenuation of contaminants. Note that quantification of soil-aquifer treatment properties within mixing zones represents a useful method to include a component of the cleanup alternatives, when combined with more specific engineered solution.*

Response: The referenced table, which is Table 4 in this ROD, was revised to reflect that the aquatic standards were considered as described in the text of the Proposed Plan. The original table did not include SSCLs that were based on the DEQ-7 aquatic standards (UBMC SSCLs for surface water) that were described in the Proposed Plan. In response to this comment, the table in the ROD now clarifies that the chronic and acute DEQ-7 aquatic standards were considered and the most protective of the surface water standards were selected as SSCLs. The table also notes that four of the metals (cadmium, copper, lead, and zinc) are hardness dependent. The hardness data will be collected at the time of sampling to demonstrate compliance with SSCLs.

Comment 3: *The discussion of preliminary remedial action objectives in Section 9.0 includes references to compliance with environmental requirements, criteria or limitations (ERCLs). In order to aid the reader, a list of these, as referenced to the feasibility study, would be useful. Further, the acronym should be placed in the list of acronyms since it is frequently used in part of the document.*

Response: The final ERCLs are included in Appendix A to the ROD. In addition, DEQ has added “ERCLs” to the acronym list in the ROD.

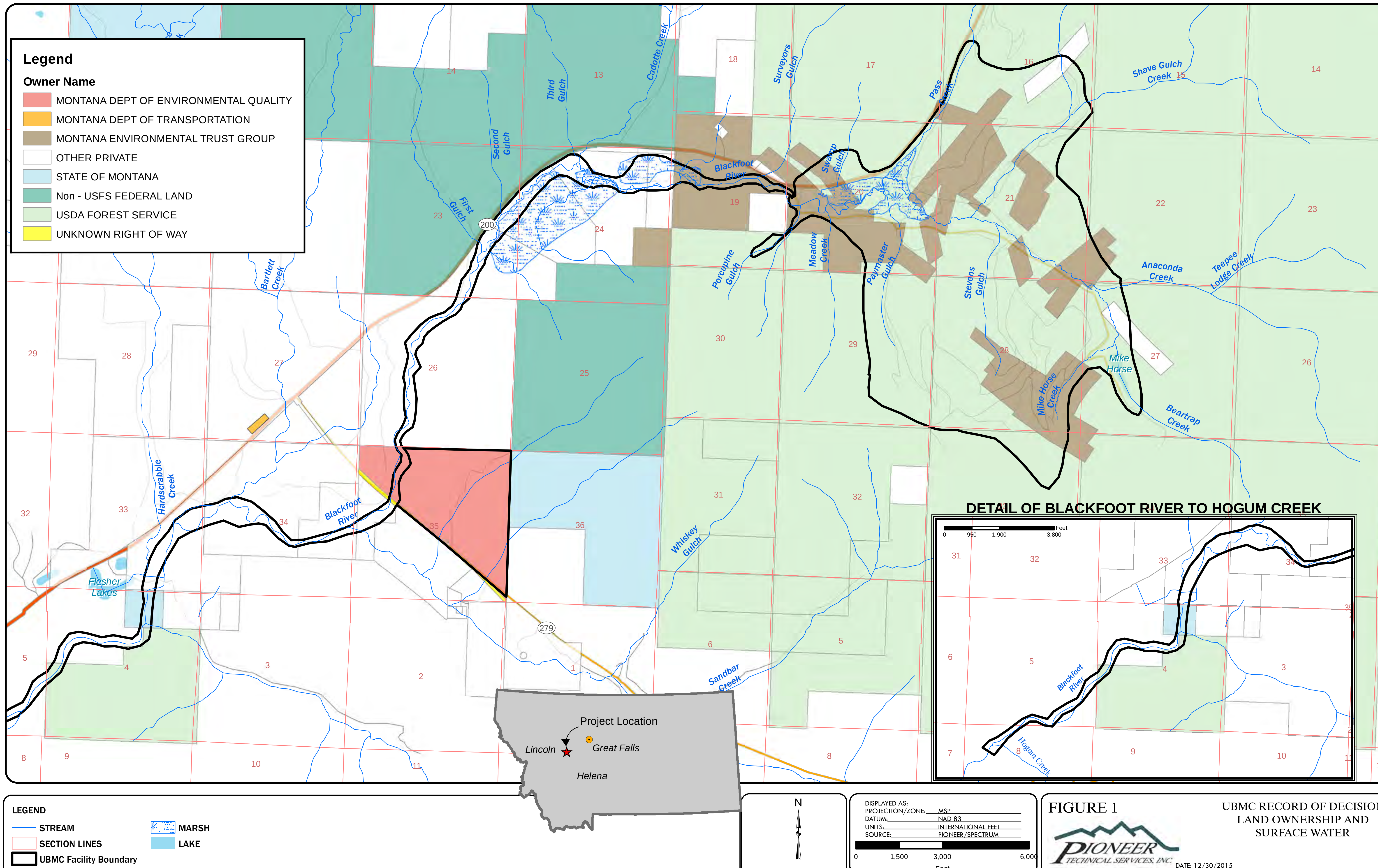


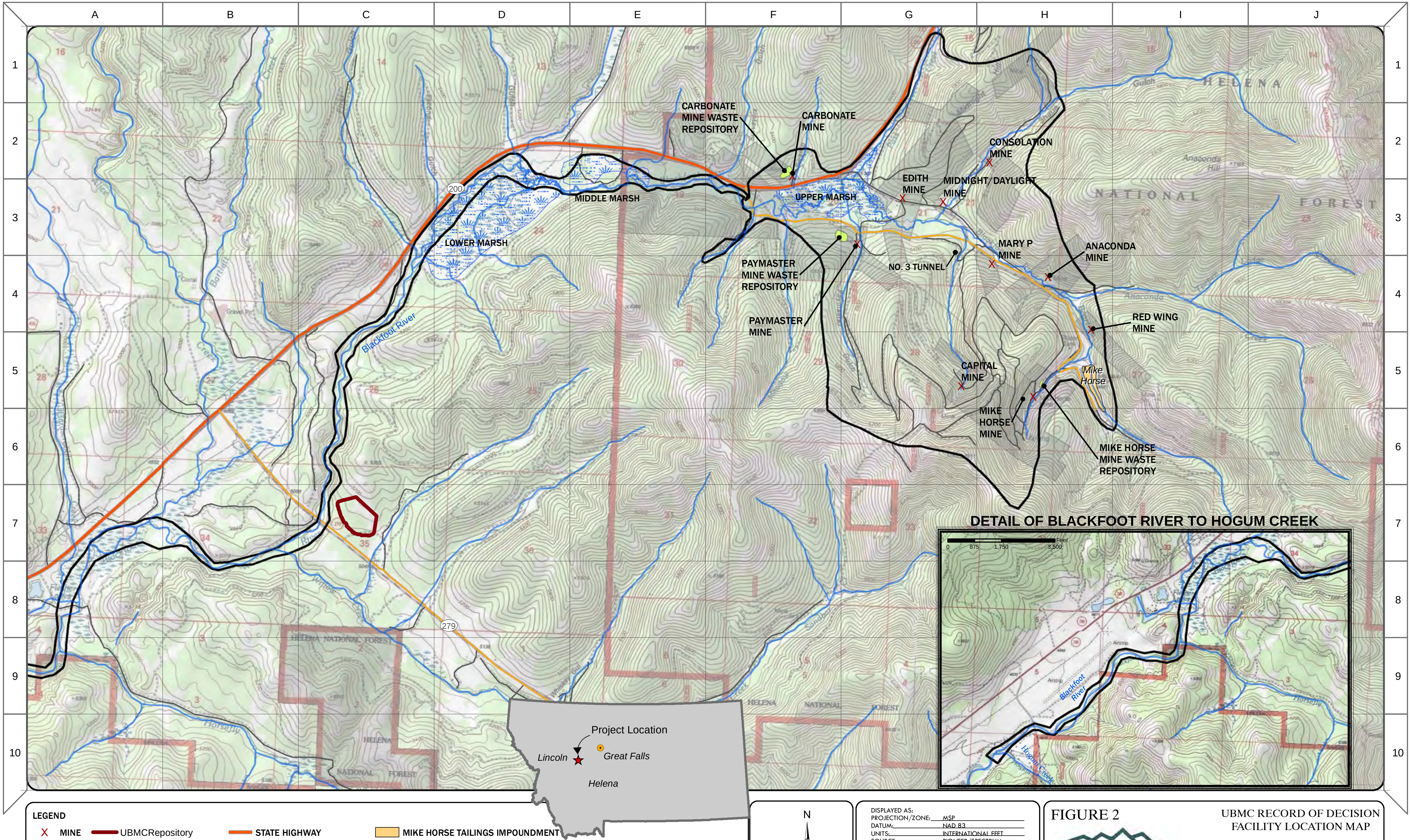
FIGURE 1

UBMC RECORD OF DECISION
LAND OWNERSHIP AND
SURFACE WATER

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD1_122015.mxd



LEGEND

- X MINE
- UBMCRepository
- STREAM
- UBMC Facility Boundary
- STATE HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- MINE WASTE REPOSITORY
- MIKE HORSE TAILINGS IMPOUNDMENT
- MARSH
- FOREST SERVICE PROPERY BOUNDARY

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

Feet
0 1,200 2,400 4,800

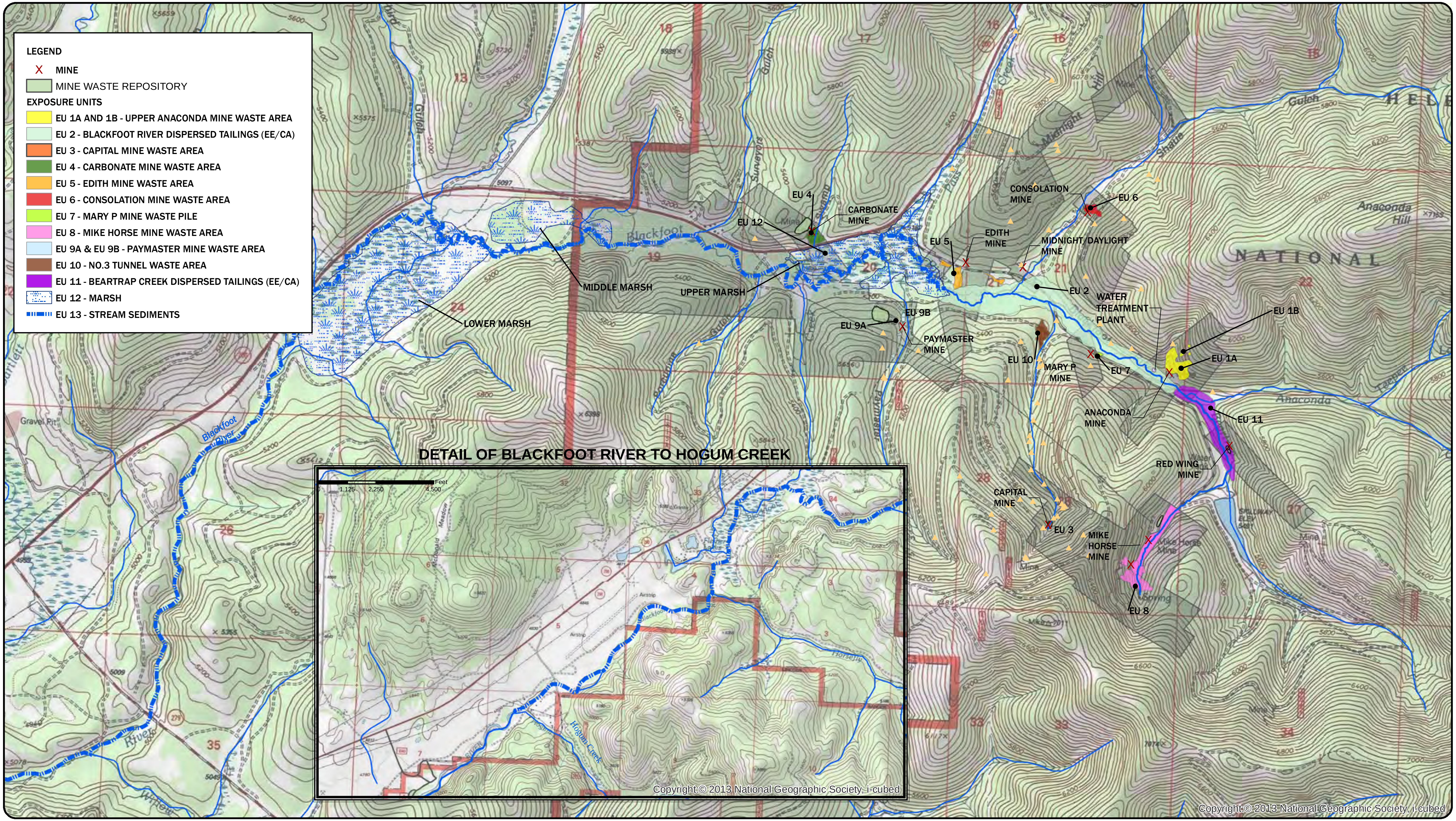
FIGURE 2

UBMC RECORD OF DECISION
FACILITY LOCATION MAP

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/2/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD2_122015.mxd



LEGEND

- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- STREAM
- FOREST SERVICE
- METG/PRIVATE
- LAKE

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 1,000 2,000 4,000
Feet

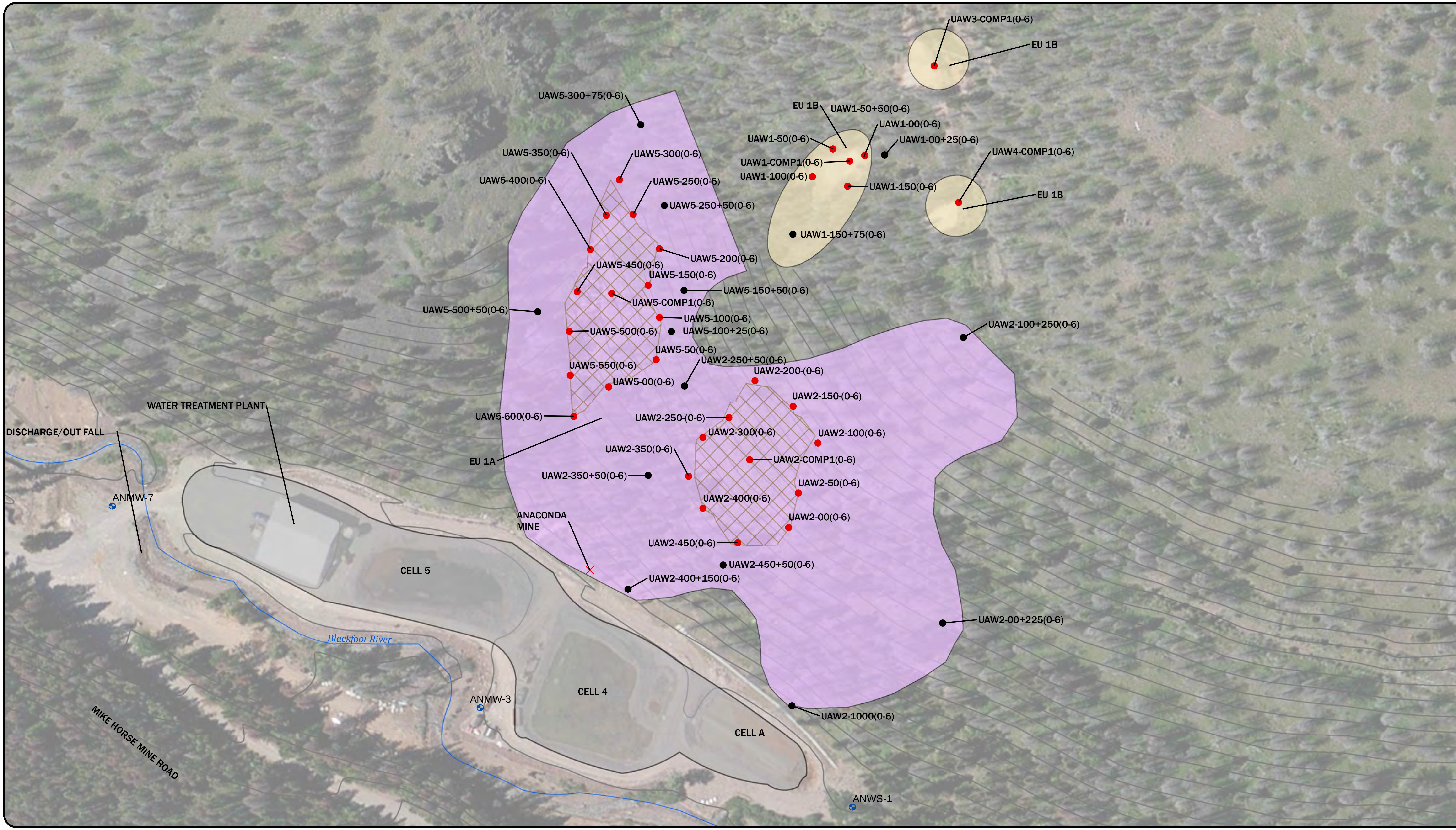
FIGURE 3

UBMC RECORD OF DECISION
EXISTING CONDITIONS FROM
REMEDIAL INVESTIGATION

PIONEER TECHNICAL SERVICES, INC.

DATE: 2/3/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD3_122015.mxd



LEGEND

- MINE
- 2007 SAMPLES
- 2008 SAMPLES
- ESTIMATED EXTENT OF CONTAMINATION IN UPPER ANACONDA MINE WASTE REMOVAL AREA
- ESTIMATED EXTENT OF CONTAMINATION IN UPPER ANACONDA MINE WASTE PILES
- FORMER WETLAND TREATMENT CELLS
- MINE WASTE REMOVAL/RECLAIMED AREA
- STREAM

Type

- MONITORNG WELL - ALLUVIAL

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 70 140 280 Feet

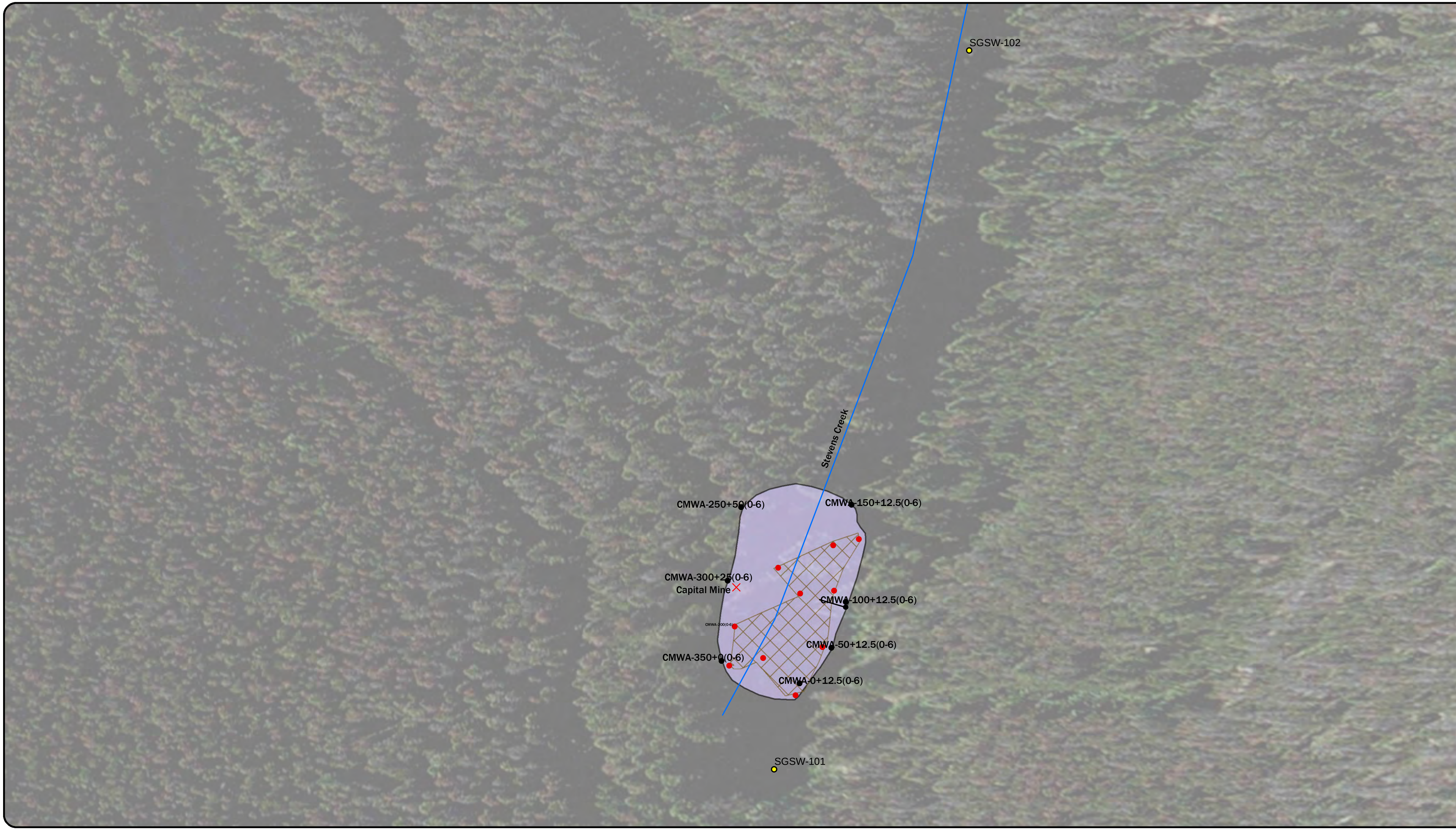
FIGURE 4

UBMC RECORD OF DECISION
EU 1A AND EU 1B UPPER ANACONDA
MINE WASTE PILES
SOIL SAMPLE LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD4_122015.mxd



LEGEND

- MINE
- 2007 SAMPLE
- 2008 SAMPLE
- ESTIMATED EXTENT OF MINE WASTE AREA
- MINE WASTE REMOVAL/RECLAIMED AREA
- STREAM

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 45 90 180 Feet

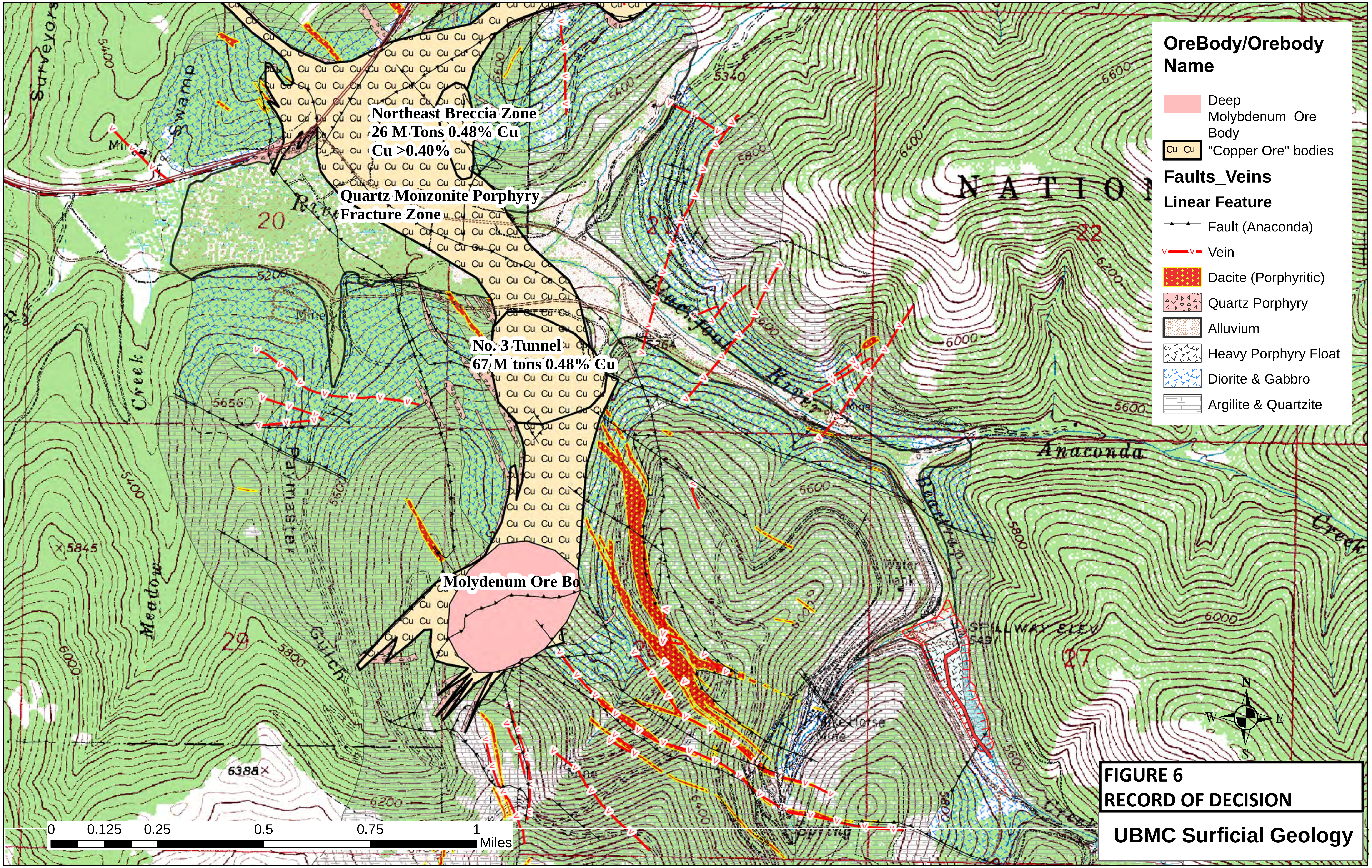
FIGURE 5

PIONEER TECHNICAL SERVICES, INC.

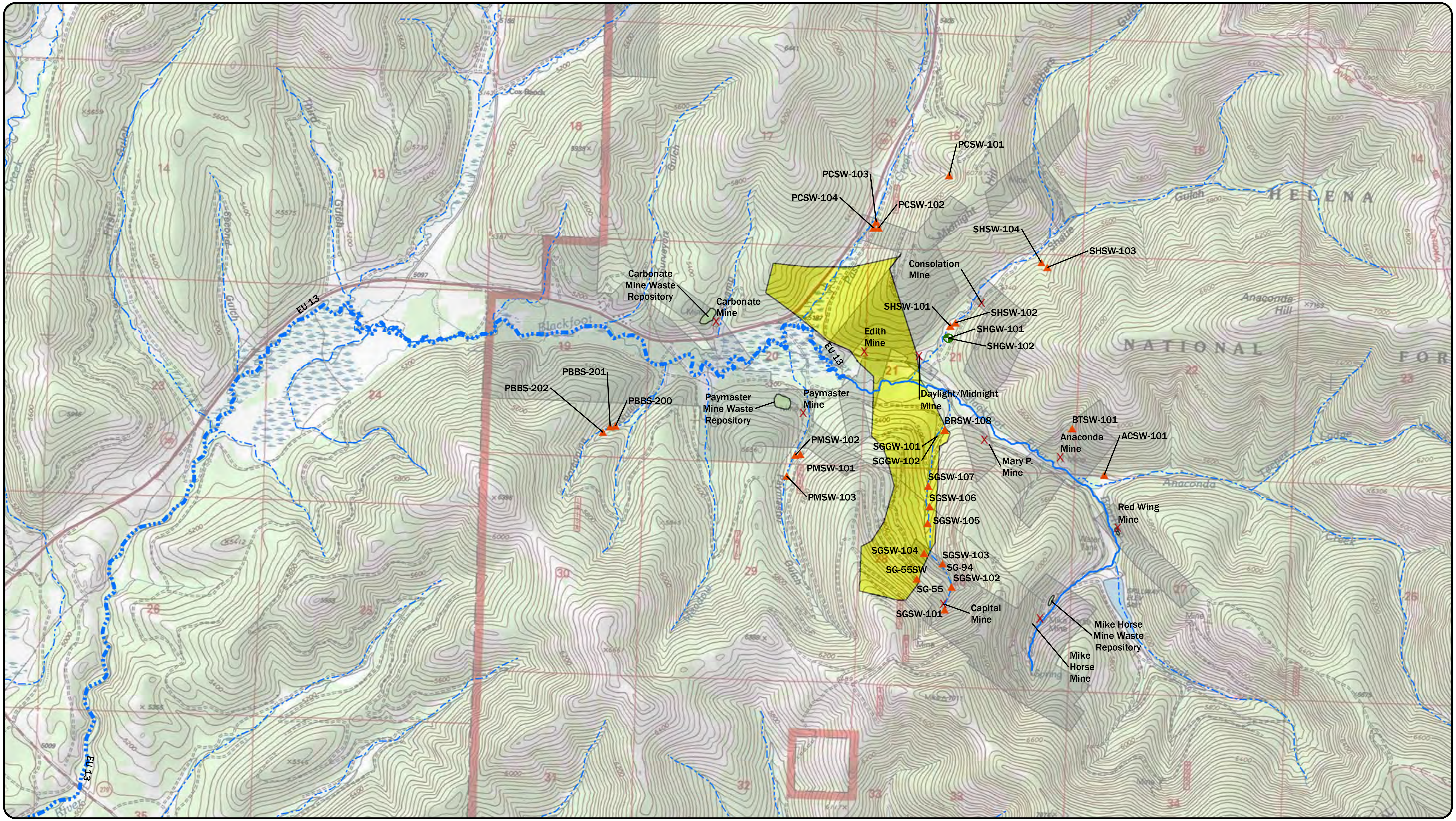
UBMC RECORD OF DECISION
EU 3 CAPITAL MINE WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 12/2/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD5_122015.mxd



C:\Projects\Mike Horse\ArcMap\UBMC Surficial Geology 11x17.mxd



LEGEND:
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- LAKE
- METG/PRIVATE
- FOREST SERVICE PROPERTY BOUNDARY
- MINE
- MONITORING WELL - ALLUVIAL/BEDROCK PAIR
- EU 13 STREAM
- SURFACE WATER SAMPLE LOCATION
- MINE WASTE REPOSITORY
- Approximate Boundary of Copper & Molybdenum Ore Body

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 1,100 2,200 4,400
Feet

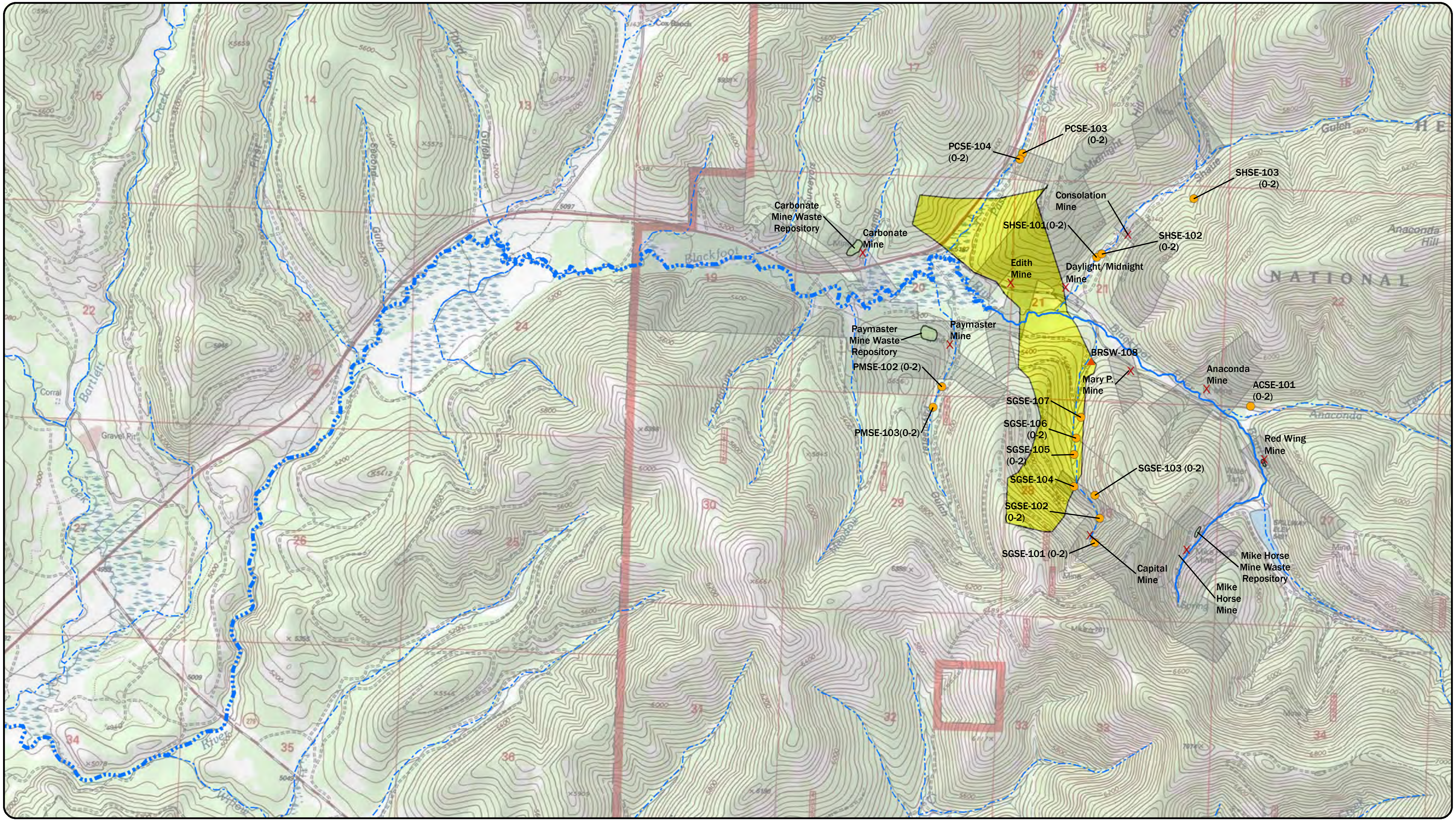
FIGURE 7

UBMC RECORD OF DECISION
MINING RELATED
FEATURES SURFACE WATER
SAMPLE LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD7_122015.mxd



LEGEND:

- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- LAKE
- METG/PRIVATE
- FOREST SERVICE PROPERTY BOUNDARY
- X MINE
- 2008 MINE INVENTORY SEDIMENT SAMPLE LOCATIONS
- EU 13 STREAM
- 2007 AND/OR 2008 SURFACE WATER SAMPLING LOCATION
- MINE WASTE REPOSITORY
- APPROXIMATE BOUNDARY OF COPPER & MOLYBDENUM ORE BODY

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 1,100 2,200 4,400
Feet

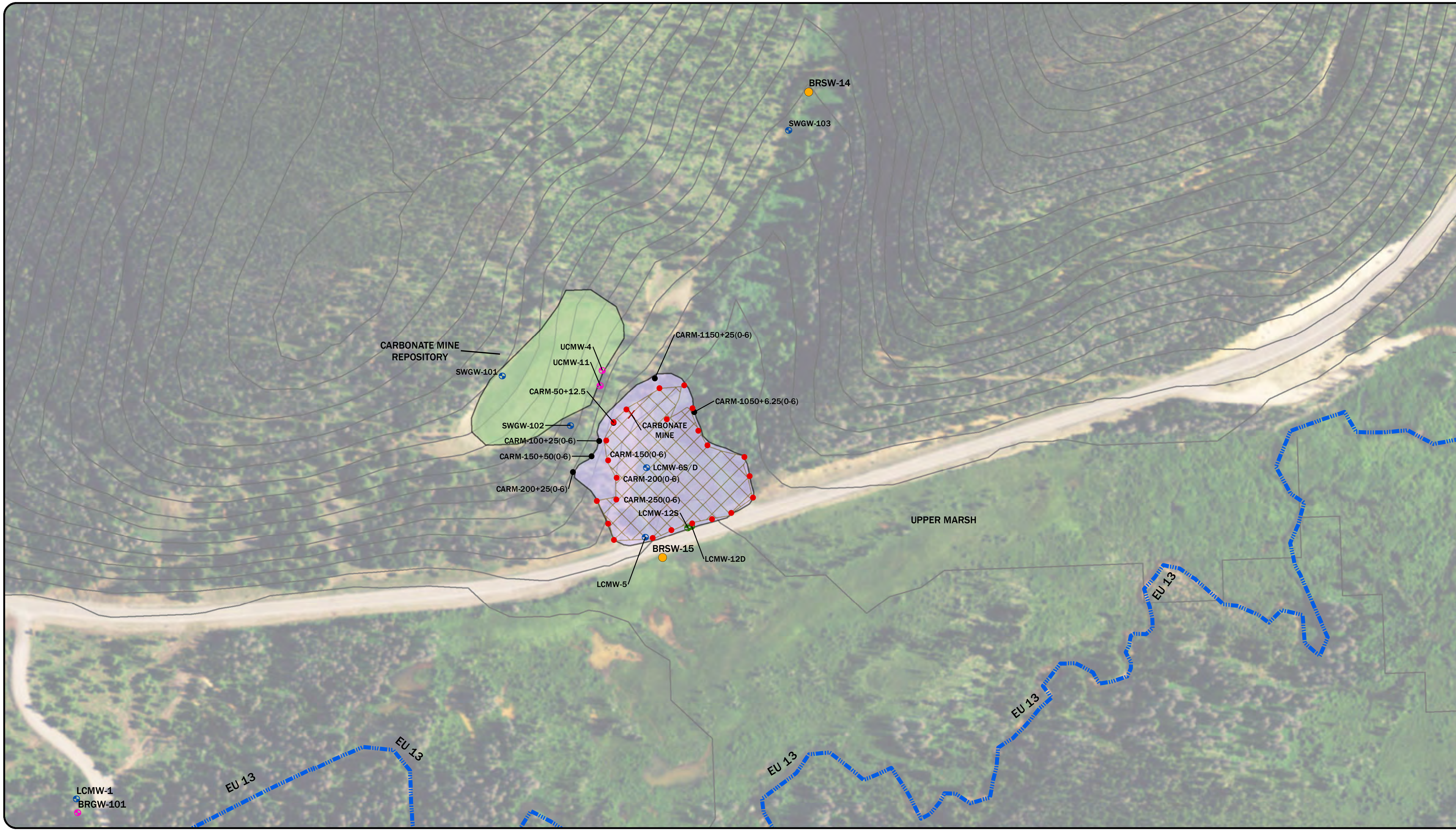
FIGURE 8

UBMC RECORD OF DECISION
MINING RELATED FEATURES
SEDIMENT SAMPLE LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD8_122015.mxd



LEGEND

- X MINE
- SURFACE WATER SAMPLING LOCATION
- 2007 SAMPLE
- 2008 SAMPLE
- STREAM (EU 13)
- MONITORING WELL - ALLUVIAL/BEDROCK PAIR
- MONITORING WELL - ALLUVIAL
- MONITORING WELL - BEDROCK
- ESTIMATED EXTENT OF MINE WASTE AREA
- MINE WASTE REMOVAL/RECLAIMED AREA
- MINE WASTE REPOSITORY

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 130 260 520 Feet

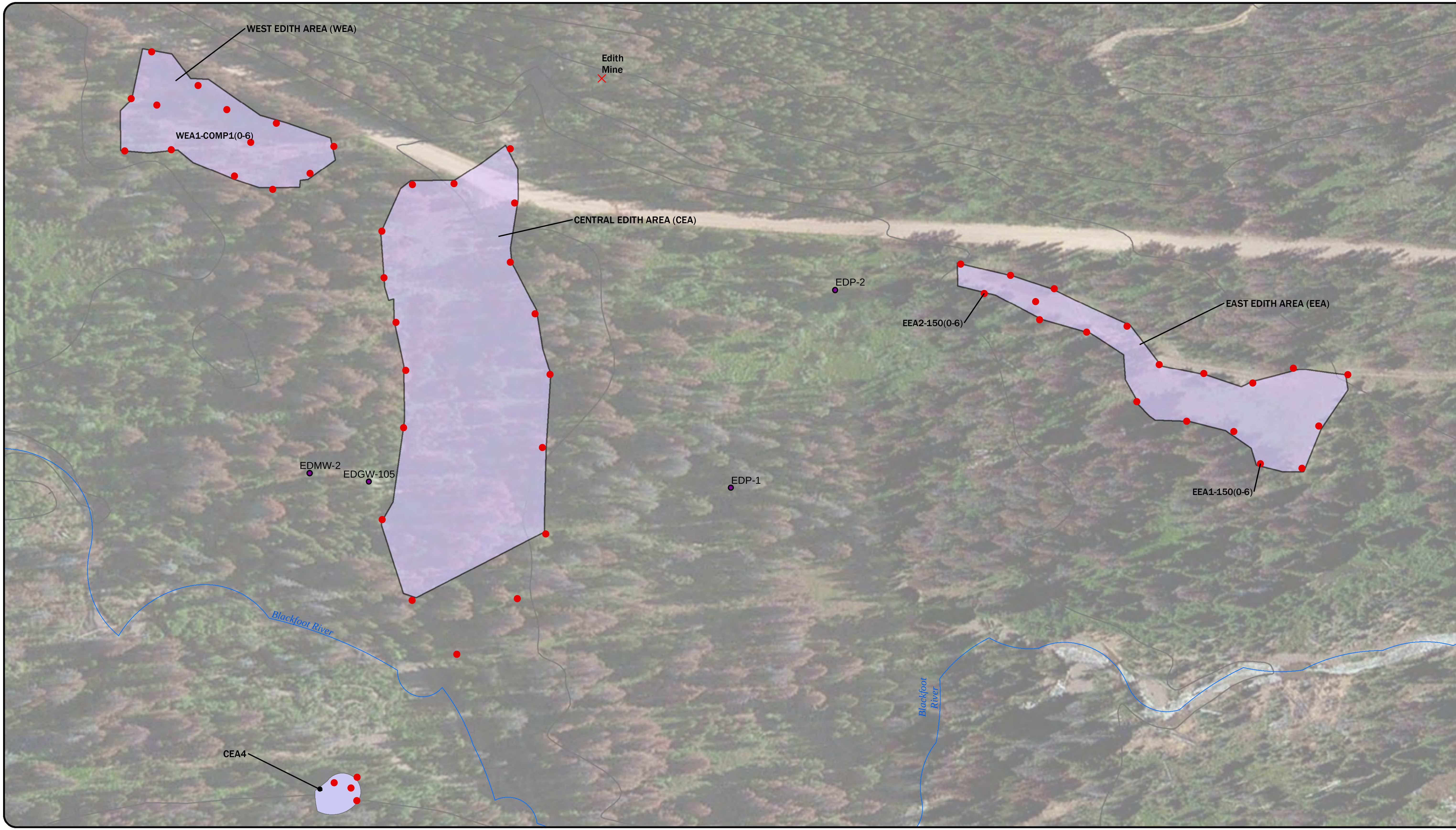
FIGURE 9

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 4 CARBONATE
MINE WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 12/2/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD9_122015.mxd



LEGEND

- MINE
- 2007 SAMPLE
- ESTIMATED EXTENT OF MINE WASTE AREA
- STREAM
- Groundwater Wells

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 70 140 280 Feet

FIGURE 10

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 5 EDITH MINE WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 1/22/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD10_122015.mxd

LEGEND

- MINE
- 2007 SAMPLE
- 2008 SAMPLE
- ESTIMATED EXTENT OF MINE WASTE AREA
- MINE WASTE REMOVAL/RECLAIMED AREA

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 35 70 140 Feet

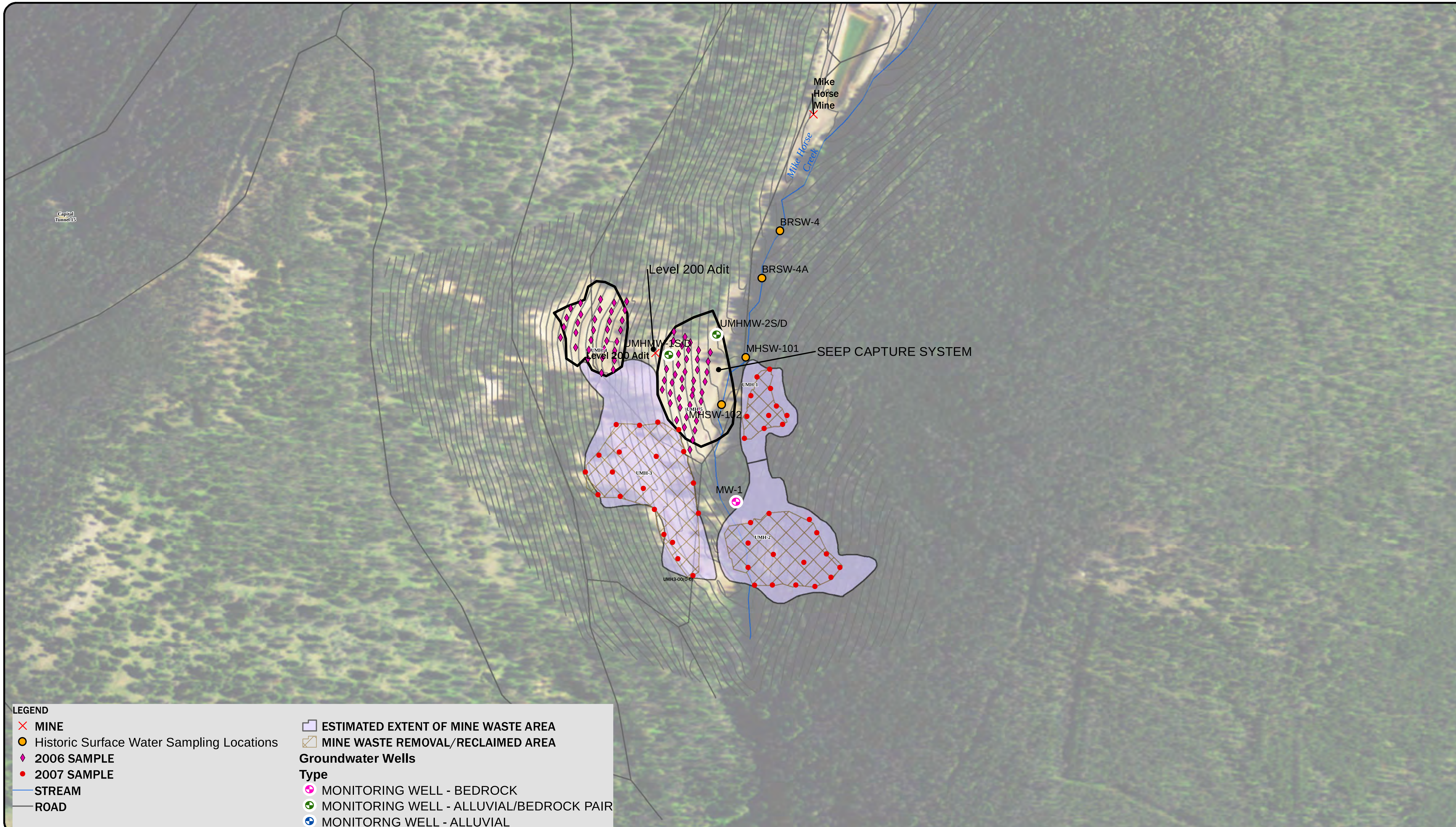
FIGURE 11

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 6 CONSOLATION MINE WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 12/7/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD11_122015.mxd



NOTE:
THE 2006 HYDROMETRICS SAMPLING LOCATIONS (DIAMONDS) ARE NOT OUTSIDE THE EXTENT OF MINE WASTE AREA; THESE TWO AREAS (UMH-4 AND UMH-5)WERE NOT INCLUDED IN THE 2007 AND 2008 RI THAT DEFINED THE ESTIMATED EXTENT OF THE MINE WASTE AREAS FOR UMH-1, UMH-2, UMH-3.

N

0 80 160 320 Feet

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

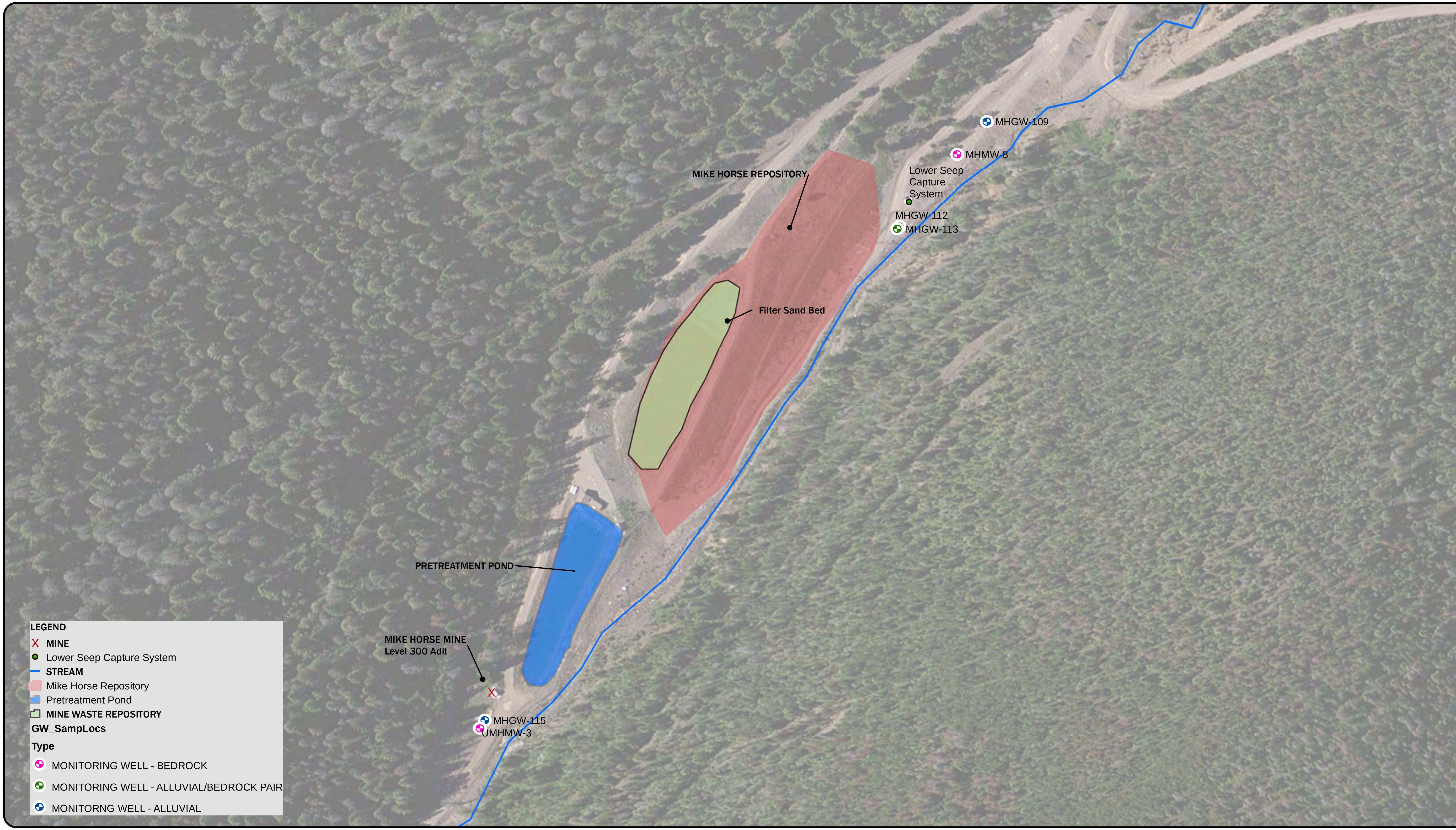
FIGURE 12a

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 8 UPPER MIKE HORSE MINE WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 1/21/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD12a_122015.mxd



DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

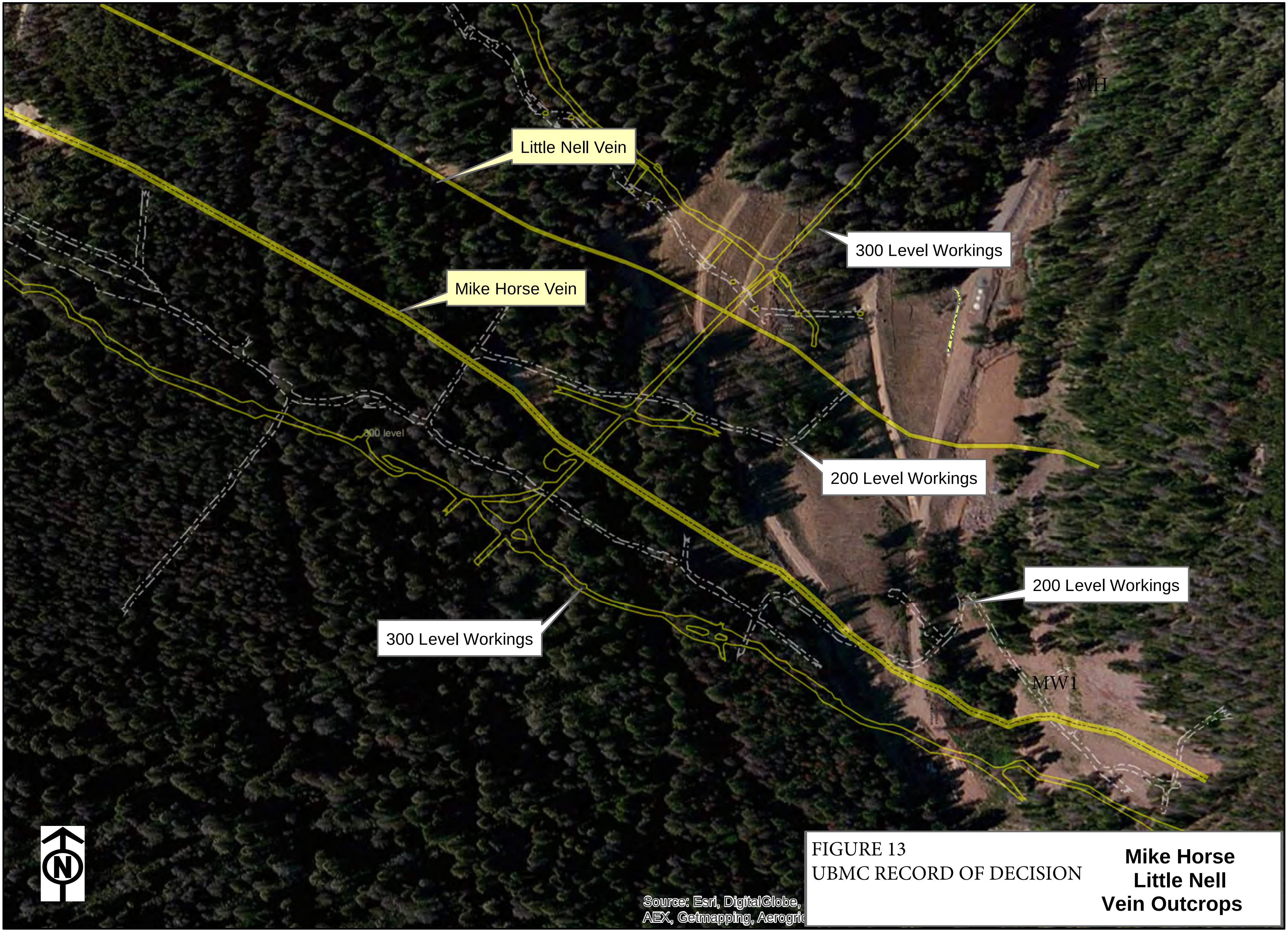
FIGURE 12b

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 8 LOWER MIKE HORSE MINE
GROUNDWATER SAMPLE
LOCATIONS

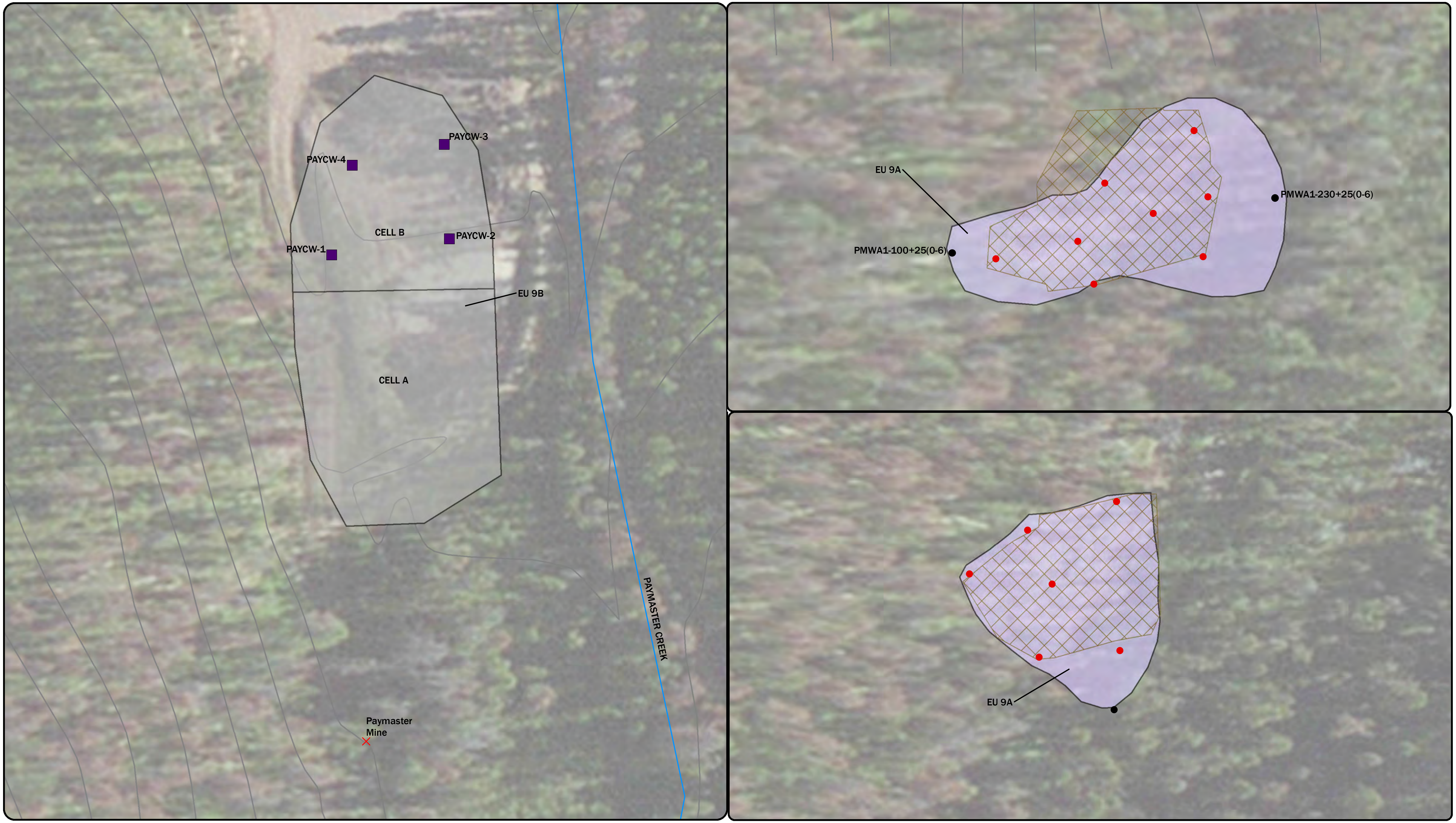
DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD12b_122015.mxd



0 50 100 200 300 400
Feet
1 in = 150 ft

Author: Donald Sutton P.E.
Vein Outcrops.mxd
5/8/2015



LEGEND

- MINE
- 2007 SAMPLE
- 2008 SAMPLE
- PAYMASTER SUBSURFACE SOIL SAMPLE
- ESTIMATED EXTENT OF MINE WASTE AREA
- CONSTRUCTED WETLAND TREATMENT CELLS
- MINE WASTE REMOVAL/RECLAIMED AREA
- STREAM

N

DISPLAYED AS:

PROJECTION/ZONE:	MSP
DATUM:	NAD 83
UNITS:	INTERNATIONAL FEET
SOURCE:	PIONEER/SPECTRUM

0 25 50 100 Feet

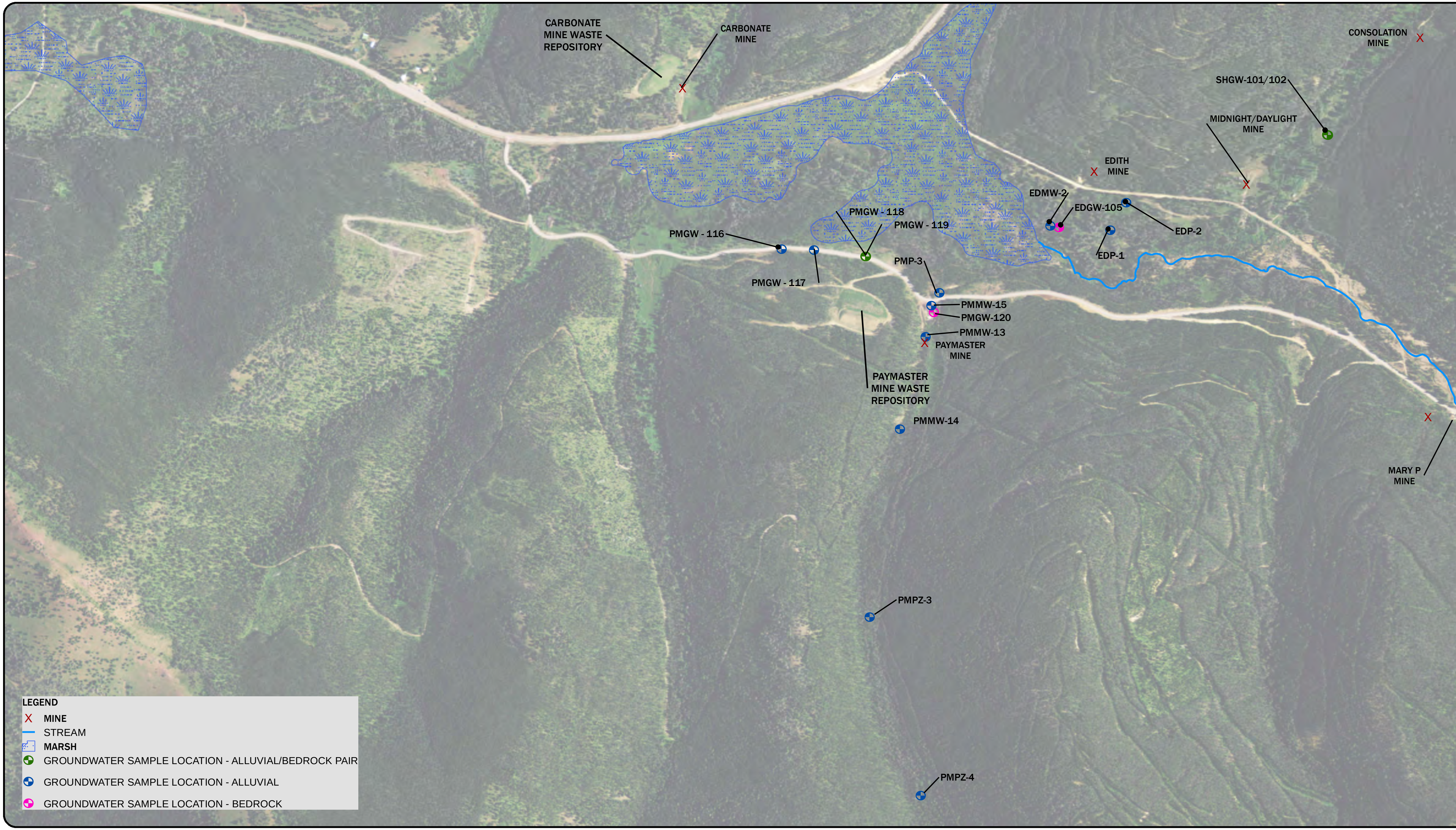
FIGURE 14

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 9A AND EU 9B PAYMASTER
MINE WASTE AREA SOIL
SAMPLE LOCATIONS

DATE: 12/7/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD14_122015.mxd



DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

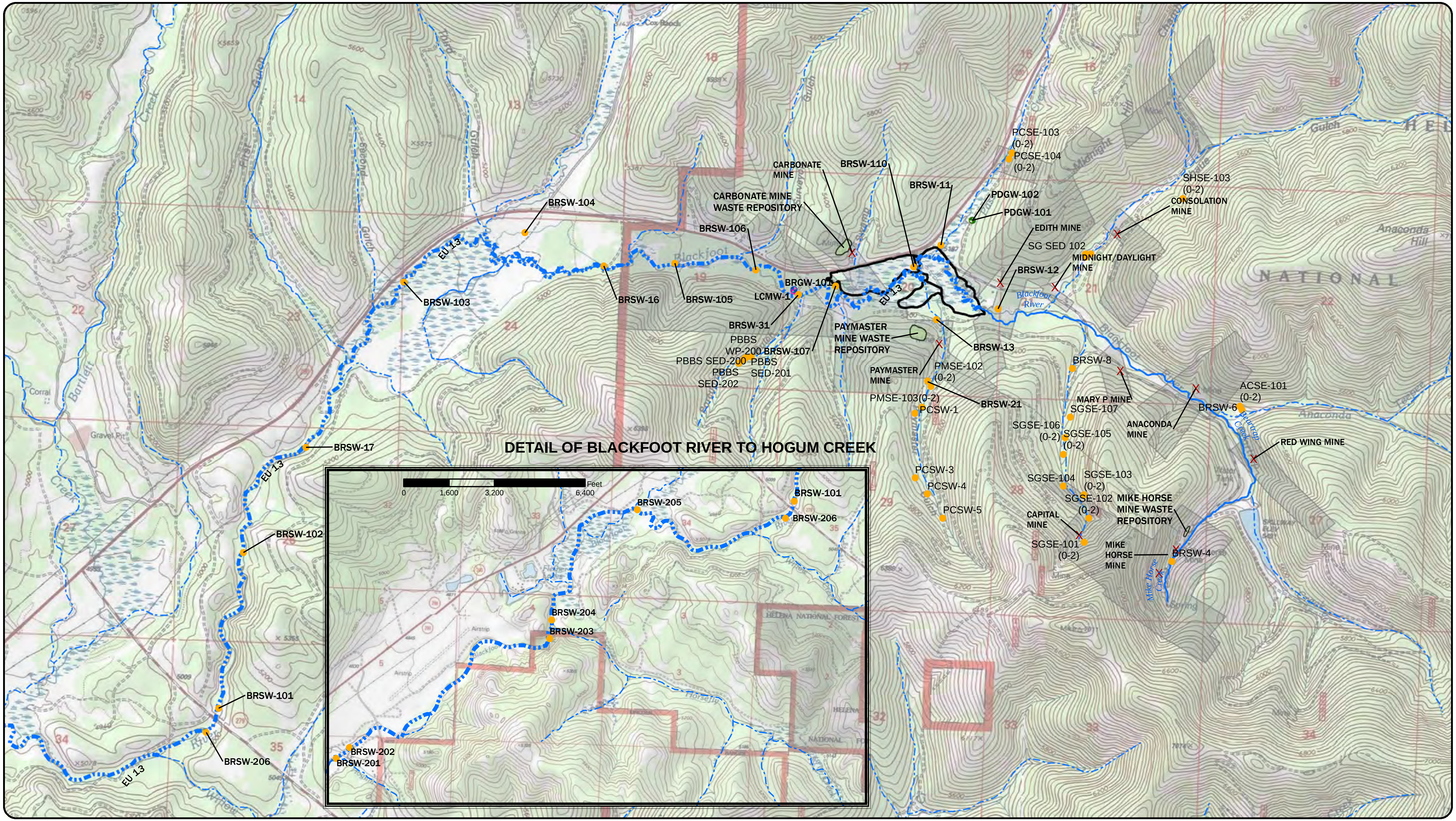
FIGURE 15

UBMC RECORD OF DECISION
PAYMASTER MINE & EDITH MINE AREAS
GROUNDWATER SAMPLE LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 2/2/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD15_122015.mxd



LEGEND:

HIGHWAY
MAJOR ROAD
LOCAL ROAD
STREAM
FOREST SERVICE PROPERTY BOUNDARY
METG/PRIVATE
LAKE
MINE
EU 13 STREAM
COLLOCATED SEDIMENT AND SURFACE WATER SAMPLES
MINE WASTE REPOSITORY

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 1,100 2,200 4,400
Feet

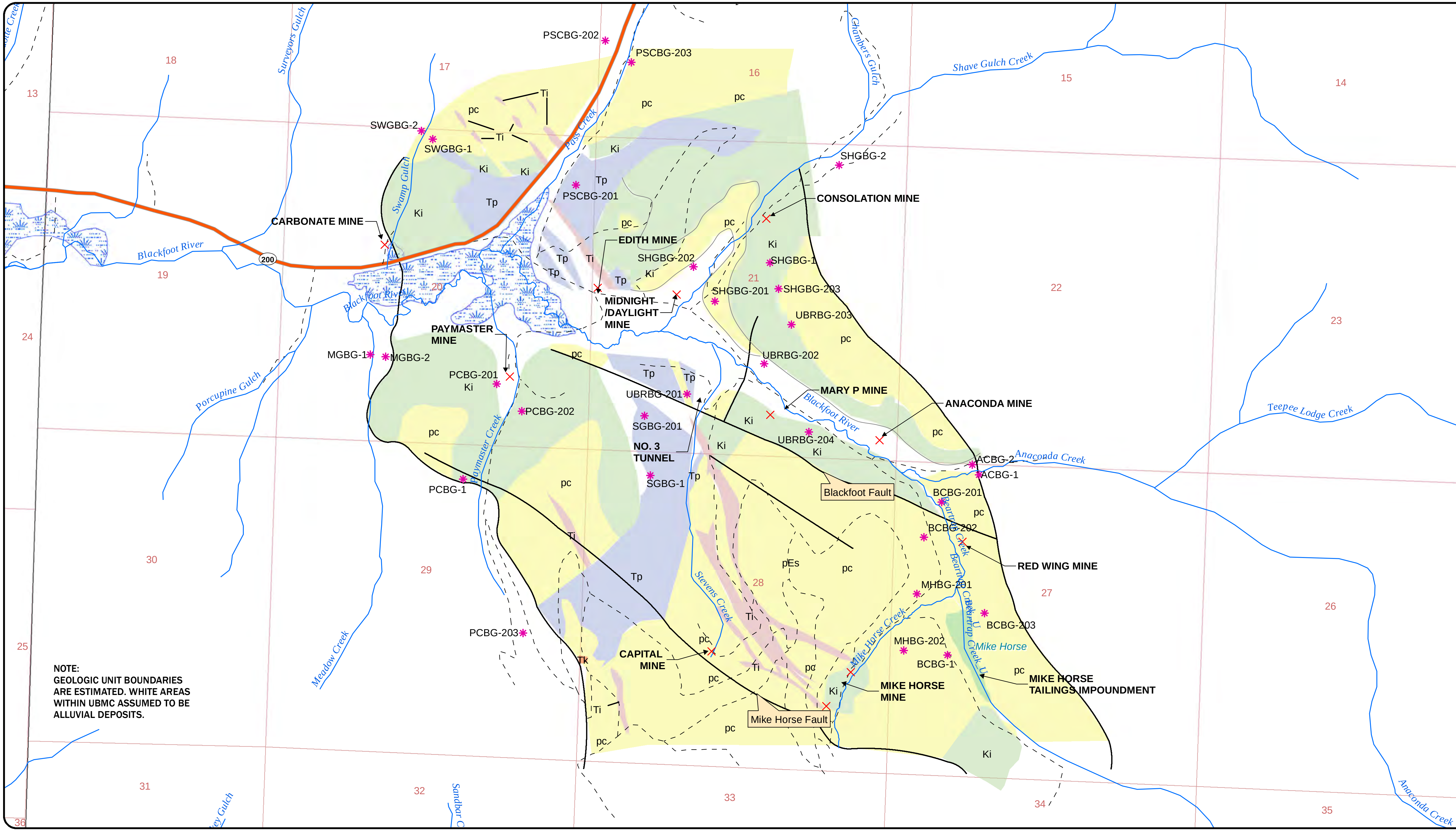
FIGURE 16

UBMC RECORD OF DECISION
BLACKFOOT RIVER
SURFACE WATER AND SEDIMENT
SAMPLE LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 1/22/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD16_122015.mxd



LEGEND

- MINE
- BACKGROUND SOIL SAMPLE
- FAULT
- LOCAL ROAD
- STATE HIGHWAY
- Ki DIORITE (GABBRO) SILL
- Ti QUARTZ MONZONITE PORPHYRY DIKES
- Tk KLEINSCHMIDT BRECCIA PIPE
- Tp QUARTZ MONZONITE PORPHYRY AND QUARTZ PORPHYRY INTRUSIVES
- pc SPOKANE SHALE (BELT SUPERGROUP)
- MARSH
- STREAM

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 650 1,300 2,600 Feet

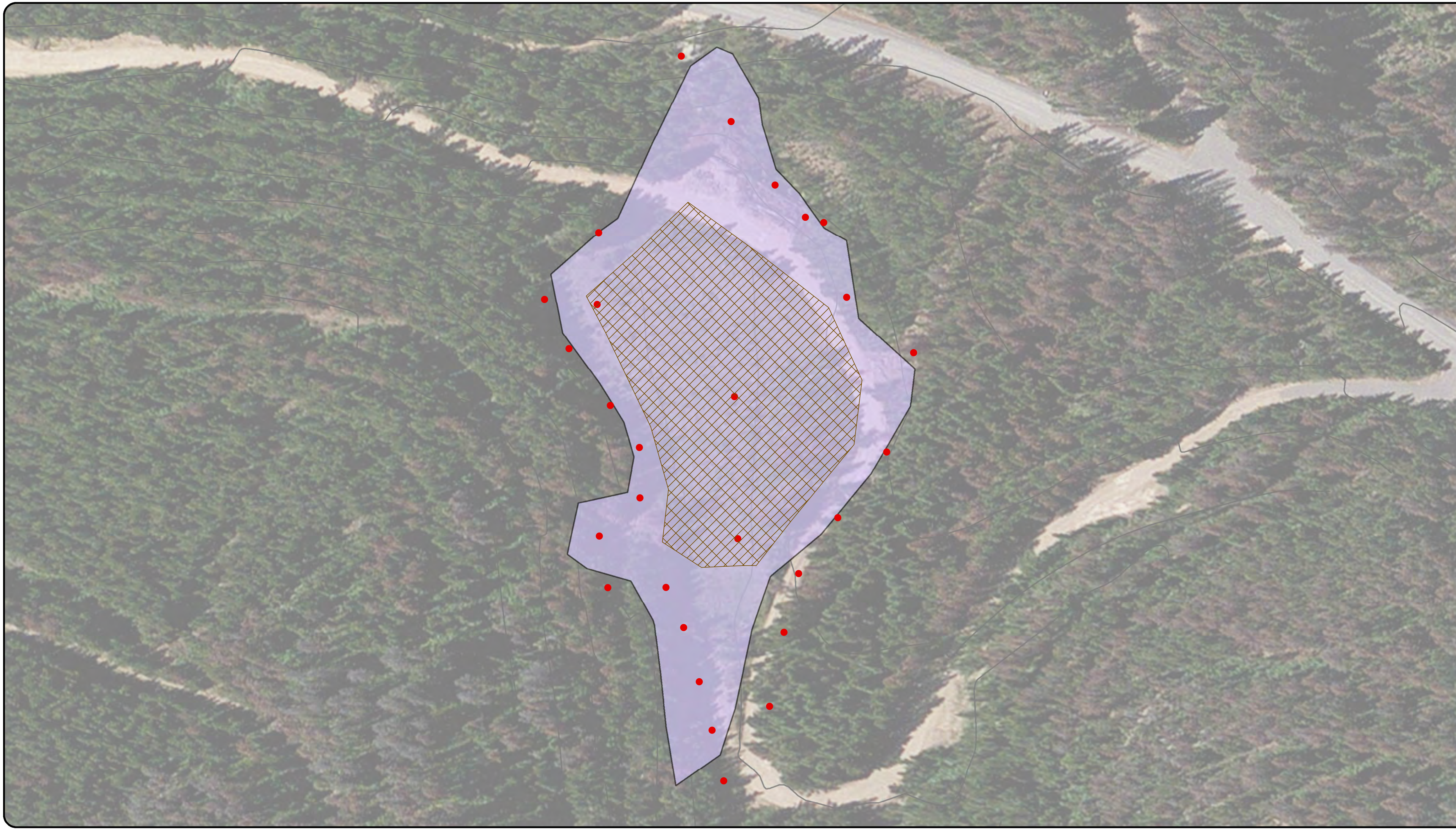
FIGURE 17

UBMC RECORD OF DECISION
GEOLOGY MAP & BACKGROUND SOIL SAMPLING LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 2/2/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD17_122015.mxd



LEGEND

- MINE
- 2007 SAMPLE
- Mine Waste Removal/Reclaimed Area
- ESTIMATED EXTENT OF MINE WASTE AREA

N

DISPLAYED AS:

PROJECTION/ZONE:	MSP
DATUM:	NAD 83
UNITS:	INTERNATIONAL FEET
SOURCE:	PIONEER/SPECTRUM

Feet
0 55 110 220

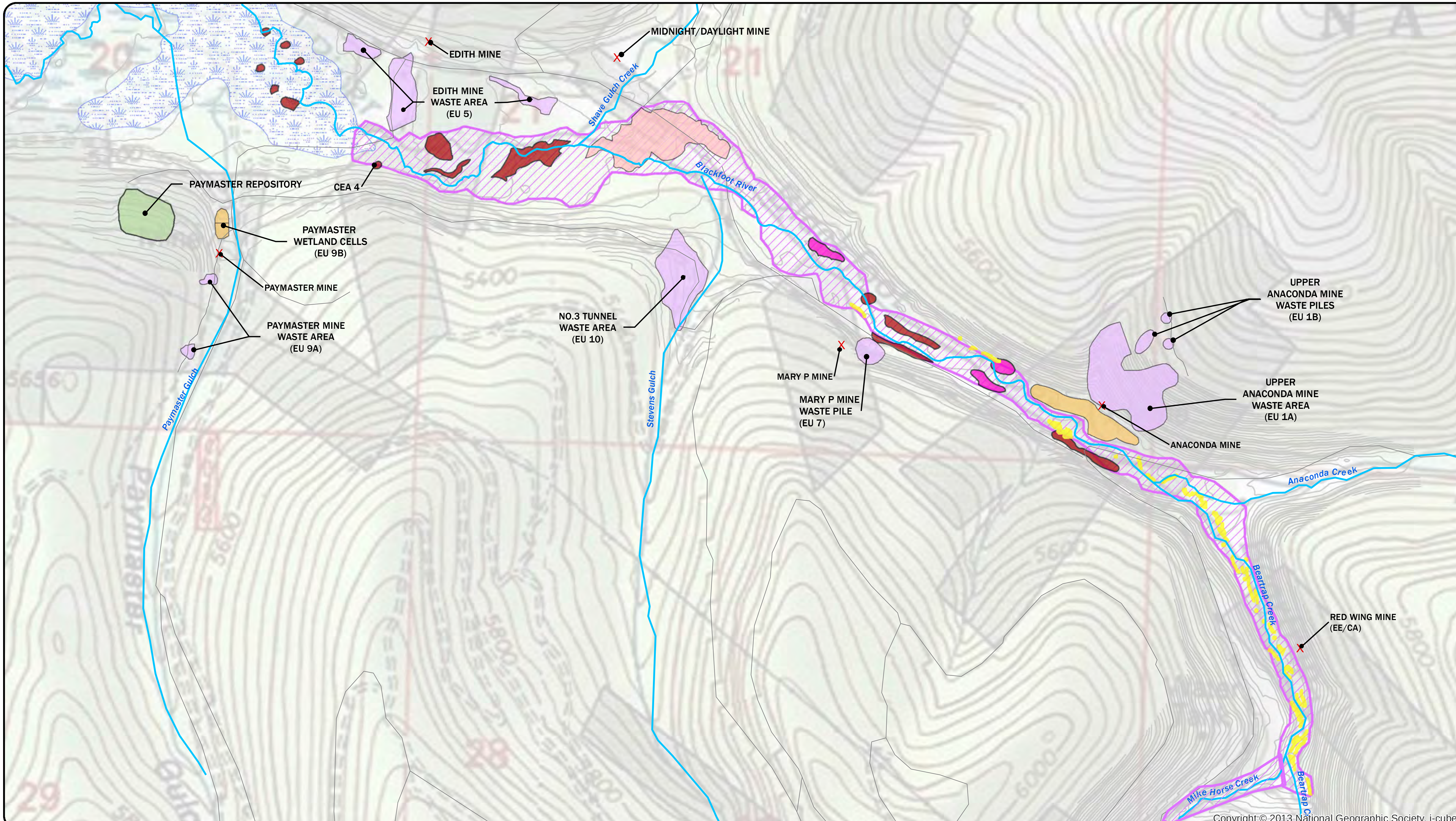
FIGURE 18

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
EU 10 NO. 3 TUNNEL WASTE AREA
SOIL SAMPLE LOCATIONS

DATE: 12/7/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD18_122015.mxd



LEGEND

X MINE	1975 BREACH FLOOD STAGE INDICATORS
STREAM	AREA OF CONCENTRATED TAILINGS/MINE WASTE
ROAD	AREA OF DISPERSED COARSE-GRAINED TAILINGS
AREA OF DISPERSED SANDY (FINE) TAILINGS	FOREST SERVICE
FORMER WETLAND TREATMENT CELLS	METG
MINE WASTE REPOSITORY	
ESTIMATED EXTENT OF RIVER FLOODPLAIN SEDIMENTS FROM EE/CA AND RI	

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/GEUM/ESRI

0 265 530 1,060 Feet

FIGURE 19

UBMC RECORD OF DECISION
EE/CA OVERLAP AREA

PIONEER TECHNICAL SERVICES, INC.

DATE: 1/21/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD19_122015.mxd

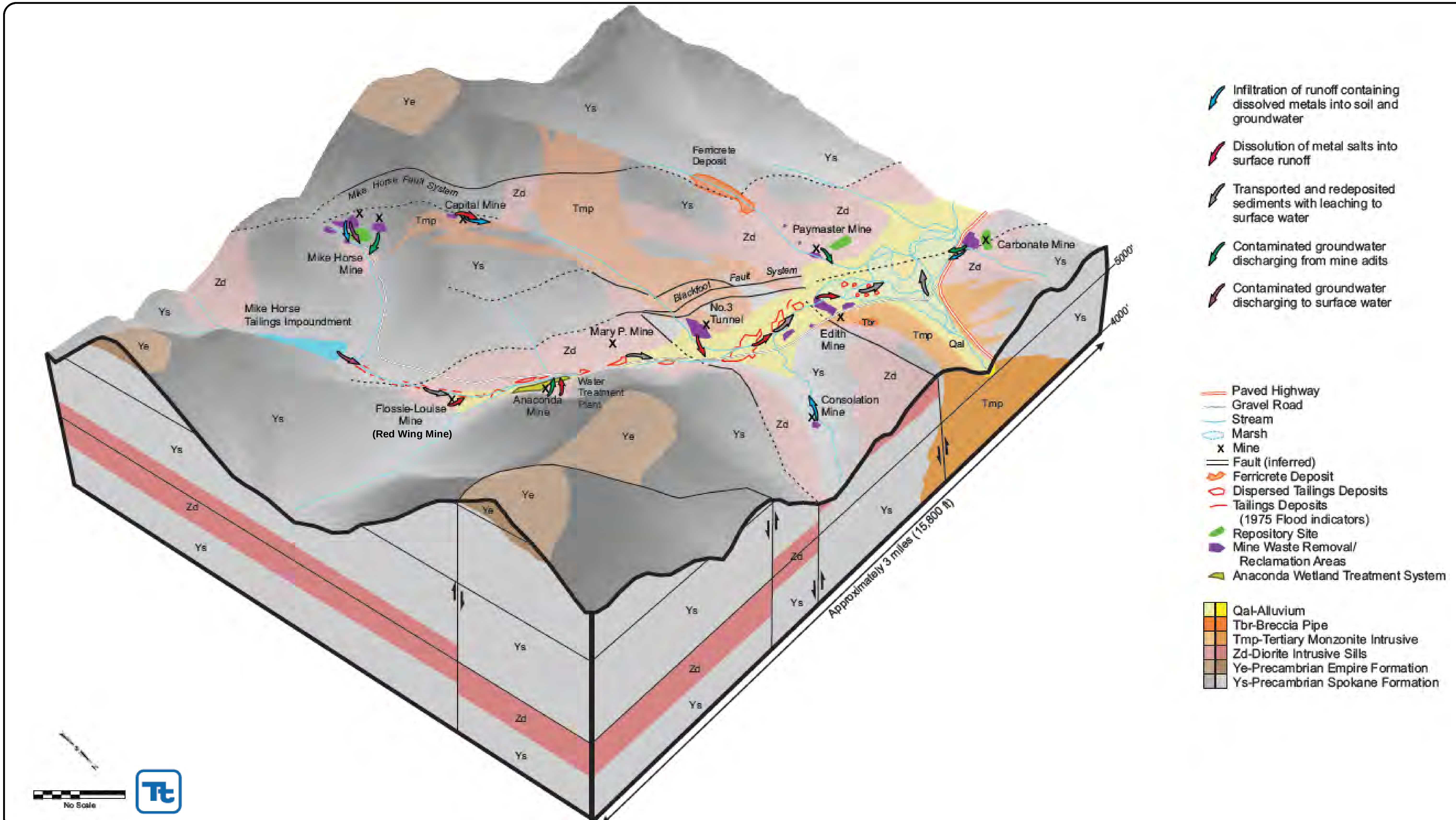


FIGURE CREATED BY TETRA TECH
JANUARY 2013
FIGURE 60
GRAPHICAL-CONCEPTUAL MODEL
REMEDIAL INVESTIGATION
UPPER BLACKFOOT MINING COMPLEX

DISPLAYED AS:
PROJECTION/ZONE:
DATUM:
UNITS:
SOURCE:

FIGURE 20

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
SITE CONCEPTUAL
MODEL GRAPHIC

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD20_122015.mxd

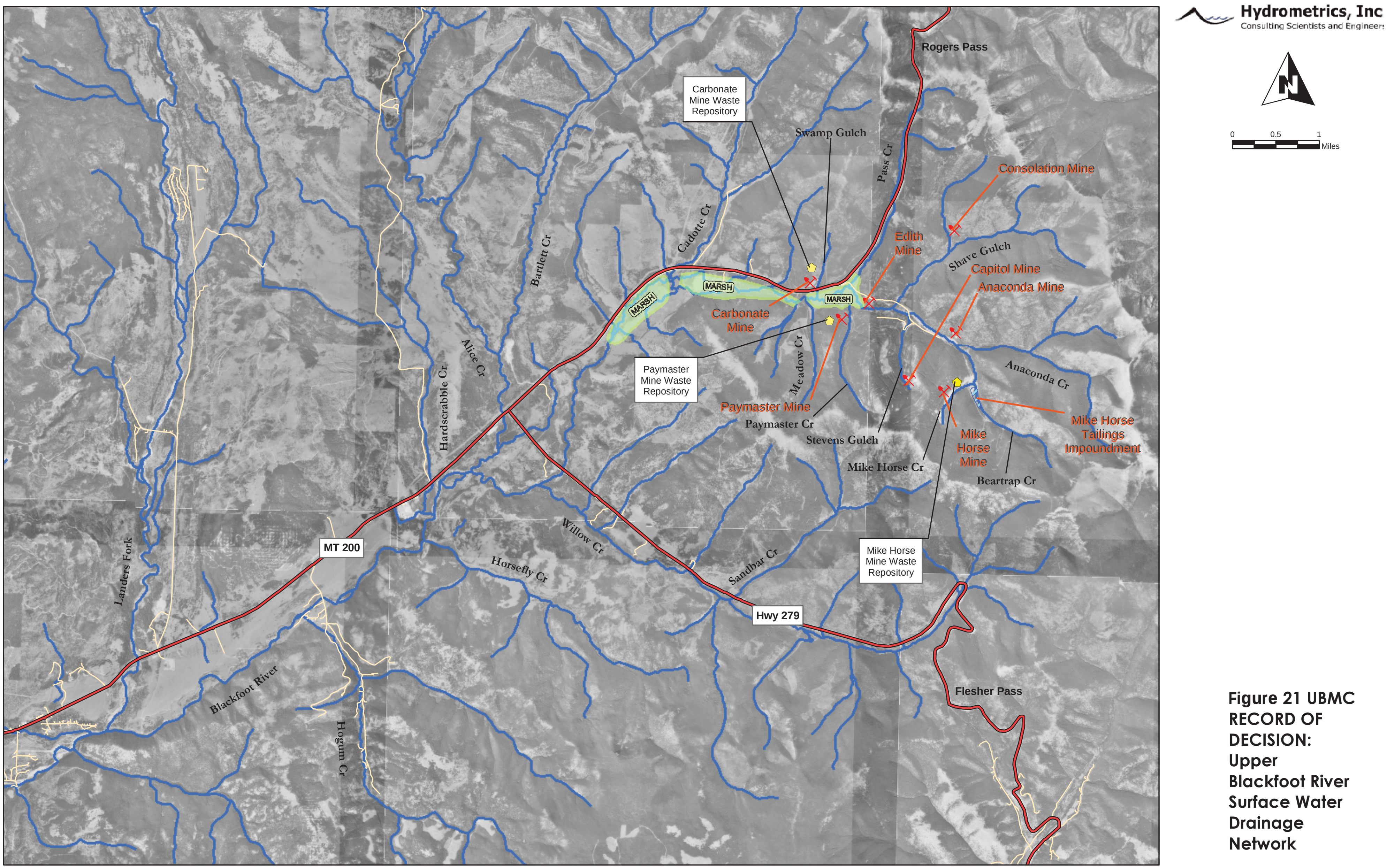
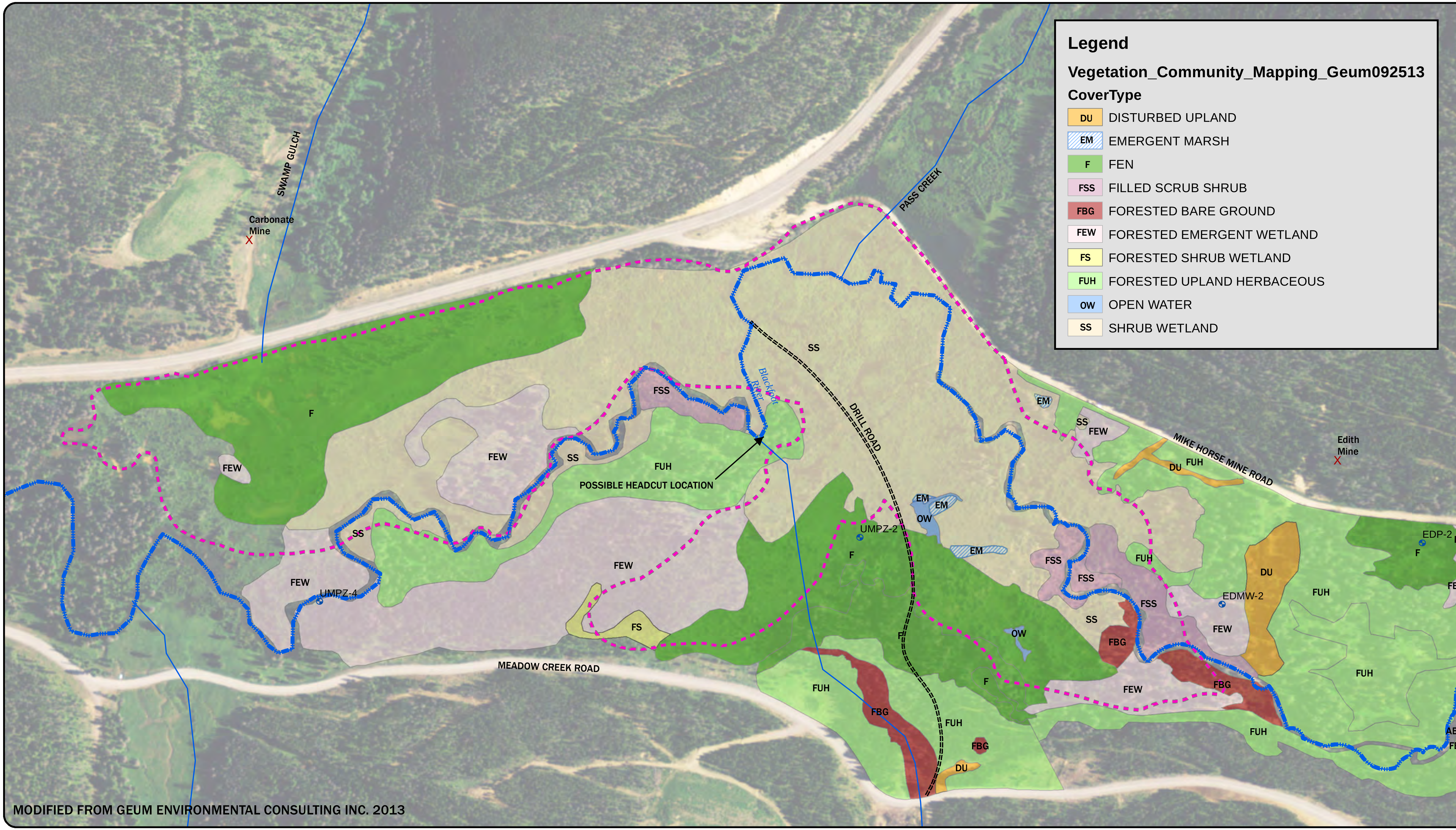


Figure 21 UBMC RECORD OF DECISION: Upper Blackfoot River Surface Water Drainage Network

K:\PROJECT\1290\2005 DEQ DATA COMPILATION\GIS\AREAMAP.MXD



LEGEND
MINE
GW_SampLocs
DRILL ROAD
STREAM
STREAM - EU 13
MARSH HIGH METALS CONCENTRATIONS BOUNDARY (Tetra Tech, 2013a)

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/GEUM/ESRI

0 125 250 500 Feet

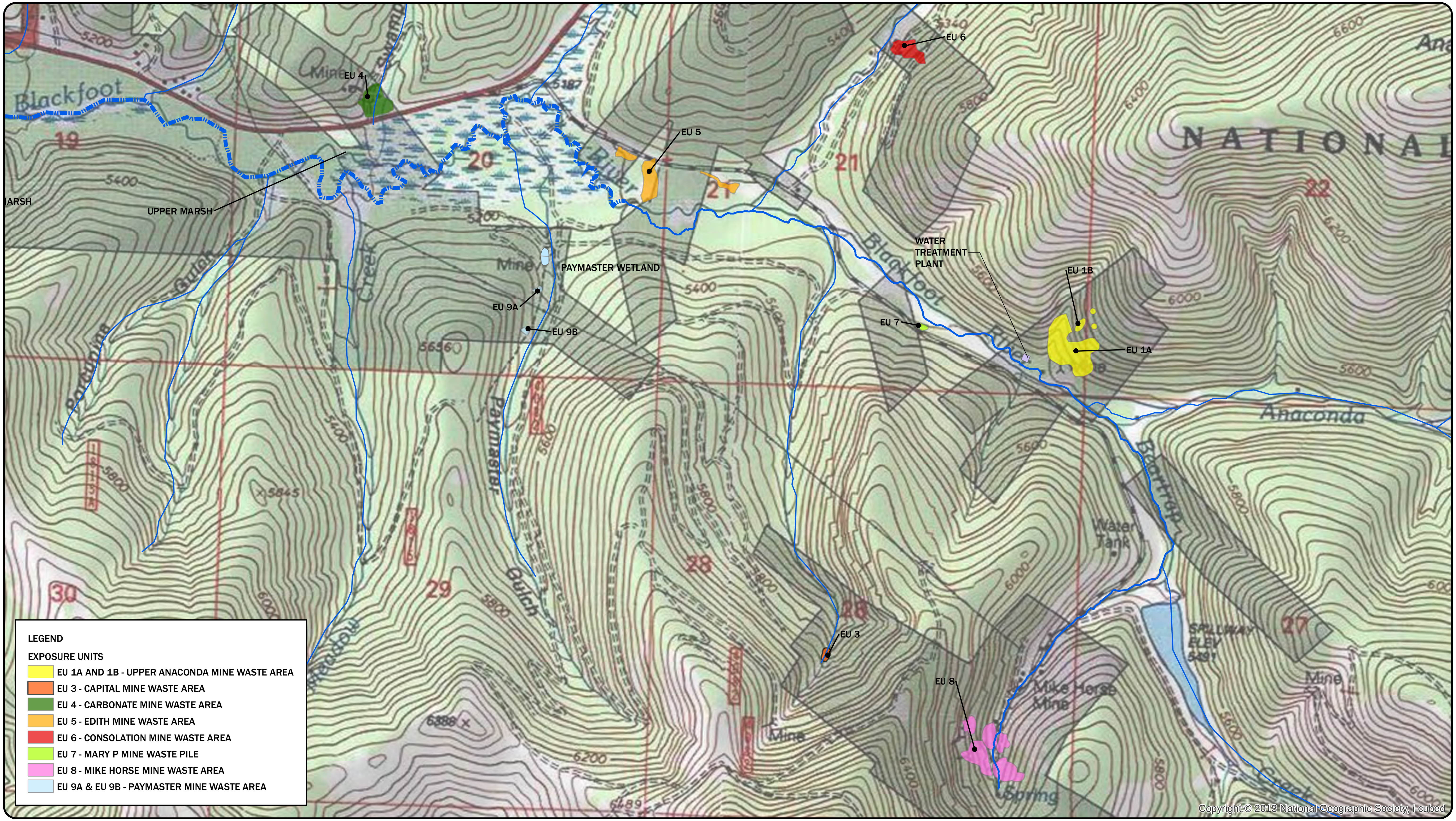
FIGURE 22

PIONEER TECHNICAL SERVICES, INC.

UBMC RECORD OF DECISION
MARSH
VEGETATION MAPPING

DATE: 2/2/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD22_122015.mxd



LEGEND

- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- STREAM
- FOREST SERVICE
- METG/PRIVATE
- LAKE

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 550 1,100 2,200
Feet

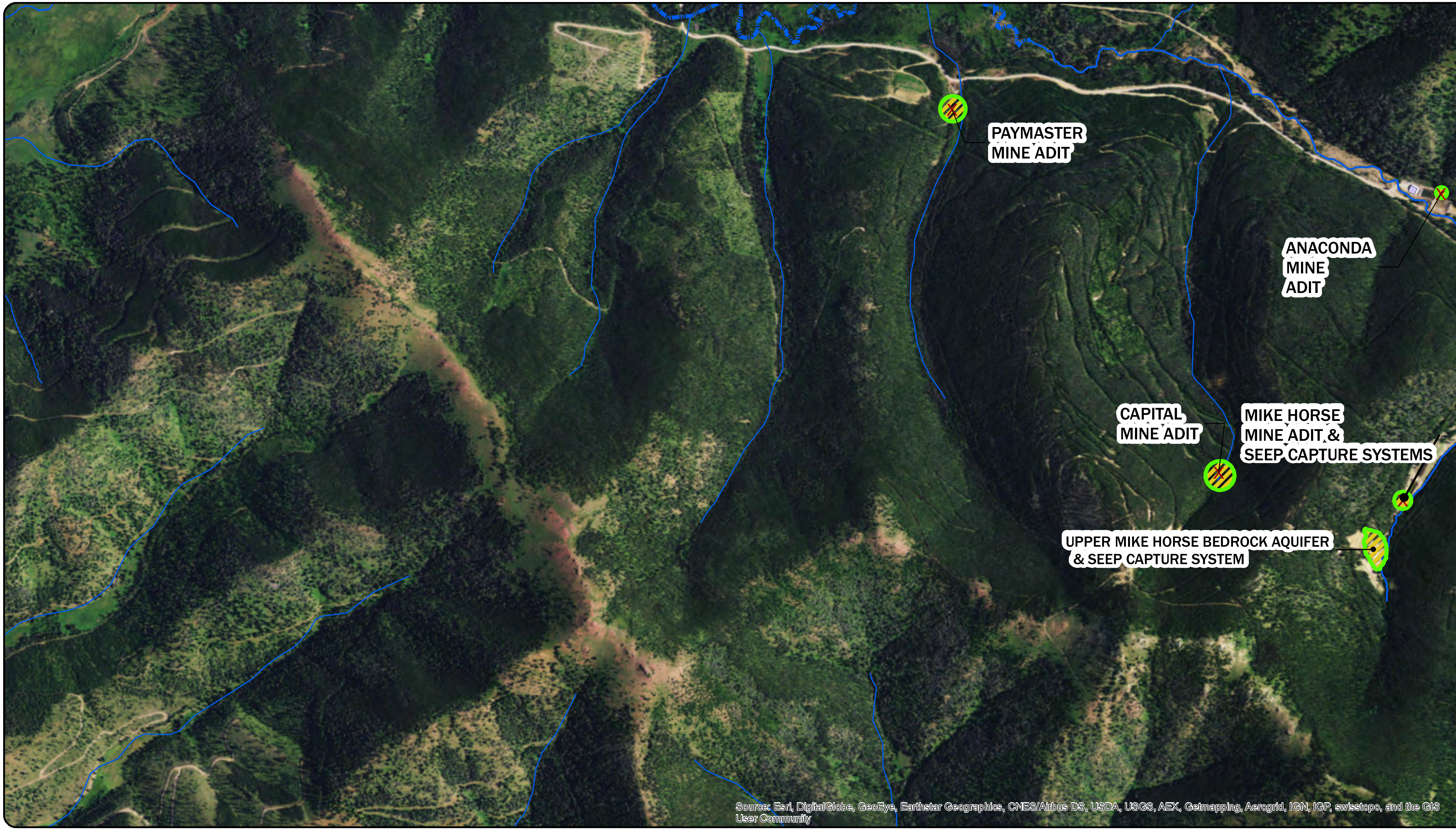
FIGURE 23

UBMC RECORD OF DECISION
EVALUATION AREA 1 (EA 1)
UPLAND EU'S

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/10/2015

Path: K:\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD23_122015.mxd



LEGEND
X MINE
GROUNDWATER

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 550 1,100 2,200
Feet

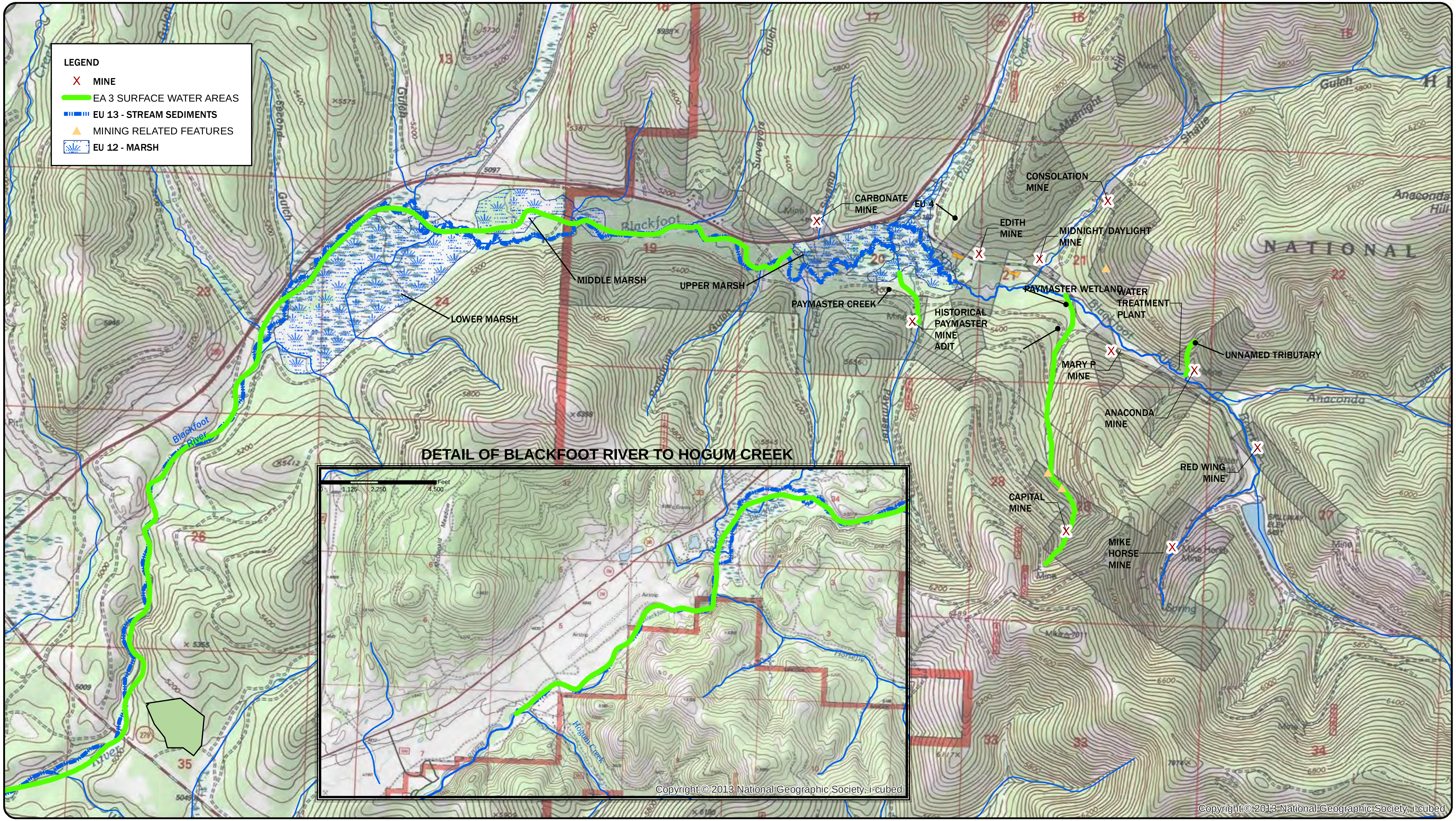
FIGURE 24

UBMC RECORD OF DECISION
EVALUATION AREA 2 (EA 2)
GROUNDWATER

PIONEER TECHNICAL SERVICES, INC.

DATE: 2/8/2016

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD24_122015.mxd



LEGEND
HIGHWAY
MAJOR ROAD
LOCAL ROAD
STREAM
FOREST SERVICE
METG/PRIVATE
LAKE

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 1,000 2,000 4,000
Feet

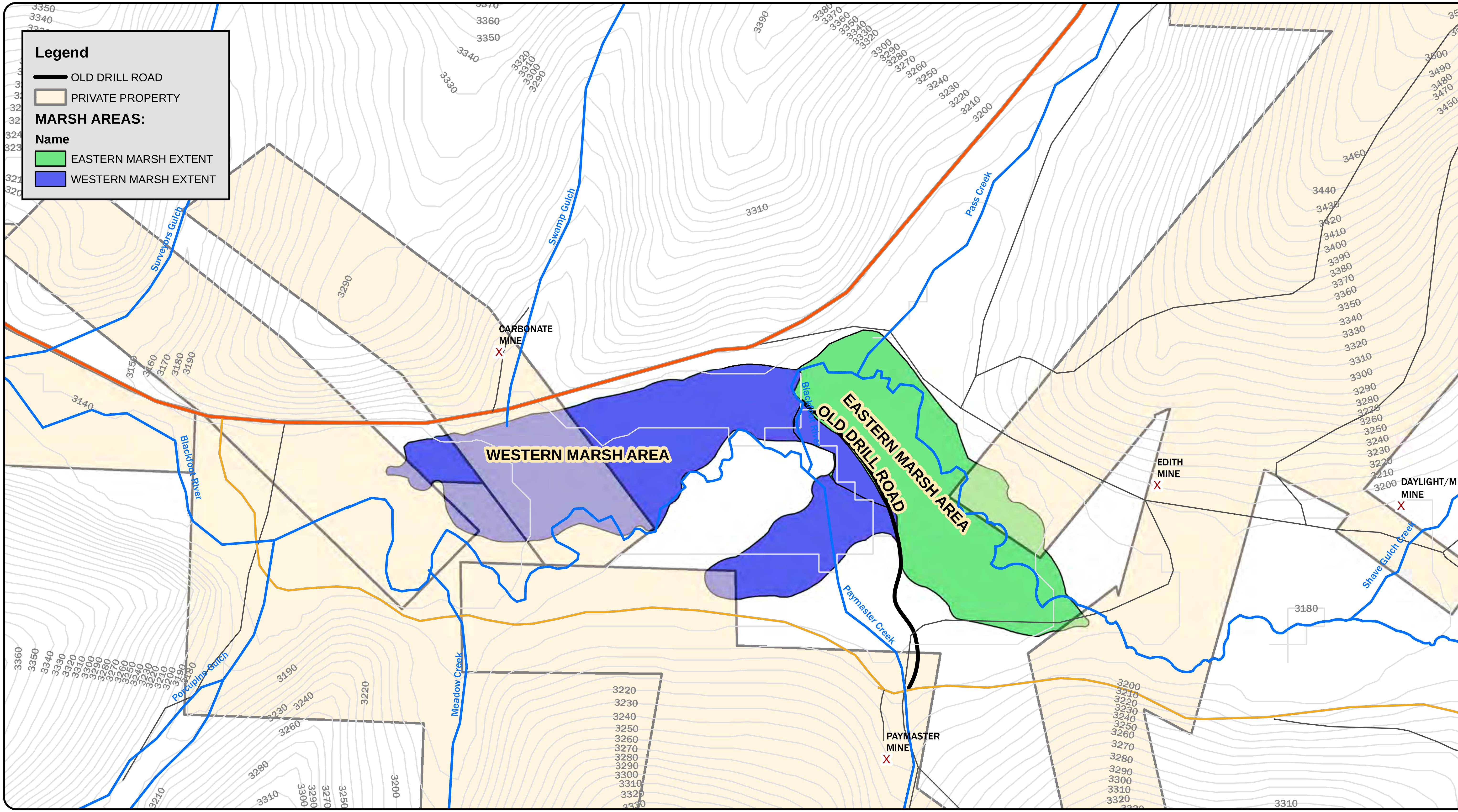
FIGURE 25

UBMC RECORD OF DECISION
EVALUATION AREA 3 (EA 3)
SURFACE WATER

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD25_122015.mxd



LEGEND

X MINES
STREAM
HIGHWAY
MAJOR ROAD
LOCAL ROAD

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 250 500 1,000
Feet

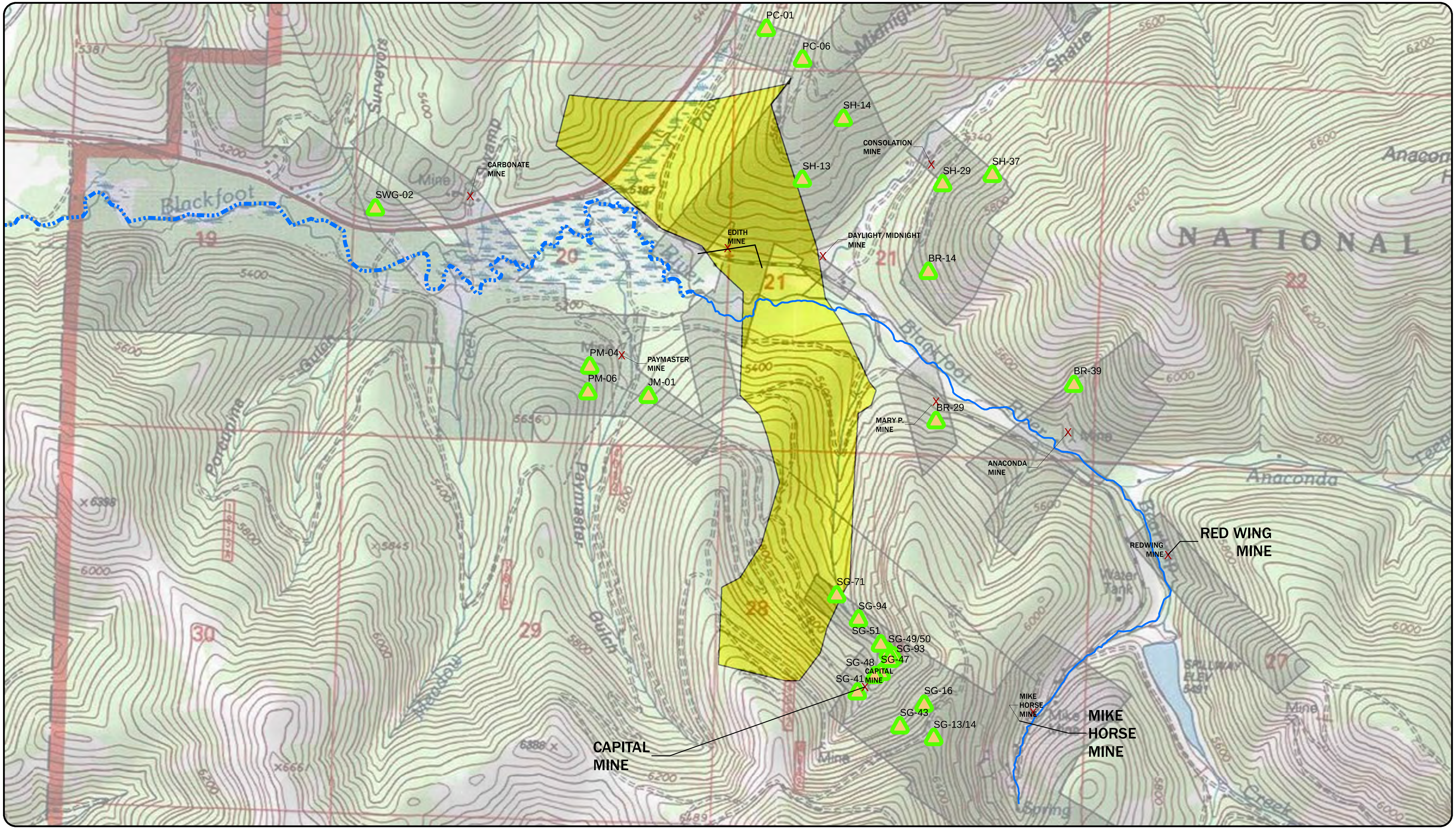
FIGURE 26

UBMC RECORD OF DECISION
EA4-UPPER MARSH AREAS

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

Path: L:\REM\CB5530\UBMC\Dave\ROD_WorkingProjectData\GIS\Project\RODFigs_122015\UBMC_FS-GI-PLN-001-15_ROD26_122015.mxd



LEGEND
- X MINE
- MINING RELATED FEATURES
- STREAM
- STREAM (EU 13)
- ApproximateBoundary_Copper_Molybdenum Ore Body

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/SPECTRUM

0 500 1,000 2,000
Feet

FIGURE 27

PIONEER TECHNICAL SERVICES, INC.

DATE: 12/30/2015

UBMC RECORD OF DECISION
EVALUATION AREA 5 (EA 5)
MINING RELATED FEATURES
NORTH & SOUTH OF THE
BLACKFOOT RIVER

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UBMC ROD TABLES

Table 1

SUMMARY OF PRE-1994 UBMC DATA COLLECTION EVENTS

Reference	Sampling Dates	Sampled Matrix
Boojum (1990)	October 1989	SLG
Corry (1991)	October 1991	SW
Decker-Hess (1978)	May, June, July, September 1977	SW
Delta (1987)	July, 1987	SW
Delta (1989)	July, August, October 1989	GW
Hydrometrics (1991a,b, 1992)	August, September, November 1991 April, May, June, August 1992	SW,SED
Ingman et al. (1990)	August 1988 April, May 1989	SW
Kerr (1986)	September 1984 May 1986	SW
Kerr (1990)	July 1990	SW
Kerr (1991)	March, April, May, June 1991	SW
MFG (1994)	1993	SW, SED, SOIL
MDHES (1994)	June 1993	SW, SED, SOIL
MDSL (1991)	June, November 1990	SW, SOIL
Montana State Board of Health (MSBOH) (1961, 1964a,b, 1966)	February 1961 July, November 1964 August 1966	SW
Moore (1990)	June, July 1988 July, August, September 1989	SW, SED
PTI Environmental Services (PTI) (1994)	1992-1993	SW, GW, SOIL
Reclamation Research Unit, Montana State University and MSI Detoxification Inc. (RRU and MSI, 1988)[1]	April, May, July 1987 January 1988	SW,GW,SED,VEG
Spence (1975a)	1975	SW
Spence (1975b)	1968-1975	SW

Notes:
[1] Also referred to as Dollhopf, D.J. et al. 1988
SW = surface water
GW = ground water
SED = stream sediment
SLG = sludge
VEG = vegetation

Table 2

SUMMARY OF 1994-2005 DATA COLLECTION EVENTS

Reference	Sampling Dates	Sampled Matrix
Asarco Consulting, Inc. (2004)[1]	2003	SW,GW,SED
Asarco Consulting, Inc. (2005)[1]	2004	SW,GW,SOIL
Asarco Consulting, Inc. (2006)[1]	2005	SW, GW
Furniss (1995)[2]	1994	SW,SED,GW
Hydrometrics (1995) [1]	1994	SW,GW,SOIL
Hydrometrics (1996) [1]	1995	SW,GW,SED,SOIL
Hydrometrics (1997) [1]	1996	SW,GW,SOIL
Hydrometrics (1998) [1]	1997	SW,GW,SOIL
Hydrometrics (2001) [1]	2000	SW,SOIL
Hydrometrics (2002) [1]	2001	SW,GW,SOIL
MBMG (1998)	June 1997	SW,SOIL
Menges (1997)	August, October 1995 January, February 1996	SW,SED
MSE (1997)	Grouting project	SW,GW
Nagorski et al. (2000)	August 1998	SW,SED
Vandeberg (2005)[3]	2002	SED, SOIL

Notes:
SW = surface water
GW = ground water
SED = stream sediment
SOIL = soil and/or mine waste
[1]Denotes annual monitoring data collected by ASARCO and ARCO.
[2] The Furniss (1995) investigation included collection of iron oxides from Paymaster Creek sediments.
[3]Vandeberg (2005) collected floodplain sediment samples at locations similar to the sites sampled by Moore (1990) and/or Nagorski et al. (2000) for streambed sediments.

Table 3

WTP Confirmation Sampling for Sub-Surface Soil (mg/kg)								
Metals	**Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Zn**
***Protection of Groundwater SSCLs (EU2)**	**31,100**	**340****	**14**	**5,300**	**259,000**	**1,100**	**4,890**	**2,950**
#Construction Worker	**NR**	**NR**	**NR**	**NR**	**NR**	**430**	**NR**	**NR**
Sample ID	**East Pile – 1994/95 Confirmation Sampling**							
9509-200	3,280	120	1	130	24,500	100	180	55
9509-201	3,270	86	2	120	23,500	190	230	250
9509-202	3,480	81	<1	110	20,200	110	610	70
9509-203	6,020	27	<1	120	11,400	76	830	87
9509-204	4,630	17	<1	120	12,600	46	940	98
Sample ID	**West Pile – 2008 Cell 6 Confirmation Sampling during WTP Construction**							
North	14,000	80	5.7	310	51,000	310	790	340
Northeast	10,000	42	6.5	120	25,000	330	1,300	570
TP1	10,300	17.5	0.6	85.6	30,800	103	275	241
TP2-PostEx	9,240	295	0.55	240	36,200	296	708	296
TP3	9,660	111	1.31	120	30,200	69.9	672	162
Sample ID	**Cell 5 – (between East & West piles) Confirmation Sampling during 2011 Cell 5 Reconstruction**							
AHD-1109-111	7,510	26	1.4	192	81,500	85	754	884
AHD-1109-112	9,610	21	4.3	207	117,000	99	1,010	1,210
AHD-1109-113	9,470	27	2.7	267	70,200	82	1,700	1,480
AHD-1109-114	10,000	32	0.2	206	98,500	113	389	510
AHD-1109-115	8,880	26	0.3	360	85,500	113	367	616
AHD-1109-116	9,960	37	<0.2	340	85,500	133	335	616
AHD-1109-117	9,740	19	<0.2	213	68,800	97	222	704
AHD-1109-118	10,700	38	4.1	320	67,000	333	1,130	757
AHD-1109-119	10,600	36	2.8	403	56,200	200	950	879
AHD-1109-120	12,500	48	6.5	465	61,800	369	1,930	1,120
AHD-1109-121	10,700	45	5.7	359	49,500	371	2,020	1,560
AHD-1109-130	9,150	29	1.8	129	23,600	163	594	411
AHD-1109-131	7,830	20	1.2	183	24,300	176	858	294
AHD-1109-132	8,380	17	5.2	187	22,300	197	649	355
AHD-1109-133	8,380	17	1.6	148	26,100	229	765	366
AHD-1109-134	8,540	39	3.1	181	27,700	338	1,290	563

EU – Exposure Unit The RI divided the UBMC into 13 EUs to either assess the effectiveness of previous interim actions or delineate the lateral extent of floodplain contamination in Mike Horse Creek, Beartrap Creek, and the Blackfoot River.

NR – No exceedance of allowable risk level.

* The protection to groundwater site-specific cleanup levels (SSCLs) are specific to EU2.

** If a sample has a collocated synthetic precipitation leaching procedure (SPLP; simulates rainfall and ability for metals to leach into the soil and/or groundwater) analysis, that sample's SPLP result can be used to calculate the protection to groundwater SSCL that is specific to that location. Sample location TP2-Post Ex had a site-wide (EU2) exceedance for arsenic, but it didn't exceed that location specific (WTP area) screening level of 340 mg/kg. Therefore, based on site-specific leaching-to-groundwater conditions, the arsenic SSCL for the WTP area is 340 mg/kg. See Section 7.6 for more information on developing leaching-to-groundwater SSCLs.

Construction worker for subsurface soils (> 2 feet) only – clean fill imported for surface soils around the old WWTS.

Table 4A – Groundwater Cleanup Levels

Contaminant of Concern	SSCLs (mg/L) (except for the Paymaster and Edith EUs)	Paymaster (EU 9) (mg/L)	Edith (EU 5) (mg/L)
Aluminum	20[1]	20[1]	20[1]
Arsenic	0.01[2]	0.01[2]	0.01[2]
Cadmium	0.005[2]	0.0056[4]	0.005[2]
Copper	1.3[2]	2.866[4]	1.3[2]
Iron	14[1]	15.12[4]	27.8[55]
Lead	0.015[2]	0.015[2]	0.015[2]
Manganese	0.94[3]	2.29[4]	3.03[5]
Zinc	2[2]	2[2]	2[2]

Note: For those compounds that have them, DEQ-7 standards are the groundwater SSCLs unless site-specific background exceeds the DEQ-7 standards in a particular location, in which case background becomes the SSCL for that location. For those compounds in groundwater for which no DEQ-7 human health standard exists (aluminum, iron, and manganese), DEQ calculated SSCLs or used site-specific background levels (Tetra Tech, 2014). For the Paymaster and Edith EUs – the geology in the Paymaster and Edith mine groundwater areas is from the gabbro geologic formation and is highly mineralized, which results in elevated metal concentrations in the groundwater. In addition, the Edith Mine area groundwater is also influenced by unique sensitive areas (fen and forested emergent wetland environments) known to accumulate peat layers that act to collect and retain metals. See ROD sections 2.3.4 and 2.3.7.1 for detailed explanations.

SSCL Source:

1 SSCL based upon site-specific calculation (Section 10,Tetra Tech, 2014)

2 Circular DEQ-7 Montana Numeric Water Quality Standards, October 2012 (DEQ, 2012)

3 SSCL based on background (Section 10,Tetra Tech, 2014)

4 Paymaster background (see Table 11)

5 Edith background (see Table 8)

mg/L milligrams per Liter

SSCL Site-specific cleanup level

Table 4B – Surface Water Cleanup Levels

Chemical	SSCLs (mg/L) (except for Swamp Gulch)	Swamp Gulch (mg/L)
Aluminum (dissolved)	0.087**[1]	0.27[3]
Arsenic (total recoverable)	0.01[1]	0.01[1]
Cadmium (total recoverable)	0.000097*[1]	0.005[3]
Copper (total recoverable)	0.00285*[1]	0.15[3]
Iron (total recoverable)	1[1]	3.155[3]
Lead (total recoverable)	0.000545*[1]	0.028[3]
Manganese (total recoverable)	0.43[2]	0.509[3]
Zinc (total recoverable)	0.037*[1]	0.584[3]

Note: For those compounds that have them, DEQ-7 standards are the surface water SSCLs. When taken from DEQ-7, the surface water SSCL is the most protective (lowest) concentration found between the human health, chronic aquatic, and acute aquatic standards for each COC. However, if a site-specific background COC concentration exceeds the DEQ-7 standards in a particular location, the background becomes the SSCL for that location. A detailed explanation regarding the Swamp Gulch surface water background conditions is found in Section 2.3.3.1.

SSCL Source:

1 Circular DEQ-7 Montana Numeric Water Quality Standards, October 2012 (DEQ, 2012)

2 SSCL based upon site-specific calculation (Section 10,Tetra Tech, 2014)

3 Swamp Gulch Creek background (see Table 8; Background was calculated using ProUCL (EPA, 2009) and calculations are located in Appendix D, Section D1)

* Based on 25 mg/L hardness for surface water. Hardness data will need to be collected at the time of sampling (to calculate the hardness specific to each sample) to demonstrate compliance (DEQ, 2012. Footnote 12).

** Based on pH 6.5 to 9.0

mg/L milligrams per Liter

SSCL Site-specific cleanup level

Table 5A
Soil Cleanup Levels

Location	COC	UBMC SSCLs (mg/kg)	Source
Site-Wide Surface Soil SSCLs (unless noted below for a specific EU)	Aluminum	31,092	UBMC Background
	Arsenic	**40.44	UBMC Background
	Cadmium	**4.8	UBMC Background
	Copper	**275.1	UBMC Background
	Iron	See specific EU values below	Site-specific Calculations
	Lead	**1,109	UBMC Background
	Manganese	**4,893	UBMC Background
	Zinc	**550.9	UBMC Background
EU 2	Iron	259,173	*
EU 4	Iron	58,270	*
EU 5	Iron	58,270	*
EU 7	Iron	762,134	*
EU 9A	Iron	675,408	*
EU 9B	Iron	675,408	*
EU 11	Iron	199,000	*

Notes:

mg/kg milligrams per kilogram
COC Contaminant of concern
EU Exposure unit
SSCL Site-specifc cleanup level
DAF Dilution-attenuation Factor
SPLP Soil precipitation leaching procedure

* Leaching-to-groundwater SSCL. Iron is only a COC for groundwater. Leaching-to-groundwater SSCLs for all COCs for each EU were derived using site-specific DAFs and SPLP results from each EU. The development of leaching-to-groundwater SSCLs (see Section 7.6 in this ROD) is documented in Section 10.4 and Appendix G of the HHRA (Tetra Tech, 2014).

** Because site or area-specific background levels were higher, in most cases, than the human health risk-based concentrations and the risk-based remedial ecological goals, the site or area-specific background levels were selected as the SSCLs. Site or area-specific background levels were chosen because it is not necessary to remediate soils to a level that is lower than the background concentration.

Table 5B

Sediment Cleanup Levels

Location	COC	(mg/kg)	Source
EU 12 Upper Marsh Flood Plain Sediment	Aluminum	8,030	UBMC Background
	Arsenic	32.3	UBMC Background
	Cadmium	*3.53	Eco: Aquatic
	Copper	*197	Eco: Aquatic
	Iron	14,500	UBMC Background
	Lead	174	UBMC Background
	Manganese	696	UBMC Background
	Zinc	*315	Eco: Aquatic
EU 13 Streambed Sediment (Upper Marsh downstream to Hogum Creek)	Aluminum	8,980	UBMC Background
	Arsenic	*17	Eco: Aquatic
	Cadmium	*3.53	Eco: Aquatic
	Copper	*197	Eco: Aquatic
	Iron	35,800	Not a COC
	Lead	*91	Eco: Aquatic
	Manganese	578	UBMC Background
	Zinc	*315	Eco: Aquatic

Notes:

mg/kg milligrams per kilogram
COC Contaminant of concern
EU Exposure unit
SSCL Site-specifc cleanup level

* Based on aquatic invertebrates and fish ecological remediation goals. (Tetra Tech, 2013b)

Table 6 - Stevens Gulch Sediment

Stevens Gulch Sediments								
Metals	**Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Zn**
SSCL Source	**NA**	**Eco/Aquatic**	**Eco/Aquatic**	**Eco/Aquatic**	**NA**	**Eco/Aquatic**	**Bkgrd**	**Eco/Aquatic**
Sediment SSCLs mg/kg	**NR**	**17**	**3.53**	**197**	**Not a COC**	**91**	**578**	**315**
Above/Below Capital Mine to end of Trust Property								
SGSE-101	NS	NS	NS	NS	NS	NS	NS	NS
Capital Mine RI Soil Data (highest values)**	2850	1570	3.04	361	194000	2140	178	628
Capital Mine RI Soil Data (highest values)**	11100	354	2.98	462	51600	2270	712	1230
SGSE-102	3740	324	11	500	147000	2300	436	2170
SGSE-103	4450	300	10.9	588	159000	1220	370	2320
Below Trust Property/Above old Paymaster Road on Forest Property								
SGSE-105	5000	196	4.12	375	91400	1070	481	895
SGSE-106	5870	145	1.29	336	58000	674	383	369
SGSE-107	6460	168	1.84	341	73400	694	259	415
BRSW-108	No Analysis	59.2	0.6	283	No Analysis	395	336	194

Exceeds Aquatic SSCLs

NA - Not Applicable

NR - No Risk

NS - Not Sampled (too rocky/no fines for sediment sample)

Note: SGSE-104 is an iron precipitate cone-forming spring that is not connected to Stevens Creek. Therefore, it is not included in this table.

Table 7 - Stevens Gulch Surface Water

Upper Stevens Gulch near Capital Mine								
Metals & Other Pertinent Data	**[b]Al**	**As**	**[a]Cd**	**[a]Cu**	**Fe**	**[a]Pb**	**Mn**	**[a]Zn**
DEQ-7 Human Health mg/L	***20**	**0.01**	**0.005**	**1.3**	***14**	**0.015**	***0.43**	**2**
DEQ-7 Aquatic (Chronic)	**0.087**	**0.15**	**0.00023**	**0.0076**	**1**	**0.0024**	****NS**	**0.098**
DEQ-7 Aquatic (Acute)	**0.75**	**0.34**	**0.0017**	**0.011**	****NS**	**0.061**	****NS**	**0.098**
SGSW-5 (1995-97) Above Capital Mine - Pre-removal	<0.05 - 0.091	<0.002 - 0.012	<0.001	0.009 - 0.16	<0.03 - 0.17	<0.003	<0.01 - 0.042	0.021 - 0.07
SGSW-5 (1998) Above Capital Mine - First Year Post Removal	<0.05	<0.002	<0.001	0.016 - 0.054	<0.03 - 0.49	<0.003 - 0.005	0.032 - 0.036	0.042 - 0.043
SGSW-5 (2001) Above Capital Mine - Post Removal	<0.05	<0.005	<0.0002 - 0.0003	0.011 - 0.027	<0.05 - 0.031	<0.003	<0.01 - 0.025	0.031 - 0.044
SGSW-101 (2008) Similar location to SGSW-5	<0.03	<0.003	0.00018	0.086	0.11	0.0065	0.024	0.03
SGSW-7 (1995-97) Below Capital Mine - Pre-removal	<0.05 - 0.11	<0.002 - 0.021	<0.001 - 0.001	0.024 - 0.065	0.84 - 4.9	0.008 - 0.12	0.064 - 0.4	0.074 - 0.19
SGSW-7 (1998) Below Capital Mine - First Year Post Removal	<0.05 - 0.1	<0.002 - 0.11	<0.001 - 0.001	0.007 - 0.14	0.42 - 16.0	0.008 - 0.69	0.1 - 0.35	0.059 - 0.55
SGSW-7 (2001) Below Capital Mine - Post Removal	<0.05	<0.005	<0.0002 - 0.0002	0.002 - 0.011	0.31 - 0.76	0.003 - 0.022	0.033 - 0.076	0.036 - 0.046
SGSW-102 (2008) Similar location to SGSW-7	<0.03	<0.003	<0.00008	0.004	<0.05	0.002	0.007	0.01
SGSW-103 (2008)	0.03	<0.003	0.00047	0.011	<0.05	0.0009	0.024	0.1
SGSW-105 (2008)		<0.003	0.00032	0.015	0.1	0.0028	0.02	0.06
SGSW-106 (2008)		<0.003	0.00053	0.054	0.06	0.0022	0.18	0.12
SGSW-107 (2008)		<0.003	0.00076	0.076	0.14	0.0025	0.299	0.17

Lower Stevens Gulch near Tunnel #3 and the confluence with the Blackfoot River								
Metals & Other Pertinent Data	**[b]Al**	**As**	**[a]Cd**	**[a]Cu**	**Fe**	**[a]Pb**	**Mn**	**[a]Zn**
DEQ-7 Human Health mg/L	***20**	**0.01**	**0.005**	**1.3**	***14**	**0.015**	***0.43**	**2**
DEQ-7 Aquatic (Chronic)	**0.087**	**0.15**	**0.00012**	**0.0038**	**1**	**0.00084**	****NS**	**0.049**
DEQ-7 Aquatic (Acute)	**0.75**	**0.34**	**0.00073**	**0.0052**	****NS**	**0.0022**	****NS**	**0.049**
BRSW-8 (1995-97) Upstream of old Paymaster Road and Tunnel #3 - Pre-removal	0.33 - 2.1 (pH N/A)	<0.002 - <0.008	<0.001 - 0.002	0.083 - 0.31	<0.05 - 0.84	<0.003 - 0.015	0.21 - 0.6	0.14 - 0.33
BRSW-8 (1998) Upstream of old Paymaster Road and Tunnel #3 - First Year Post Removal	1.4 - 1.5 (pH N/A)	<0.002	0.001	0.14 - 0.18	0.19	<0.003 - 0.007	0.47 - 0.53	0.27 - 0.29
BRSW-8 (2001) Upstream of old Paymaster Road and Tunnel #3 - Post Removal	0.6 - 1.2 (pH N/A)	<0.005	0.001 - 0.0011	0.092 - 0.16	<0.02 - 0.11	0.004 - 0.006	0.26 - 0.44	0.19 - 0.28
BRSW-108 (2008) Similar location to BRSW-8	<0.03	<0.003	0.00042	0.055	0.23	0.001	0.137	0.1
BRSW-26 (1995-97) Above confluence with Blackfoot River - Pre-removal	<0.05 - 0.87 (pH N/A)	<0.002	<0.001 - 0.001	0.085 - 0.13	0.72 - 0.84	0.008 - 0.016	0.2 - 0.37	0.17 - 0.26
BRSW-26 (1998) Above confluence with Blackfoot River - First Year Post Removal	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
BRSW-26 (2001) Above confluence with Blackfoot River - Post Removal	0.59	<0.005	0.0009	0.094	0.15	0.006	0.26	0.19

(red)	Exceeds Human Health and Aquatic for Fe & Pb; Human Health only for As & Mn
(yellow)	Exceeds Aquatic only

a Freshwater Aquatic Life Standards for these metals are expressed as a function of total hardness (mg/L, $CaCO^3$, DEQ-7, October 2012)

b Applies only to surface water that has a pH between 6.5 and 9.0.

* The cleanup levels are site-specific (EPA 2014) calculations.

**NS Currently in DEQ-7, there is neither an acute aquatic standard for iron nor chronic or acute aquatic standards for manganese. Aluminum does not have a human health standard.

mg/L milligrams per Liter

Note: SGSW-104 is water from an iron precipitate cone-forming spring that is not connected to Stevens Creek. Therefore, it is not included in this table.

Table 8

Swamp Gulch Surface Water Quality								
BRSW-14 Metals Concentrations Range Pre/Post Cleanup (mg/L)								
Metals	**Al**	**As**	**Cd[a]**	**Cu[a]**	**Fe**	**Pb[a]**	**Mn**	**Zn[a]**
DEQ-7 Human Health	***20**	**0.01**	**0.005**	**1.3**	***14**	**0.015**	***0.43**	**2**
DEQ-7 Aquatic[b] (Chronic)	**[t]0.087**	**0.15**	**0.00018**	**0.0059**	**1**	**0.0016**	****NS**	**0.076**
DEQ-7 Aquatic[b] (Acute)	**[t]0.75**	**0.34**	**0.0012**	**0.0084**	****NS**	**0.041**	****NS**	**0.076**
BRSW-14 Background (1991-96)	**0.27**	**0.01**	**0.005**	**0.15**	**3.155**	**0.028**	**0.509**	**0.584**
BRSW-15 Metals Concentrations Range Pre Cleanup (mg/L)								
BRSW-15 Pre (1991-94)	<0.05-0.16	<0.003-<0.02[c]	0.001 - 0.042	0.16 - 1.35	8.85 - 64.7	<0.005 - 0.18	0.96 - 6.8	0.145 - 3.73
BRSW-15 Metals Concentrations Range Post Cleanup (mg/L)								
BRSW-15 Post (1995-98)	<0.05	<0.002 - 0.002	<0.001-<0.001	<0.005 - 0.01	0.11 - 1.3	<0.003 - 0.005	0.06 - 0.33	0.01 - 0.065

Exceeds site-specific background

Background was calculated, based on 15 sampling events, using ProUCL (EPA, 2009) and calculations are located in Appendix D, Section D1

a Freshwater Aquatic Life Standards for these metals are expressed as a function of total hardness (mg/L, $CaCO^3$; DEQ-7, October 2012)

b BRSW-14 total hardness as $CaCO^3$ is 58 mg/L and is based on total hardness results averaged over 15 sampling events.

c Detection limit for arsenic is higher than the DEQ-7 Human Health surface water standard and background. However, all of the other samples were non-detect at a detection limit less than the standard.

* The cleanup levels are site-specific (EPA, 2014) calculations.

**NS Currently in DEQ-7, there is neither an acute aquatic standard for iron nor chronic or acute aquatic standards for manganese.

t Applies only to surface water that has a pH between 6.5 and 9.0.

mg/L milligrams per Liter

Table 9 Edith Mine Area Groundwater

Non-Mining Area and Mining Area Groundwater Comparisons in Fens and Forested Emergent Wetlands		
Metals	**Fe**	**Mn**
Groundwater SSCLs mg/L	***14**	****0.94**
UMPZ-2 (2008) Fen Area Piezometer in Non-Mining Area	27.8	1.5
EDP-2 (2007-08) Fen Area Piezometer in Mining Area	24 - 24.2	1.50 - 1.54
UMPZ-4 (2008) Forested Emergent Wetland Area in Non-Mining Area	1.67	3.027
EDMW-2 (2007-08) Forested Emergent Wetland Area in Mining Area	1.24 - 1.84	0.56 - 1.04

Background and Mining Area Comparisons of Subsurface Soil Metals Concentrations		
Metals	**Fe**	**Mn**
Soil SSCLs mg/kg	**58,270**	**4,893**
Shaue Gulch Sub-Surface Soils (Non-Mining Area Reference Soil Concentrations)	20,500 - 152,000	31 - 1,420
Number Exceeding SSCLs/20 Total Samples	10	0
Edith Mine Area (EU 5) Pre-Removal Mine Waste and Surrounding Soils	16,425 - 138,175	<1 - 1,427
Number Exceeding SSCLs/32 Total Samples	7	0
Edith Mine Area (EU 5) Post Removal Mine Waste Areas	15,493 - 53,562	66 - 3,347
Number Exceeding SSCLs/65 Total Samples	0	0

Exceeds SSCLs

* The cleanup levels are site-specific calculations (Tetra Tech, 2014).

** Background

mg/L milligrams per Liter

mg/kg milligrams per kilograms

Table 10

Paymaster Creek Surface Water Quality							
Metals	**As**	**Cd[a]**	**Cu[a]**	**Fe**	**Pb[a]**	**Mn**	**Zn[a]**
DEQ-7 Human Health	**0.01**	**0.005**	**1.3**	**14***	**0.015**	**0.43***	**2**
DEQ-7 Aquatic[b] (Chronic)	**0.15**	**0.0001**	**0.0029**	**1**	**0.00054**	**NS****	**0.037**
DEQ-7 Aquatic[b] (Acute)	**0.34**	**0.00052**	**0.0038**	**NS****	**0.014**	**NS****	**0.037**
PCSW-4 & 5 (1994-97 – 3 samples taken) Metals Concentrations Range – Reference Above Mike Horse Fault	<0.002-<0.005	<0.001-<0.001[c]	<0.005-<0.01[c]	<0.03-0.1	<0.003-<0.01[c]	<0.01-0.02	<0.01-0.04
PCSW-1 & 3 (1994-97 – 6 samples taken) Metals Concentrations Range – Reference Below Mike Horse Fault and Above Paymaster Area Mining Claims	<0.002-<0.005	<0.001-<0.001[c]	<0.005-<0.01[c]	0.3-2.4	<0.003-<0.01[c]	0.014-0.32	0.024-0.11
BRSW-21 (1993-99/2007 – 19 samples taken) Metals Concentrations Range – Upstream End of Paymaster Area Mining Claims/Above Known Mining Activities	<0.002-0.007	<0.0001 - <0.001[c]	0.007-0.079	0.6-6.1	<0.0005-0.096[d]	0.041-0.36	0.02-0.1
BRSW-13 (1991-2000/2007 – 31 samples taken) Metals Concentrations Range – Downstream End of Paymaster Area Mining Claims/Below Known Mining Activities	<0.002 - <0.02[e]	<0.0001 - <0.008[f]	0.025-0.2	0.5-6.7	<0.002-0.01	0.039-0.42	0.02-0.11

Exceeds DEQ-7 Surface Water Standard for Human Health and Aquatic Life.

Exceeds DEQ-7 Surface Water Standards for Aquatic Life

a Freshwater Aquatic Life Standards for these metals are expressed as a function of total hardness (mg/L, $CaCO^3$; DEQ-7, October 2012)

b Total hardness as $CaCO^3$ is 25 mg/L for all of the sampling stations. The total hardness is an average based on total hardness results divided by sampling events for each sampling station.

c Detection limit is higher than the DEQ-7 human health and/or aquatic surface water standard.

d This human health exceedance (0.096 mg/L) for lead appears to be an anomaly and the location is upstream of the historical mining area. It is the only exceedance of the 19 samples and the other samples were right at or near the detection limits that ranged between <0.0005 - <0.01. In addition, the dissolved portion of the sample was <0.003 mg/L for lead.

e All arsenic samples for this station were below detection limits. Only 3 of the 31 samples had the high (<0.02 mg/L; sampled in 1991) detection limit, while the other samples detection limits ranged from <0.002 - <0.008 mg/L.

f All but 3 cadmium samples for this station were below the human health standard. The 3 exceedances were samples that had non-detects with a high (<0.008 mg/L; sampled in 1991) detection limit, while the other 28 samples detection limits ranged from <0.0001 - <0.005 mg/L.

* The cleanup levels are site-specific calculations.

** Currently, in DEQ-7 there is neither an acute aquatic standard for iron nor chronic or acute aquatic standards for manganese.

NS **No Standard or SSCL.**

Table 11

	Background Groundwater Quality in the Paymaster Mine Area							
Metals	**Al**	**As**	**Cd[a]**	**Cu[a]**	**Fe**	**Pb[a]**	**Mn**	**Zn[a]**
SSCLs (mg/L)	**20**[1]	**0.01**[2]	**0.005**[2]	**1.3**[2]	**14**[1]	**0.015**[2]	**0.94**[3]	**2**[2]
[4]**PMGW-116**	<0.03	<0.002	0.0026	0.004	<0.03	<0.0005	0.02	0.3
[4]**PMGW -117**	5.31	<0.002	0.0056	1.029	0.05	0.0032	0.94	0.8
[4]**PMGW -118**	0.29	<0.002	0.0022	0.127	<0.03	0.0010	1.74	0.2
[4]**PMGW -119**	4.44	<0.002	0.0037	2.866	4.66	0.0007	1.31	0.5
[4]**PMMW-14**	0.25	<0.002	0.0014	0.186	14.91	0.0011	2.29	0.35
[4]**PMPZ-3**	3.93	<0.002	0.0005	0.002	15.12	<0.0005	0.50	0.19
[4]**PMPZ-4**	4.51	<0.002	<0.00008	0.004	14.96	0.0009	0.50	0.27

Exceeds SSCLs but represents background conditions for the Paymaster Mine area groundwater.

Note: For those compounds that have them, DEQ-7 standards are the groundwater SSCLs unless site-specific background exceeds the DEQ-7 standards in a particular location, in which case background becomes the SSCL for that location. For those compounds in groundwater for which no DEQ-7 human health standard exists (aluminum, iron, and manganese), DEQ calculated SSCLs or used site-specific background levels (Section 10, Tetra Tech, 2014).

SSCL Source:

1 SSCL based upon site-specific calculation (Section 10,Tetra Tech, 2014)

2 Circular DEQ-7 Montana Numeric Water Quality Standards, October 2012 (DEQ, 2012)

3 SSCL based on background (Section ,Tetra Tech, 2014)

4 Paymaster Mine area background well

mg/L milligrams per Liter

SSCL Site-specific cleanup level

Table 12 Site Conceptual Exposure Model

PRIMARY SOURCE	PRIMARY RELEASE MECHANISM	SECONDARY SOURCE	SECONDARY RELEASE MECHANISM	TERTIARY SOURCE	TERTIARY RELEASE MECHANISM	QUATERNARY SOURCE	EXPOSURE ROUTE	POTENTIAL RECEPTORS – Human: Current and Future Recreational User (1)	Current and Future Construction Worker	Current and Future Industrial Worker	Current and Future Resident
Mine Waste: Waste Piles, Tailings, Mining Disturbed Areas							Ingestion	●	●	●	●
							Dermal Contact	●	●	●	●
							Plant Uptake	○	○	○	○
Mine Waste	Wind Suspension & Vehicle Traffic	Outdoor Air (Particulates)					Inhalation	●	●	●	●
Mine Waste; Untreated Mine Adit Water	Infiltration and Percolation	Groundwater					Ingestion	○(5)	~(5)	●(5)	●(5)
							Dermal Contact	○(5)	●(5)	●(5)	●(5)
Mine Waste; Untreated Mine Adit Water	Surface Runoff and Flood (Particulate and Dissolved)	Surface Water					Ingestion	●(5)	~(5)	~(5)	●(5)
							Dermal Contact	●(5)	~(5)	~(5)	●(5)
							Plant Uptake	○(5)	○(5)	○(5)	○(5)
		Sediment (2) (Resuspension to Surface Water)					Ingestion	●	●	●	●
							Dermal Contact	●	●	●	●
							Plant Uptake	○	○	○	○
		Sediment (2)	Wind Suspension of Floodplain Sediments/Soils	Outdoor Air (Particulates)			Inhalation	●	●	●	●
		Sediment (2)	Biota (Plant/Animal) Uptake	Food Chain			Ingestion	●(3)	○	○	○
							Dermal Contact	○	○	○	○
Mine Waste; Untreated Mine Adit Water	Infiltration and Mixing	Soil					Ingestion	●	●	●	●
							Dermal Contact	●	●	●	●
							Plant Uptake	○	○	○	○
		Soil	Wind Suspension & Vehicle Traffic	Outdoor Air (Particulates)			Inhalation	●	●	●	●
		Soil	Infiltration and Percolation	Groundwater			Ingestion	○(5)	~(5)	●(5)	●(5)
							Dermal Contact	○(5)	●(5)	●(5)	●(5)
		Soil	Surface Runoff and Flood (Particulate and Dissolved)	Surface Water			Ingestion	●(5)	~(5)	~(5)	●(5)
							Dermal Contact	●(5)	~(5)	~(5)	●(5)
							Plant Uptake	○(5)	○(5)	○(5)	○(5)
				Sediment (2) (Resuspension to Surface Water)			Ingestion	●	●	●	●
							Dermal Contact	●	●	●	●
							Plant Uptake	○	○	○	○
				Sediment (2)	Wind Suspension of Floodplain Sediments/Soils	Outdoor Air (Particulates)	Inhalation	●	●	●	●
				Sediment (2)	Biota (Plant/Animal) Uptake	Food Chain	Ingestion	●(3)	○	○	○
							Dermal Contact	○	○	○	○
		Soil	Biota (Plant/Animal) Uptake	Food Chain			Ingestion	●(3)	○	○	○
							Dermal Contact	○	○	○	○

LEGEND

- ● Complete exposure pathway; will be quantitatively evaluated
- ~ Complete exposure pathway; will be qualitatively evaluated
- ○ Not applicable; incomplete exposure pathway

(1) Four categories of recreational users will be evaluated: fisherman, hunter, rock hound, and all-terrain vehicle and motorcycle rider

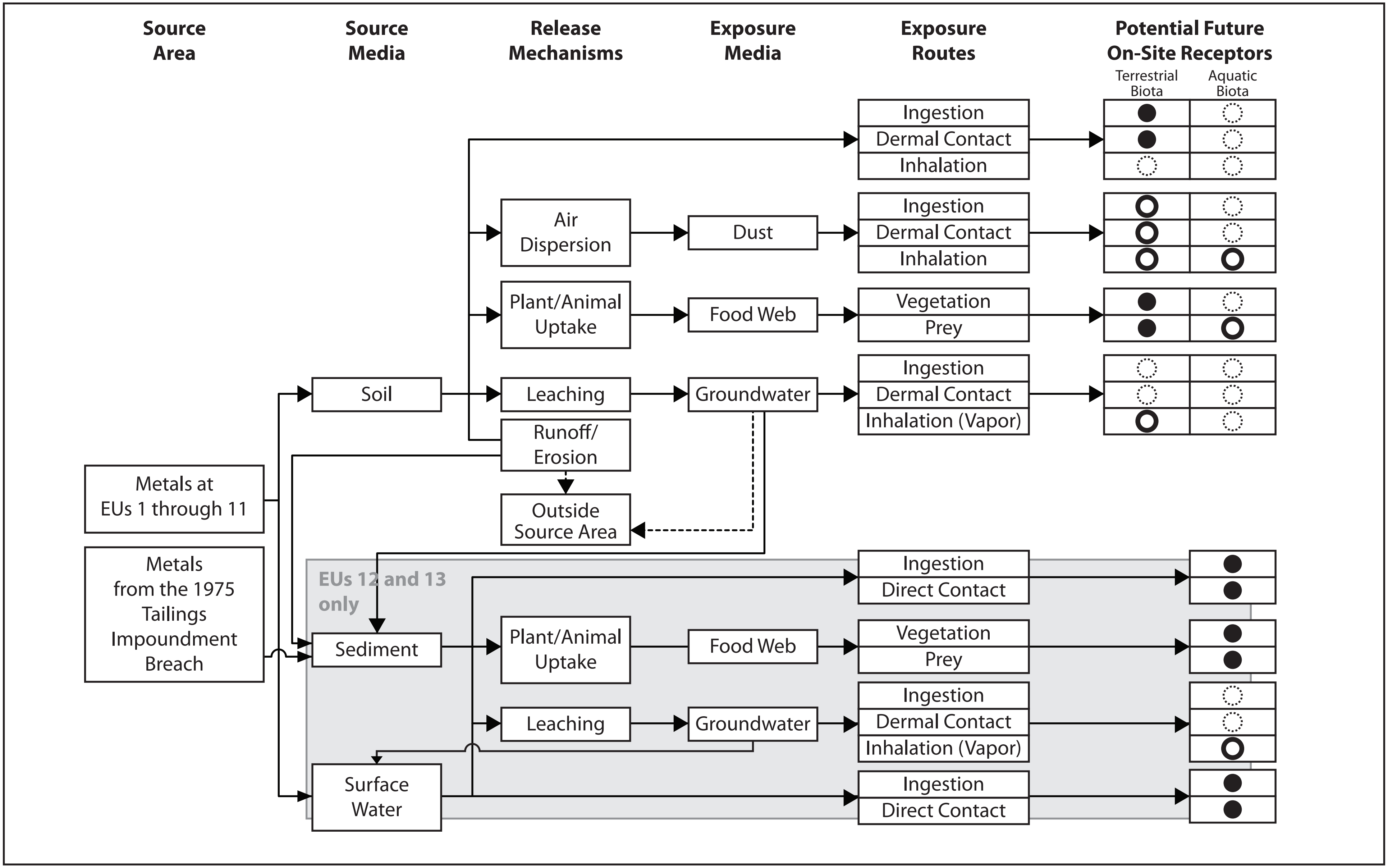
(2) Includes pore water for ecological exposure

(3) For human receptors (recreational fisherman and hunters), the food chain pathway includes ingestion of fish and terrestrial wildlife

(4) For ecological receptors, the food chain pathway includes ingestion of plants, invertebrates, fish, and terrestrial wildlife

(5) Groundwater and Surface Water will be compared to DEQ-7 water quality standards. No numerical risk calculations needed.

Table 12
Site Conceptual Exposure Model
Upper Blackfoot Mining Complex



Notes:

- ● Complete Pathway; quantitatively evaluated
- ○ Potentially Complete Pathway; not evaluated
- ◌ Incomplete Pathway; not evaluated

Table 13

Conceptual Site Model of Exposure Routes and Potential Ecological Receptors

Proposed Plan
Upper Blackfoot Mining Complex

Table 14-1 Feasibility Study Alternatives for EA 1 - Upland Waste Areas

EVALUATION AREA EA 1 Upland Waste Areas	REMEDIAL ALTERNATIVE								COMMENTS
		PHYSICAL HAZARDS/SOLID MEDIA							
		ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT			
						In-situ	Ex-situ		
	No Action	Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Blending and Co-Disposal	Neutralization W/Alkaline Amendment	
Upper Anaconda Mine (EU 1A) Waste Areas	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Anaconda adit water is addressed in EA 2. Waste removal areas previously reclaimed using lime and cover. Steep, rocky terrain makes access difficult. No apparent impacts to GW or SW.
Upper Anaconda Mine (EU 1B) Waste Piles	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Anaconda adit water is addressed in EA 2. Waste removal areas previously reclaimed using lime and cover. Steep, rocky terrain makes access difficult. In-situ treatment will be difficult due to rocky soil. No apparent impacts to GW or SW.
Capital Mine (EU 3) Waste Area	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Site is bisected by Stevens Creek. Waste removal areas previously reclaimed using lime and cover. No apparent impact to SW at downgradient SGSW-102. Coarse rock and steep terrain will make in-situ treatment difficult. Access very difficult on narrow, windy road.
Carbonate Mine (EU 4) Waste Area	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Groundwater issues are addressed in EA 2. Waste removal areas previously reclaimed using lime and cover. Located in the Swamp Gulch drainage adjacent to Hwy 200. Removal will likely require stream diversion and dewatering.
Edith Mine (EU 5) Waste Area	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Waste removal areas previously reclaimed using lime and cover. Relatively easy access to this site. No apparent impacts to GW or SW associated with these removal areas. Located on private and Forest Service lands.
Consolation Mine (EU 6) Waste Area	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Waste removal areas previously reclaimed using lime and cover. Relatively easy access to the site, but the removal area is on a partially timbered slope. Rocky surface soils would make in-situ treatment difficult.
Mary P Mine (EU 7) Waste Pile	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Site located adjacent to Blackfoot River floodplain wastes, with easy access. Relatively small volume of waste; would require regrading for in-situ treatment. Potential susceptibility to erosion from high water if left in place. Located on private and Forest Service lands.
Mike Horse Mine (EU 8) Waste Area	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Mike Horse adit and seep water, and Mike Horse bedrock GW are addressed in EA 2. Waste removal areas previously reclaimed using lime and cover. Previous removals left bare rock and in some areas ore-body exposed, making in-situ treatment difficult. Steep slopes in areas will make containment difficult.
Paymaster Mine (EU 9A) Waste Area -Surface	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Paymaster Gulch GW is addressed in EA 2. SW has metals exceedances both upstream and downstream of known mine disturbances. Waste removal areas previously reclaimed using lime and cover. Relatively easy access to site.
Paymaster Mine (EU 9B) Waste Area -Subsurface	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Paymaster Gulch GW is addressed in EA 2. SW has metals exceedances both upstream and downstream of known mine disturbances. Relatively easy access to site. Impacted soils are below the surface, requiring uncovering or removal for in-situ treatment.

GW: Groundwater. SW: Surface Water.

Table 14-2 Feasibility Study Alternatives for EA 2 - Groundwater

EVALUATION AREA EA 2 Groundwater	REMEDIAL ALTERNATIVE – No Action	GROUNDWATER – Monitored Natural Attenuation	ENGINEERING CONTROLS – Containment (Retention)	ENGINEERING CONTROLS – Detention	ENGINEERING CONTROLS – Hydrologic and Hydraulic Control	ENGINEERING CONTROLS – Inundation	TREATMENT – Active – Chemical Reagent	TREATMENT – Active – Physical/ Mechanical	TREATMENT – Passive – Chemical Reagent	COMMENTS
Anaconda Mine (EU 1) Adit Discharge	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Mine waste areas addressed in EA 1. Adit discharge currently routed to and treated at the WTP. Site constraints (access, steep terrain) may preclude passive treatment.
Carbonate Mine (EU 4) Groundwater	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Mine waste areas addressed in EA 1. Capturing and conveying the GW to the WTP (Active Treatment) would require constructing a new capture and conveyance system, constructing a pump station, and expanding the WTP. SW/GW diversion (Hydraulic control) could reduce the quantity of impacted GW.
Mike Horse Mine (EU 8) Adit Discharge and Seeps	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Mine waste areas addressed in EA 1. GW collection system currently conveys this water to the existing WTP for treatment. Construction of passive treatment may be difficult due to the complexity of the site and the chemistry of the water.
Upper Mike Horse Mine Bedrock Groundwater Aquifer	Yes	Yes	No	No	No	No	Yes	Yes	No	Unknown quantity of water. Capturing all of the impacted water will be difficult. Conveying to WTP would require new system and expansion of the WTP. Use of passive treatment (PRB) is not applicable for this bedrock aquifer with complex underground workings and the chemistry of the water.
Capital Mine Adit Plug	Yes	No	No	No	No	Yes	No	No	No	Leaking mine adit was closed with a grout seal and backfilled as part of a 1997 interim action. No mention of plugged adit site condition in the RI field notes.

GW: Groundwater. SW: Surface Water.

Table 14-3 Feasibility Study Alternatives for EA 3 - Surface Water and Sediment

EVALUATION AREA EA 3 Surface Water and Sediment	REMEDIAL ALTERNATIVE															
	No Action	PHYSICAL HAZARDS/SOLID MEDIA								SURFACE WATER						
		Monitored Natural Recovery	ENGINEERING CONTROLS/ LAND DISPOSAL				TREATMENT			ENGINEERING CONTROLS				TREATMENT		
							In-situ	Ex-situ						Active		Passive
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment	Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Blackfoot River (EU 13) [1]	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Comments	Several variables make water treatment problematic including: quantity of water, variable flow rate, and variable water quality. Removal and disposal alternatives refer to stream sediments. Removal of sediment will require stream channel reconstruction, multiple temporary stream diversions and dewatering systems. Anticipate that both water quality and sediment COC levels will improve with time, following the upstream floodplain sediment removals conducted within the EE/CA area.															
Stevens Creek	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Comments	Several variables make water treatment problematic including: quantity of water, variable flow rate, and variable water quality. Removal and disposal alternatives refer to stream sediments. Removal of sediment will require stream channel reconstruction, multiple temporary stream diversions, dewatering systems, and extensive road building in steep, timbered terrain and mineralized rock. Multiple sources along Stevens Creek contribute to water quality exceedances. Waste source removals are addressed in EA 1 and EA 5.															
Other Streams																
Paymaster Creek	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Comments	Surface water quality at the downstream end of Paymaster Gulch (BRSW-13) exceeded DEQ-7 aquatic life standards. Paymaster Creek flows through a highly mineralized zone with ferricrete deposits and other evidence off natural high metals concentrations. Several variables make water treatment problematic including: quantity of water, variable flow rate, and variable water quality. The BRSW-13 sediment sample showed exceedances. Removal and disposal alternatives refer to stream sediments. Removal of sediments will require stream channel reconstruction, multiple temporary stream diversions and dewatering systems.															
Unnamed Tributary above WTP	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Comments	Surface water exceedances (Chronic: Cd, Zn; Acute: Zn) in one sample of this intermittent drainage – possibly runoff or seep. No sediment data.															
Mining-related Feature Discharge, Seep or Spring																
Mine Feature BR-14 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Collapsed adit with leaking water that is pooled near entrance supporting vegetation. No flow or water quality data.															

EVALUATION AREA EA 3 Surface Water and Sediment	REMEDIAL ALTERNATIVE															
	No Action	PHYSICAL HAZARDS/SOLID MEDIA								SURFACE WATER						
		Monitored Natural Recovery	ENGINEERING CONTROLS/ LAND DISPOSAL				TREATMENT			ENGINEERING CONTROLS				TREATMENT		
							In-situ	Ex-situ						Active		Passive
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment	Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Mine Feature SG-71 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Spring at possible adit location 70 feet from creek. Water has pooled and is 6 inches deep. No flow or water quality data.															
Mine Feature SG-94 Discharge, seep, or spring	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No
Comments	Iron precipitate, cone-forming spring. Flow estimated at 2 to 5 gpm. Surface water (SGSW-104) exceeds HH: As, Fe; Chronic: Fe, Zn; Acute: Zn. Sediment exceeds for As.															
Historical Paymaster Adit Discharge	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Adit was plugged and a discharge collection system and wetland treatment system were installed in 1996-1997 with the intent to discharge water into the upper wetlands cell. Water is currently seeping out of the slope toe on to the road next to the plugged adit. Wetland cells solid media addressed as Paymaster Mine Waste Areas in EA 1.															

[1]From the Upper Marsh to Hogum Creek.
Acute: DEQ-7 Acute Aquatic Standard and Chronic: DEQ-7 Chronic Aquatic Standard.

Table 14-4 Feasibility Study Alternatives for EA 4 - Upper Marsh

EVALUATION AREA EA 4 Upper Marsh	REMEDIAL ALTERNATIVE																
	No Action	PHYSICAL HAZARDS/SOLID MEDIA								GROUNDWATER/SURFACE WATER							
		Monitored Natural Recovery	ENGINEERING CONTROLS/ LAND DISPOSAL				TREATMENT			Monitored Natural Attenuation (Groundwater only)	ENGINEERING CONTROLS				TREATMENT		
							In-situ	Ex-situ							Active		Passive
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment		Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Upper Marsh (EU 12) Eastern Area	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	No
Comments:	Containment of marsh sediments may require special permitting for fill within jurisdictional wetlands and the floodplain and would require extensive design engineered measures to control flood flows and prevent erosion from flood events. Removal of marsh sediments will require stream channel reconstruction, wetland reconstruction, extensive temporary stream diversions, dewatering systems, and haul road network construction. The eastern area generally contains higher concentrations of As, Cd, Cu, Pb, and Zn in the upper 12 inches than in the western area of the Upper Marsh, with some exceptions downstream of the Carbonate Mine site. The Upper Marsh contains sensitive areas including two large fens and one large emergent forested wetland, considered as special aquatic sites by the Army Corps of Engineers that should be protected from impacts associated with remedial activities.																
Upper Marsh (EU 12) Western Area	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	No
Comments:	Containment of marsh sediments may require special permitting for fill within jurisdictional wetlands and the floodplain and would require extensive design engineered measures to control flood flows and prevent erosion from flood events. Removal of marsh sediments will require stream channel reconstruction, wetland reconstruction, extensive temporary stream diversions, dewatering systems, and haul road network construction. The western area generally contains lower concentrations of As, Cd, Cu, Pb, and Zn in the upper 12 inches than in the eastern area of the Upper Marsh, with some exceptions downstream of the Carbonate Mine site. The Upper Marsh contains sensitive areas including two large fens and one large emergent forested wetland, considered as special aquatic sites by the Army Corps of Engineers that should be protected from impacts associated with remedial activities.																

Table 14-5 Feasibility Study Alternatives for EA 5 - Mining-related Features

EVALUATION AREA EA 5 Mining-related Features[4]	REMEDIAL ALTERNATIVE								COMMENTS
		PHYSICAL HAZARDS/SOLID MEDIA							
		ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT			
						In-situ	Ex-situ		
	No Action	Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Blending and Co-Disposal	Neutralization W/Alkaline Amendment	
Blackfoot River Drainage									
BR-14, BR-39	Yes	No	Yes	Yes	Yes	Yes	No	No	BR-39 is a caved adit and waste pile along edge of unnamed creek. BR-14 is a collapsed adit with seeps. Access to these sites will be difficult on the steep, timbered slope. Seepage water and unnamed creek water quality are addressed in EA 3.
BR-29	Yes	No	Yes	Yes	Yes	Yes	No	No	Located approximately 350 feet uphill from Mary P Mine in heavy timber on steep slopes. There are no roads to this feature; access difficult.
Pass Creek Drainage									
PC-01, PC-06	Yes	Yes	Yes	Yes	Yes	Yes	No	No	PC-01 includes an open timber shaft with water which creates a physical hazard requiring a physical barrier. Water quality (PCSW-102) meets DEQ-7 GW Standards. PC-06 is a collapsed adit with waste rock.
Paymaster Gulch Drainage									
PM-04, PM-06, JM-01	Yes	No	Yes	Yes	Yes	Yes	No	No	Access to each of these sites will be moderately difficult as there are no maintained roads and the features are located on heavily timbered slopes on either side of Paymaster Creek.
Shave Gulch Drainage									
SH-29, SH-37	Yes	No	Yes	Yes	Yes	Yes	No	No	SH-29 and 37 are located on the east side of Shave Gulch, uphill from the creek.
SH-13, SH-14	Yes	Yes	Yes	Yes	Yes	Yes	No	No	These features are located on the east side of Midnight Hill, with poor or no road access.
Stevens Gulch Drainage									
SG-13/14, SG-16, SG-43	Yes	No	Yes	Yes	Yes	Yes	No	No	These features are all located at the top of the ridge dividing Mike Horse and Stevens Gulches. Access will require construction of an extensive road network in steep, heavily timbered areas.
SG-41, SG-47, SG-48, SG-49/50, SG-51, SG-71, SG-93, SG-94	Yes	No	Yes	Yes	Yes	Yes	No	No	All of these sites are located along Stevens Creek. Access will be difficult and may require pioneering a road directly alongside the stream, or constructing multiple, switch-back roads along the steep valley slopes.
Swamp Gulch Drainage									
SWG-02	Yes	No	Yes	Yes	Yes	Yes	No	No	No existing roads to access this waste rock site, located 300 feet NE of Highway 200 on a heavily timbered, steep slope.

[4]Mine features are grouped by drainage basin. Within each basin, the features are grouped by proximity and/or common access road.

APPENDIX A. DETERMINATION OF ENVIRONMENTAL REQUIREMENTS, CRITERIA, AND LIMITATIONS

INTRODUCTION

Remedial actions undertaken pursuant to the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), §§ 75-10-701, et seq., MCA, must "attain a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety, and welfare and of the environment." Section 75-10-721(1), MCA. Additionally, the Montana Department of Environmental Quality (DEQ) "shall require cleanup consistent with applicable state or federal environmental requirements, criteria, or limitations" and "may consider substantive state or federal environmental requirements, criteria or limitations that are relevant to the site conditions." Sections 75-10-721(2)(a) and (b), MCA.

A distinction exists between "applicable" requirements and those that are "relevant." "Applicable" requirements are those requirements that legally apply at the Upper Blackfoot Mining Complex (UBMC) Facility regardless of the CECRA action. "Relevant" requirements are those requirements that are not applicable, but address situations or problems sufficiently similar to those at the UBMC Facility and, therefore, are relevant for use at the facility.

Environmental requirements, criteria, and limitations (ERCLs) are grouped into three categories: contaminant-specific, location-specific, and action-specific. Contaminant-specific requirements are those that establish an allowable level or concentration of a hazardous or deleterious substance in the environment or which describe a level or method of treatment for a hazardous or deleterious substance. Location-specific requirements are those that serve as restrictions on the concentration of a hazardous or deleterious substance or the conduct of activities because they are in specific locations. Action-specific requirements are those that are relevant or applicable to implementation of a particular remedy. Action-specific requirements do not in themselves determine the remedy but rather indicate the manner in which the remedy must be implemented. Some ERCLs may fit into more than one category and will not typically be repeated. For example, dust suppression and control of certain substances that may be released into the air as a result of earth moving, transportation and similar actions may be necessary to meet air quality requirements and could be included in the contaminant-specific or action-specific analysis.

CECRA defines cleanup requirements as only state and federal ERCLs. Remedial actions, including but not limited to designs, implementation, operation, and maintenance must, nevertheless, comply with all other applicable laws, including local, state, and federal. Many such laws, while not strictly environmental, have environmental impacts. It remains the responsibility of the entity implementing the remedial action to identify and comply with all other laws.

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, often pursuant to delegated environmental programs administered by the Environmental Protection Agency (EPA) and the states, such as the requirements of the federal Clean Water Act and the Montana Water Quality Act. ERCLs and other laws that are unique to state law are also identified.

Within this document, DEQ has identified applicable or relevant state and federal ERCLs for the remedial actions at the UBMC Facility. The description of applicable or relevant federal and state requirements that follows includes summaries of the legal requirements which set out the requirement in a reasonably concise fashion that is useful in evaluating compliance with the requirement. These descriptions are provided to allow the user a basic indication of the requirement without having to refer back to the statute or regulation itself. However, in the event of any inconsistency between the law itself and the summaries provided in this document, the actual requirement is ultimately the requirement as set out in the law, rather than any paraphrase of the law provided here.

CONTAMINANT SPECIFIC REQUIREMENTS

Groundwater: The federal Safe Drinking Water Act, 42 USC §§ 300f et seq. and the National Primary Drinking Water Regulations (40 CFR Part 141) (Relevant) establishes maximum contaminant levels (MCLs) for contaminants in drinking water distributed in public water systems. These requirements were evaluated during this ERCLs analysis in conjunction with the groundwater classification standards promulgated by the State of Montana.[1] The MCLs are identified because the groundwater in the area of the UBMC Facility is a potential source of drinking water.

EPA's guidance on Remedial Action for Contaminated Groundwater at Superfund Sites states that MCLs developed under the Safe Drinking Water Act generally are applicable or relevant and appropriate requirements (ARARs) [the federal equivalent of ERCLs] for current or potential drinking water sources. EPA has also established maximum contaminant level goals (MCLGs) for contaminants in drinking water distributed in public water systems. MCLGs which are above zero are relevant under the same conditions (55 Fed.Reg. 8750-8752, March 8, 1990). See also, *State of Ohio v. EPA*, 997 F.2d 1520 (D.C. Cir. 1993), which upholds EPA's application of MCLs and non-zero MCLGs as ARARs for groundwater which is a potential drinking water source. At the UBMC Facility, cadmium and copper are the only primary contaminants of concern with a non-zero MCLG; the MCLG for cadmium is 5 μg/L and the MCLG for copper is 1,300 μg/L, both of which are equivalent to their respective MCLs.

MCLs for the primary contaminants of concern in groundwater are listed below. However, compliance with all MCLs is required and remedial actions must meet the MCLs for all contaminants at the UBMC Facility, including any breakdown products generated during remedial actions.

1 MCLs are promulgated pursuant to both federal and state law. Under the Safe Drinking Water Act, EPA has granted the State of Montana primacy in implementation and enforcement of the Safe Drinking Water Act.

Chemical	**MCL**
Arsenic	10 µg/l
Cadmium	5 µg/L
Copper	1,300 µg/L*
Lead	15 µg/L*

* Lead and copper are regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1,300 µg/L and for lead the action level is 15 µg/L.

In addition, the Secondary Maximum Contaminant Levels (SMCLS) specified in 40 CFR Part 143.3 are relevant requirements to be attained by the remedy for the UBMC Facility. This regulation contains levels for iron, manganese, color, odor, and corrosivity that are relevant to the remedial actions.

The Montana Water Quality Act, § 75-5-605, MCA (Applicable) provides that it is unlawful to cause pollution of any state waters or cause to be placed any wastes where they will cause pollution of any state waters. Section 75-5-303, MCA (Applicable) requires that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected.

ARM 17.30.1006 (Applicable) classifies groundwater into Classes I through IV based upon its natural specific conductance and establishes the groundwater quality standards applicable with respect to each groundwater classification. Class I is the highest quality class; class IV the lowest. Class I groundwater has a specific conductance of less than or equal to 1,000 microSiemens per centimeter (µmhos/cm) at 25 degrees Celsius. A review of both field and laboratory specific conductance data at the UBMC for the period of 2007 and 2008 indicates sampled groundwater is classified as Class I groundwater. Two specific areas, the upper Mike Horse waste pile area and the Carbonate mine area, exhibited Class II groundwater characteristics based on specific conductance. However, the groundwater in both of these areas is contaminated by mining-related activities that increase the specific conductance to a level indicative of Class II groundwater. As the lowest measured specific conductance from unimpacted groundwater determines the classification, the groundwater is Class I. Concentrations of substances in groundwater within Class I may not exceed the human health standards for groundwater listed in Circular DEQ-7, Montana Numeric Water Quality Standards, October 2012 (Applicable). In addition, no increase of a parameter may cause a violation of § 75-5-303, MCA (Applicable). For concentrations of parameters for which human health standards are not listed in DEQ-7, ARM 17.30.1006 allows no increase of a parameter to a level that renders the waters harmful, detrimental or injurious to the beneficial uses listed for that class of water.

DEQ-7 human health standards for the primary contaminants of concern in groundwater are listed below. (The standards for metals in groundwater are based upon the dissolved portion of the sample.) However, compliance with all DEQ-7 standards is required and remedial actions must meet the DEQ-7 standards for all contaminants at the UBMC Facility, including any breakdown products generated during remedial actions.

Chemical	**DEQ-7 Standard**
Arsenic	10 μg/L
Cadmium	5 μg/L
Copper	1,300 μg/L
Lead	15 μg/L
Zinc	2,000 μg/L

ARM 17.30.1011 (Applicable) provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality in accordance with § 75-5-303, MCA, and ARM Title 17, chapter 30, subchapter 7.

However, ARM 17.30.1005 provides that "it is not necessary to treat discharges to a purer condition than the natural condition of the receiving water." Therefore, if background concentrations exceed a DEQ-7 standard, compliance with the ERCL is met when groundwater meets background.

Surface Water: There are significant surface water bodies at the UBMC Facility. The major tributary streams in the UBMC include Beartrap Creek, Mike Horse Creek, Anaconda Creek, the Blackfoot River, Stevens Gulch, Shave (or Shaue) Creek, Paymaster Creek, Pass Creek, and Swamp Gulch. The Blackfoot River is formed by the confluence of Beartrap Creek and Anaconda Creek within the Facility. Numerous tributaries of lesser significance join the Blackfoot River downstream of Swamp Gulch. All of these surface water bodies are within the Clark Fork River drainage. ARM 17.30.607 provides that the Clark Fork River is classified as B-1. ARM 17.30.623 provides the classification standards and beneficial uses for the B-1 classification and provides that concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters that would remain in the water after conventional water treatment may not exceed DEQ-7 standards. The section also provides the specific water quality standards for water classified as B-1 that must be met.

In addition, the following criteria apply:

1. Dissolved oxygen concentration must not be reduced below the levels given in DEQ-7, as provided in the following table (in milligrams per liter):

	Early Life Stages[1, 2]	Other Life Stages
30 Day Mean	n/a[3]	6.5
7 Day Mean	9.5 (6.5)	n/a[3]
7 Day Mean Minimum	n/a[3]	5.0
1 Day Minimum[4]	8.0 (5.0)	4.0

1 These are water column concentrations recommended to achieve the required inter-gravel dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.
2 Includes all embryonic and larval stages and all juvenile forms of fish to 30 days following hatching.
3 not applicable
4 All minima should be considered instantaneous concentrations to be achieved at all times

2. Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be maintained less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0;
3. The maximum allowable increase above naturally occurring turbidity is five nephelometric turbidity units, except as permitted by § 75-5-318, MCA;
4. Temperature increases must be kept within the limits specified in the rule;
5. No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except authorized under § 75-5-318, MCA), settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife;
6. True color must not be increased more than five color units above naturally occurring color;
7. E-coli must be kept below the limits specified in the rule; and
8. Unless a nutrient standards variance is granted, the standards in Circular DEQ-12A must be met.

For the primary contaminants of concern, the DEQ-7 surface water standards are listed below. (The standards for metals (except aluminum) in surface water are based upon the analysis of samples following a "total recoverable" digestion method.) However, compliance with all DEQ-7 standards is required. If both Aquatic Life Standards and Surface Water Human Health Standards exist for the same analyte, the more restrictive of these values is used as the applicable numeric standard.

Chemical	DEQ-7 Standard for Surface Water
Aluminum	87 µg/l (pH 6.5 – 9.0 only)
Arsenic	10 µg/l
Cadmium	.097 µg/l (at 25 mg/L hardness)
Copper	2.85 µg/l (at 25 mg/L hardness)
Iron	1,000 µg/l
Lead	.545 µg/l (at 25 mg/L hardness)
Zinc	37 µg/l (at 25 mg/L hardness)

Creeks, rivers, ditches, sloughs, and certain other bodies of surface water must meet these requirements.[2]

ARM 17.30.637 (Applicable) requires state surface waters to be free from substances attributable to municipal, industrial, agricultural practices, or other discharges that will:

1. settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;
2. create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;
3. produce odors, colors or other conditions as to which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;
4. create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and
5. create conditions which produce undesirable aquatic life.

ARM 17.30.637 also states that no waste may be discharged and no activities conducted which, either alone or in combination with other waste activities, will cause violation of surface water quality standards.

ARM 17.30.705 (Applicable) provides that for any surface water, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

<u>Air Quality</u>: The Clean Air Act (42 USC §§ 7401 et seq.) provides limitations on air emissions resulting from cleanup activities or emissions resulting from wind erosion of exposed hazardous

[2] As provided under ARM 17.30.602(31), "'surface waters' means any waters on the earth's surface including, but not limited to, streams, lakes, ponds, and reservoirs; and irrigation and drainage systems discharging directly into a stream, lake, pond, reservoir, or other surface water. Water bodies used solely for treating, transporting, or impounding pollutants shall not be considered surface water."

substances. Sections 75-2-101, et seq., MCA (Applicable) provides that state emission standards are enforceable under the Clean Air Act of Montana.

ARM 17.8.204 (Applicable) establishes monitoring, data collection and analytical requirements to ensure compliance with ambient air quality standards.

ARM 17.8.220 (Applicable) provides that settled particulate matter shall not exceed a 30 day average of 10 grams per square meter.

ARM 17.8.223 (Applicable) provides that PM-10 concentrations in ambient air shall not exceed a 24 hour average of 150 micrograms per cubic meter of air and an annual average of 50 micrograms per cubic meter of air.

Ambient air standards are also promulgated for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, hydrogen sulfide, and lead. If emissions of these compounds were to occur at the UBMC Facility in connection with any remedial action, these standards would also be applicable. See ARM 17.8.210, 17.8.211, 17.8.212, 17.8.213, 17.8.214, and 17.8.222.

LOCATION-SPECIFIC REQUIREMENTS

The Endangered Species Act, 16 USC §§ 1531 et seq., 50 CFR Part 402, 40 CFR 6.302(h), and 40 CFR 257.3-2, (Relevant) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. Compliance with this requirement involves consultation with the U.S. Fish and Wildlife Service (USFWS) and a determination of whether there are listed or proposed species or critical habitats present at the Facility, and, if so, whether any proposed activities will impact such wildlife or habitat. The USFWS has provided DEQ a list of the current threatened and endangered species and critical habitat occurring within the UBMC area. These include the bull trout, Canada lynx and grizzly bear. The USFWS is providing ongoing consultation regarding these species and their critical habitat.

Montana Nongame and Endangered Species Conservation Act, §§ 87-5-101, et seq., MCA (Applicable) provides that endangered species should be protected in order to maintain and to the extent possible enhance their numbers. These sections list endangered species, prohibited acts and penalties. Section 87-5-201, MCA, (Applicable) addresses protection of wild birds, nests and eggs; and ARM 12.5.201 (Applicable) prohibits certain activities with respect to specified endangered species. There are significant ecological receptors within the UBMC Facility, and if any threatened or endangered species or critical habitat is subsequently encountered during remedial actions, compliance with these ERCLs is required.

Migratory Bird Treaty Act, 16 USC §§ 703 et seq. (Relevant) establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement. If any migratory birds are encountered during remedial actions, consultation with the USFWS will occur.

Bald Eagle Protection Act, 16 USC §§ 668 et seq. (Relevant) establishes a federal responsibility for protection of bald and golden eagles, and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup does not unnecessarily adversely affect the bald and golden eagle. No bald or golden eagles have been identified at the UBMC Facility. However, if any bald or golden eagles are subsequently encountered during remedial actions, consultation with the USFWS will occur.

Archaeological and Historic Preservation Act, 16 USC § 469 and 40 CFR 6.301(c) (Relevant) establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archaeological data that might be destroyed through alteration of terrain as a result of a federal activity.

Montana Antiquities Act, §§ 22-3-421, et seq., MCA (Applicable) addresses a state agency's responsibility to avoid or mitigate impacts to heritage property or paleontological remains. If these are encountered during remedial actions, compliance with these ERCLs is required.

Montana Human Skeletal Remains and Burial Site Protection Act, §§ 22-3-801, et seq., MCA (Applicable) prohibits purposefully or knowingly disturbing or destroying human skeletal remains or burial sites. If these are encountered during remedial actions, compliance with these ERCLs is required.

Resource Conservation and Recovery Act, 40 CFR 264.18 (Relevant) provides location standards for facilities where treatment of hazardous waste will occur. Portions of those treatment areas must not be located within 200 feet of a fault which has had displacement in Holocene time and treatment areas in or near a 100 year floodplain must be designed, constructed, operated, and maintained to avoid washout.

Fish and Wildlife Coordination Act, 16 USC §§ 661 et seq. (Relevant) requires that federally funded or authorized projects ensure that any modification of any stream or other water body affected by a funded or authorized action provide for adequate protection of fish and wildlife resources. The regulations are relevant because there are surface water bodies within the UBMC Facility.

Floodplain Management Order, Executive Order 11,988 (Relevant) requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In addition, application of the Montana floodplain requirements (see below) addresses protection of the floodplain.

Montana Floodplain and Floodway Management Act, §§ 76-5-401, et seq., MCA and ARM 36.15.601, et seq. (Applicable) specify types of uses and structures that are allowed or prohibited in the designated 100-year floodway and floodplain. Portions of the UBMC Facility are within a floodplain.

ARM 36.15.701 (Applicable) allows certain activities in the flood fringe.

ARM 36.15.605(2) and 36.15.703 (Applicable) prohibit certain uses in either the floodway or the flood fringe, respectively.

Section 76-5-402, MCA (Applicable) allows uses in the floodplain outside the flood way.

Section 76-5-404, MCA (Applicable) establishes that it is unlawful to establish an artificial obstruction or nonforming use within a designated floodplain or designated floodway without a permit. This section applies to any remedial action in the designated floodplain or designated floodway where such action requires more than maintenance. The substantive requirements of a Floodplain Development Permit are applicable to activities planned in the floodway.

The substantive requirements specify factors that must be considered in allowing diversions of the stream, changes in place of diversion of the stream, flood control works, new construction or alteration of artificial obstructions, or any other nonconforming use within the floodplain or floodway. Many of these requirements are set forth as factors that must be considered in determining whether a permit can be issued for certain obstructions or uses. Section 76-5-406, MCA and ARM 36.15.216 (Applicable) identify factors which must be considered in addressing any obstruction or use within the floodway or floodplain; these include:

1. the danger to life and property from backwater or diverted flow caused by the obstruction or use;
2. the danger that the obstruction or use will be swept downstream to the injury of others;
3. the availability of alternate locations;
4. the construction or alteration of the obstruction or use in such a manner as to lessen the danger;
5. the permanence of the obstruction or use; and
6. the anticipated development in the foreseeable future of the area which may be affected by the obstruction or use.

Conditions or restrictions that generally apply to specific activities within the floodway or floodplain are:

1. the proposed activity, construction, or use cannot increase the upstream elevation of the 100-year flood a significant amount (0.5 foot or as otherwise determined by the permit-issuing authority) or significantly increase flood velocities, ARM 36.15.604 (Applicable);
2. the proposed activity, construction, or use must be designed and constructed to minimize potential erosion from a base flood, ARM 36.15.603 (Applicable); and
3. a proposed permanent diversion structure crossing the full width of the stream channel must be designed and constructed to safely withstand up to a base flood, ARM 36.15.603 (Applicable).

For the substantive conditions and restrictions applicable to specific obstructions or uses, see the following applicable regulations:

Excavation of material from pits or pools - ARM 36.15.602(1).

Storage of materials must be readily removable – ARM 36.15.602(5)(b).

Storage of flammable, toxic, or explosive materials not allowed – ARM 36.15.602(5)(b).

Water diversions or changes in place of diversion - ARM 36.15.603.

Flood control works (levees, floodwalls, and riprap must comply with specified safety standards) - ARM 36.15.606.

Roads, streets, highways and rail lines (must be designed to minimize increases in flood heights) - ARM 36.15.701(3)(c).

Structures and facilities for liquid or solid waste treatment and disposal (must be floodproofed to ensure that no pollutants enter flood waters and may be allowed and approved only in accordance with DEQ regulations, which include certain additional prohibitions on such disposal) - ARM 36.15.701(3)(d).

Structures -ARM 36.15.702(1)(2).

Montana Stream Protection Act, §§ 87-5-501, et seq., MCA (Applicable) provides that a state agency may not construct, modify, operate, maintain, or fail to maintain any construction which may or will obstruct, damage, diminish, destroy, change, modify, or vary the natural existing shape and form of any stream or its banks or tributaries by any type or form of construction without first causing notice of such planned construction to be served upon the Montana Department of Fish, Wildlife and Parks not less than 60 days prior to commencement of final plans for construction.

Protection of Wetlands Order, Executive Order No. 11,990 (Relevant) provides for the avoidance of adverse impacts associated with the destruction or loss of wetlands and avoids support of new construction in wetlands if a practicable alternative exists.

Montana Solid Waste Management Act, §§ 75-10-201, et seq., MCA, and ARM 17.50.501 et seq. (Applicable) specify requirements that apply to the location of any Class II solid waste management facilities, which include the repositories at the UBMC.

ARM 17.50.523 (Applicable) requires that waste be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.

ARM 17.50.525 (Applicable) provides for DEQ inspection at reasonable hours.

ARM 17.50.1004 (Applicable) addresses Class II landfills in floodplains.

ARM 17.50.1005 (Applicable) prohibits placement of a Class II landfill in a wetland unless special conditions are met.

ARM 17.50.1006 (Applicable) prohibits placement of a Class II landfill within 200 feet of a fault which has had displacement in Holocene time unless special conditions are met.

ARM 17.50.1007 (Applicable) prohibits placement of a Class II landfill in a seismic impact zone (as defined in ARM 17.50.1002(35)) unless special conditions are met.

ARM 17.50.1008 (Applicable) prohibits placement of a Class II landfill in an unstable area, which are defined in ARM 17.50.1002(40) as including locations that are susceptible to events or forces that are capable of impairing the integrity of the landfill structural components responsible for preventing releases from the landfill.

ARM 17.50.1009 (Applicable) provides that a solid waste management facility must be located where a sufficient acreage of suitable land is available for solid waste management, including adequate separation of wastes from underlying groundwater and adjacent surface water. The facility may not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife or result in the destruction or adverse modification of critical habitat for those species. Also, the facility must manage solid waste, gas, and leachate.

ARM 17.50.1009 (Applicable) requires that Class II landfills be designed, constructed, and maintained with a run-on and run-off control system to address 25 year storm events.

ARM 17.50.1110 (Applicable) prohibits a Class II landfill from causing a discharge of a pollutant into state waters, including wetlands.

ARM 17.50.1116 (Applicable) requires that a solid waste management facility be designed, constructed, and operated in a manner to prevent harm to human health and the environment.

ARM 17.50.1204(1)(b) (Applicable) requires that a Class II landfill be constructed utilizing a composite liner and leachate collection and removal system that is designed and constructed to maintain less than a 30 centimeter depth of leachate over the liner.

ARM 17.50.1205(3) (Applicable) requires that the leachate system provide for accurate monitoring of the leachate level and provide a minimum slope at the base of the overlying leachate collection layer equal to at least two percent.

ARM 17.50.1303 (Applicable) identifies requirements for groundwater monitoring.

ARM 17.50.1312 (Applicable) identifies requirements for monitoring well abandonment.

ARM 17.50.1403 (Applicable) sets forth the closure requirements for Class II landfills. This includes the requirement that the cap be a minimum of 24 inches thick and other criteria, as follows:

1. install a cover that is designed to minimize infiltration and erosion;
2. design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than 1 X 10-5 cm/sec, whichever is less; and
3. minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant.

ARM 17.50.1404 (Applicable) sets forth post closure care requirements for Class II landfills. Post closure care requires maintenance of the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cover and comply with the groundwater monitoring requirements found at ARM Title 17, chapter 50, subchapter 13.

Section 75-10-212, MCA, (Applicable) prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the restriction relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.

ACTION-SPECIFIC REQUIREMENTS

Point Source: If point sources of water contamination are retained or created by any remediation activity, applicable Clean Water Act standards would apply to those discharges. The State of Montana established state standards and permit requirements in conformity with the Clean Water Act, and these standards and requirements apply to point source discharges. See ARM 17.30.1201 et seq., (standards) and ARM 17.30.1301 et seq. (permits).

Dredge and Fill: The Clean Water Act, Section 404 (33 USC 1251, et seq., 33 CFR Part 330) prohibits the discharge of dredged or fill material into water of the United States without a permit and may apply depending on the remedial alternative.

Air Quality: ARM 17.8.304 and 17.8.308 (Applicable) provide that no person shall cause or authorize the production, handling, transportation or storage of any material; or cause or authorize the use of any street, road, or parking lot; or operate a construction site or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken. Emissions of airborne particulate matter must be controlled so that they do not exhibit an opacity of 20% or greater averaged over six consecutive minutes.

ARM 17.24.761 (Relevant) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities and requires that an air monitoring plan be implemented.

Groundwater Act: § 85-2-505, MCA (Applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

Section 85-2-516, MCA and ARM 36.21.809 (Applicable) requires that within 60 days after any well (including a monitoring well) is completed, a well log report must be filed by the driller with the Montana Bureau of Mines and Geology.

ARM 17.30.641 (Applicable) provides standards for sampling and analysis of water to determine quality.

ARM 17.30.646 (Applicable) requires that bioassay tolerance concentrations be determined in a specified manner.

ARM 36.21.801 et seq. (Applicable) provides standards for installing monitoring wells.

ARM 36.21.670-678 and 810 (Applicable) specifies certain requirements that must be fulfilled when abandoning monitoring wells. This includes filing a well log report with the Montana Bureau of Mines and Geology.

Substantive MPDES Permit Requirements: Because the State of Montana has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Montana through the Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1342-1344) (Applicable). These regulations set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control are applicable requirements. As discussed in the ROD, MPDES permit MTR-0030031 was active until May 2011 when DEQ's Site Response Section assumed administrative duties to monitor water quality compliance under its CECRA authority.

Technology-Based Treatment: ARM 17.30.1203 (Applicable) incorporates provisions of the federal Clean Water Act for criteria and standards for the imposition of technology-based treatment requirements. For toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case by case basis.

Storm Water Runoff: ARM 17.30.1341 to 1344 (Applicable) requires a Storm Water Discharge General Permit for stormwater point sources. Generally, the permit requires the permittee to implement Best Management Practices (BMP) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, additional protections may be required.

The Resource Conservation and Recovery Act (RCRA): 42 USC §§ 6901 et seq., (Applicable) and the Montana Hazardous Waste Act, §§ 75-10-401 et seq., MCA, (Applicable) and the regulations under these acts establish a regulatory structure for the generation, transportation, treatment, storage and disposal of hazardous wastes. These requirements are applicable to substances and actions at the UBMC Facility that involve the active management of hazardous wastes.

Wastes may be designated as hazardous by either of two methods: listing or demonstration of a hazardous characteristic. Listed wastes are the specific types of wastes determined by EPA to be hazardous as identified in 40 CFR Part 261, Subpart D (40 CFR 261.30 - 261.33) (Applicable, as incorporated by the Montana Hazardous Waste Act). Listed wastes are designated hazardous by virtue of their origin or source, and must be managed as hazardous wastes. Characteristic wastes are those that by virtue of concentrations of hazardous constituents demonstrate the characteristic of ignitability, corrosivity, reactivity or toxicity, as described at 40 CFR Part 261, Subpart C (Applicable, as incorporated by the Montana Hazardous Waste Act).

There have been no listed hazardous wastes identified at the UBMC. Prior to the summer of 2014, there were a few occasions when the filter sludge cake from the water treatment plant was identified as a characteristic hazardous waste based on toxicity characteristic leaching procedure (TCLP) sampling. However, in the summer of 2014, the standard operating procedures at the water treatment plan were modified to optimize the system, and there have been no further TCLP exceedances. Also, to date, no waste pile samples have exceeded TCLP levels for lead. Therefore, no hazardous waste ERCLs have been identified but if, in the future, characteristic hazardous waste is identified at the facility, compliance with RCRA is required.

<u>Reclamation Requirements</u>: Section 75-10-1404, MCA (Applicable) requires that mine waste repositories be capped with a minimum of 24 inches of cover material, including a minimum of six inches of topsoil, and revegetated using plant species native to the area. Revegetated areas must achieve a vegetative cover equal to 85% of the vegetation cover of adjacent lands (that were not previously disturbed) within three years of the initial seeding.

In addition, certain portions of the Montana Strip and Underground Mining Reclamation Act, §§ 82-4-101 et seq., MCA, and Montana Hard Rock Mining Reclamation Act, §§ 82-4-301 et seq., MCA, as outlined below are relevant requirements for activities at the UBMC Facility. While no mining activities are currently occurring at the UBMC Facility, past mining activities resulted in the releases of hazardous or deleterious substances at the facility. These requirements are relevant for the management and reclamation of areas disturbed by excavation, grading, or similar actions.

ARM 17.24.106 (Relevant) provides that exploration drill holes must be plugged with bentonite or a similar compound from the bottom of the hole to within five to ten feet of the surface, and with cement from the top of the bentonite to the surface.

ARM 17.24.505 (Relevant) provides that all exposed mineral seams must be covered with a minimum of four feet of the best available non-toxic and non-combustible material.

ARM 17.24.631 (Relevant) provides that disturbances to the prevailing hydrologic balance will be minimized. Changes in water quality and quantity, in the depth to groundwater and in the location of surface water drainage channels will be minimized, to the extent consistent with the selected remedial action. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

ARM 17.24.632 (Relevant) provides that each prospecting hole, drill hole, borehole, or well must be properly abandoned. Other exposed underground openings must be abandoned or cased and sealed to prevent acid mine drainage, minimize disturbance to the prevailing hydrologic balance, and ensure safety of people and animals.

ARM 17.24.633 (Relevant) provides that all surface drainage from a disturbed area must be treated by the best technology currently available. This includes the requirement that sediment control be maintained until the disturbed area has been restored and revegetation requirements have been met.

ARM 17.24.634 (Relevant) provides that reclaimed drainage basins must be constructed to approximate original contour and provide for the long-term relative stability of the landscape.

ARM 17.24.635 through 17.24.637 (Relevant) provide requirements for temporary and permanent diversions.

ARM 17.24.638 (Relevant) provides that sediment control measures must be implemented during operations.

ARM 17.24.640 (Relevant) provides that discharges from diversions must be controlled to reduce erosion and to minimize disturbance of the hydrologic balance.

ARM 17.24.641 (Relevant) provides that practices to prevent drainage from toxic forming spoil material into ground and surface water will be employed.

ARM 17.24.643 through 17.24.646 (Relevant) provide that discharge of mine drainage water must be controlled; the regulations provide other requirements for groundwater protection, groundwater recharge protection, and groundwater and surface water monitoring.

ARM 17.24.701 (Relevant) provides that undisturbed soils must be protected to the extent possible from contamination and soil salvage operations must be conducted in a manner that minimizes erosion, contamination, degradation, compaction, and deterioration of the biological properties of the soil.

ARM 17.24.702 (Relevant) provides that salvaged and stockpiled soil must be protected from wind or water erosion. Active stockpiles must be used within one year or revegetated. Redistributed soil must be reconditioned by subsoiling on the contour, whenever possible.

ARM 17.24.703 (Relevant) provides that, when using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use; and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

ARM 17.24.711 (Relevant) provides that, when reclaiming, a diverse, effective and permanent vegetative cover of the same seasonal variety and utility as the vegetation native to the area of land to be affected must be established. For reclamation to land use involving fish and wildlife habitat, consultation with the Montana Department of Fish, Wildlife, and Parks is necessary.

ARM 17.24.713 (Relevant) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed.

ARM 17.24.714 (Relevant) provides that mulch or cover crop or both must be used until adequate permanent cover can be established.

ARM 17.24.716 (Relevant) provides that revegetation may be done through drill or broadcast seeding, by seedling transplants, or by establishing sod plugs, and all revegetation must be done on the contour whenever possible. Seed mix must be free of weedy or other undesirable species and done in a manner to prevent establishment of noxious weeds.

ARM 17.24.717 (Relevant) provides that tree or shrub species must be adopted for local site conditions and climate, and be planted in combination with herbaceous species.

ARM 17.24.718 (Relevant) provides that soil amendment must be used if necessary to establish a permanent vegetative cover. Grazing, haying or chemical applications may not be conducted if they interfere with establishment of revegetation.

ARM 17.24.721 (Relevant) provides that reclamation must ensure that rills or gullies are stabilized and the area reseeded and replanted if the rills and gullies are disrupting the reestablishment of the vegetative cover or causing or contributing to a violation of water quality standards for a receiving stream.

ARM 17.24.723 (Relevant) provides that periodic monitoring of vegetation, soils, water, and wildlife is required.

ARM 17.24.724 (Relevant) provides that the success of revegetation is measured against unmined reference areas on lands exhibiting good ecological integrity.

ARM 17.24.726 (Relevant) provides the required methods for measuring vegetative success.

ARM 17.24.731 (Relevant) provides that, if toxicity to plants or animals is suspected, comparative chemical analyses may be required.

Noxious Weeds: §§ 7-22-2101 et seq., MCA (Applicable) establishes and authorizes weed control at the local level. Section 7-22-2101(8)(a), MCA defines "noxious weeds." Designated noxious weeds are listed in ARM 4.5.201 and 4.5.206 through 4.5.209 and must be managed consistent with weed management criteria developed under § 7-22-2109(2)(b), MCA and in compliance with § 7-22-2152, MCA. In addition, ARM 4.5.210 identifies regulated plants that may not be used for revegetation.

OTHER LAWS (NON-EXCLUSIVE LIST)

CECRA defines as ERCLs only applicable or relevant state and federal environmental laws. Remedial design, implementation, and operation and maintenance must nevertheless comply with all other applicable laws. The following "other laws" are included here to provide a reminder of other potentially legally applicable requirements for actions at the UBMC Facility. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ERCLs because they are not “environmental laws."

Occupational Safety and Health Regulations
The federal Occupational Safety and Health Act regulations found at 29 CFR 1910 are applicable to worker protection during conduct of all remedial activities.

Water Rights
Section 85-2-101, MCA, declares that all waters within the state are the state's property, and may be appropriated for beneficial uses. The wise use of water resources is encouraged for the maximum benefit to the people and with minimum degradation of natural aquatic ecosystems. Parts 3 and 4 of Title 85, Chapter 2, MCA, set out requirements for obtaining water rights and appropriating and utilizing water. All requirements of these parts are laws which must be complied with in any action using or affecting waters of the state

Controlled Groundwater Areas
Pursuant to § 85-2-506, MCA, the Montana Department of Natural Resources and Conservation may grant either a permanent or a temporary controlled groundwater area. The maximum allowable time for a temporary area is two years, with a possible two-year extension. Designation of a controlled ground water area may be proposed if: (i) excessive ground water withdrawals would cause contaminant migration; (ii) ground water withdrawals adversely affecting ground water quality within the ground water area are occurring or are likely to occur; or (iii) ground water quality within the ground water area is not suited for a specific beneficial use.

Montana Occupational Safety and Health Act
ARM 17.74.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This regulation is

applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR 1910.95 applies.

ARM 17.74.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation. This regulation is applicable to limited categories of workers and for most workers the similar federal standard in 29 CFR 1910.1000 applies.

Montana Safety Act

Sections 50-71-201 provides that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life, health, and safety of its employees.

APPENDIX B. MODEL RESTRICTIVE COVENANTS

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[State Property – Section 35 Repository Area]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Department of Environmental Quality, an agency of the State of Montana (DEQ), as of ____________, 2016.

RECITALS

WHEREAS, DEQ is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

Township 5 North, Range 7 West, P.M.M., Lewis and Clark County:

Section 35: All that portion of the E/2; NE1/4 SW1/4; and the NW1/4 lying North of Highway No. 279 Right-of-Way (Deed Reference Book 193 of Deeds, Page 222) comprising approximately 362.67 acres, more or less.

WHEREAS, DEQ has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist at the Upper Blackfoot Mining Complex (UBMC);

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the selected remedy includes placement of mine waste from the UBMC in an engineered repository on the Subject Property and a restriction on the repository area as provided for in § 75-10-727, MCA;

WHEREAS, it is important to maintain the hydrologic conditions in and near the engineered repository;

WHEREAS, within the Subject Property, there is an engineered repository and associated infrastructure known as the UBMC Mine Waste Repository Area that contains mine tailings and waste. That portion of the Subject Property has been surveyed and is more particularly described as follows:

[insert surveyed UBMC Mine Waste Repository Area property description here]

NOW, THEREFORE, DEQ hereby agrees and declares:

1. Within the UBMC Mine Waste Repository Area of the Subject Property, no soil or soil caps may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is DEQ's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the UBMC Mine Waste Repository Area that may disturb the soil or soil caps in order to ensure the integrity and effectiveness of the remedy.

2. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells on the Subject Property must be maintained and no seals may be removed on any closed wells.

3. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

4. At all times after DEQ conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, DEQ shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if DEQ conveys all or any portion of its interest in the Subject Property, DEQ retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary. The remedy of "specific performance" shall be available to DEQ in such proceedings.

5. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

6. DEQ shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

7. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Department of Environmental Quality

____

By:

State of Montana)
:ss.
County of Lewis and Clark)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of Montana, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Department of Environmental Quality.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

NOTARY PUBLIC FOR THE STATE OF MONTANA
(SEAL) Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 1]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, within the Subject Property, there are capture systems for mine adit discharge and other sources associated with historic mining operations, including an adit bulkhead plug. These capture systems and bulkhead plug are connected to or part of an engineered water treatment plant, and it is anticipated that this plant will operate in perpetuity. That portion of the Subject Property, known as the Capture System Area, has been surveyed and is more particularly described as follows;

[insert surveyed Capture System Area property description here]

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, groundwater exceeds Montana numeric water quality standards;

WHEREAS, within the Subject Property, there is an area exceeding site-specific background levels where removal is not feasible because of near-surface mine workings that pose potential subsidence issues and because slopes are too steep to establish a vegetative cover.

In that area, a rock cover has been installed to limit exposure, break up long slope lengths to reduce soil erosion, and aid in establishing vegetation on portions of the slope. That portion of the Subject Property, known as the Containment Area, has been surveyed and is more particularly described as follows:

[insert surveyed Containment Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. No residential development or use shall occur upon the Subject Property, including but not limited to construction of homes; accommodations for caretakers, watchmen, or custodians; any permanent or temporary structures which allow overnight use; or any temporary or permanent mobile home or camper. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of residential use of the Subject Property whatsoever.

3. Within the Capture System Area, no soil may be disturbed in any manner without the express prior written approval of DEQ unless such disturbance is related to the operation of the water treatment plant. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Capture System Area that may disturb the capture systems in order to ensure the integrity and effectiveness of the remedy.

4. Within the Containment Area, no soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Containment Area that may disturb the rock cover in order to ensure the integrity and effectiveness of the remedy.

5. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

6. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

7. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

8. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

9. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

10. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

11. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____

By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

NOTARY PUBLIC FOR THE STATE OF _________
(SEAL) Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 2]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, within the Subject Property, there is a grout seal in the Capital Mine adit, effectively inundating the Capital Mine workings with groundwater while eliminating seasonal discharge of water from the adit;

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Subject Property, the grout seal on the Capital Mine adit must be inspected and maintained to prevent adit discharge and to ensure the integrity of the adit plug.

3. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

   [insert surveyed area(s) property description here]

4. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

5. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

6. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

7. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

8. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for

violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

9. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

10. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

11. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

12. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

(SEAL)

NOTARY PUBLIC FOR THE STATE OF __________
Residing at ____
My Commission Expires: __________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 3]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there is an engineered system known as the Water Treatment Plant Area. This system treats water from mine adits, capture systems, and other sources associated with historic mining operations and it is anticipated that it will operate in perpetuity. It also includes an adit bulkhead plug which is part of the conveyance system to the plant. That portion of the Subject Property has been surveyed and is more particularly described as follows:

[insert surveyed Water Treatment Plant Area property description here]

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes institutional warning signs or fencing;

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject

Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. No residential development or use shall occur upon the Subject Property, including but not limited to construction of homes; accommodations for caretakers, watchmen, or custodians; any permanent or temporary structures which allow overnight use; or any temporary or permanent mobile home or camper. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of residential use of the Subject Property whatsoever.

3. Within the Water Treatment Plant Area, no soil may be disturbed in any manner without the express prior written approval of DEQ unless such disturbance is related to the operation of the water treatment plant. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Water Treatment Plant Area that may disturb the capture systems in order to ensure the integrity and effectiveness of the remedy.

4. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

   [insert surveyed area(s) property description here]

5. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

6. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

7. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

8. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

9. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

10. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

11. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

12. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

13. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of _________)
:ss.
County of ______)

On this __ day of ________, 2016, personally appeared _____________, before me, a Notary Public for the State of ____________, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as _________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____
NOTARY PUBLIC FOR THE STATE OF __________
(SEAL) Residing at ____
My Commission Expires: __________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 4]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

[insert surveyed area(s) property description here]

2. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

3. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

4. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

5. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

6. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

7. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

8. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

9. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

10. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____

By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

NOTARY PUBLIC FOR THE STATE OF _________

(SEAL) Residing at ____________________________________

My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 5]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

[insert surveyed area(s) property description here]

2. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

3. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

4. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

5. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

6. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

7. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

8. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

9. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

10. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____
NOTARY PUBLIC FOR THE STATE OF _________
(SEAL) Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 6]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, within the Subject Property, a physical barrier has been installed to reduce or prohibit entry by humans and large mammals at the PC-01 adit;

WHEREAS, within the Subject Property, groundwater exceeds Montana numeric water quality standards and there are sediments that exceed human health and ecological based site-specific cleanup levels in a marsh containing sensitive areas with fens and forested emergent wetlands. These sensitive environments take hundreds of years to form and removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The portion of the Subject Property containing those sensitive areas is known as the Eastern Marsh Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Eastern Marsh Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Eastern Marsh Area without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Eastern Marsh Area, no sediment or soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Eastern Marsh Area that may disturb the sediment or soil in order to ensure the integrity and effectiveness of the remedy.

3. DEQ's selected remedy requires the installation and maintenance of warning signs to warn and limit people from coming into contact with the Eastern Marsh Area. The warning signs must remain intact and visible at all times.

4. Within the Subject Property, the physical barrier on the PC-01 adit must be inspected and maintained to access to the adit by humans and large mammals.

5. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

   [insert surveyed area(s) property description here]

6. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

7. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

8. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

9. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

10. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

11. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

12. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

13. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

14. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

(SEAL)

NOTARY PUBLIC FOR THE STATE OF _________
Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 7]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, groundwater exceeds Montana numeric water quality standards;

WHEREAS, the selected remedy includes placement of mine waste from the UBMC in an engineered repository on the Subject Property and a restriction on the repository area as provided for in § 75-10-727, MCA;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, within the Subject Property, there is an engineered repository and associated infrastructure known as the Paymaster Repository Area that contains mine tailings and waste. That portion of the Subject Property has been surveyed and is more particularly described as follows:

[insert surveyed Paymaster Repository Area property description here]

WHEREAS, within the Subject Property, there are sediments that exceed human health and ecological based site-specific cleanup levels in a marsh containing sensitive areas with fens and forested emergent wetlands. These sensitive environments take hundreds of years to form and removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The portion of the Subject Property containing those sensitive areas is known as the Western Marsh Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Western Marsh Area property description here]

WHEREAS, within the Subject Property, there is an area containing the Paymaster constructed wetland system which includes an adit drainage collection system (retention pond). Maintaining the current subsurface geochemical/oxidation state conditions in the vicinity of the Paymaster constructed wetland system will limit deposition and mobilization of metals and to prevent a release of adit discharge. The portion of the Subject Property containing this area is known as the Paymaster Constructed Wetland Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Paymaster Constructed Wetland Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Paymaster Repository Area, no soil or soil caps may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Paymaster Repository Area that may

disturb the soil or soil caps in order to ensure the integrity and effectiveness of the remedy.

3. Within the Paymaster Constructed Wetland Area, no soil or soil caps may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Paymaster Constructed Wetland Area that may disturb the soil or soil caps in order to ensure the integrity and effectiveness of the remedy

4. Within the Western Marsh Area, no sediment or soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Western Marsh Area that may disturb the sediment or soil in order to ensure the integrity and effectiveness of the remedy.

5. DEQ's selected remedy requires the installation and maintenance of warning signs to warn and limit people from coming into contact with the Western Marsh Area. The warning signs must remain intact and visible at all times.

6. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

   [insert surveyed area(s) property description here]

7. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

8. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

9. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of

hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

10. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

11. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

12. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

13. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

14. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

15. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____

By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _________, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____

(SEAL)

NOTARY PUBLIC FOR THE STATE OF _________
Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 8]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are sediments that exceed human health and ecological based site-specific cleanup levels in a marsh containing sensitive areas with fens and forested emergent wetlands. These sensitive environments take hundreds of years to form and removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The portion of the Subject Property containing those sensitive areas is known as the Upper Marsh Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Upper Marsh Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Upper Marsh Area without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Upper Marsh Area, no sediment or soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Upper Marsh Area that may disturb the sediment or soil in order to ensure the integrity and effectiveness of the remedy.

3. DEQ's selected remedy requires the installation and maintenance of warning signs to warn and limit people from coming into contact with the Upper Marsh Area. The warning signs must remain intact and visible at all times.

4. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

5. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

6. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

7. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

8. The provisions of this Declaration governing the use restrictions of the Subject

Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

9. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

10. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of _________, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____
NOTARY PUBLIC FOR THE STATE OF _________
(SEAL) Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 9]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, the selected remedy includes placement of mine waste from the UBMC in an engineered repository on the Subject Property and a restriction on use of the property as provided for in § 75-10-727, MCA,

WHEREAS, within the Subject Property, there is an engineered repository and associated infrastructure known as the Carbonate Repository Area that contains mine tailings and waste. That portion of the Subject Property has been surveyed and is more particularly described as follows:

[insert surveyed Carbonate Repository Area property description here]

WHEREAS, within the Subject Property, groundwater exceeds Montana numeric water quality standards and there are sediments that exceed human health and ecological based site-specific cleanup levels in a marsh containing sensitive areas with fens and forested emergent wetlands. These sensitive environments take hundreds of years to form and removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The portion of the Subject Property containing those sensitive areas is known as the Western Marsh Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Western Marsh Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Carbonate Repository Area, no soil or soil caps may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction of any structures, containments, footings for any purpose, or similar below ground appurtenances. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Carbonate Repository Area that may disturb the soil or soil caps in order to ensure the integrity and effectiveness of the remedy.

3. Within the Western Marsh Area, no sediment or soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Western Marsh Area that may disturb the sediment or soil in order to ensure the integrity and effectiveness of the remedy.

4. DEQ's selected remedy requires the installation and maintenance of warning signs to warn and limit people from coming into contact with the Western Marsh Area. The warning signs must remain intact and visible at all times.

5. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety,

or welfare or the environment.

6. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

7. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

8. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

9. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

10. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

11. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____
By:

State of ________)
:ss.
County of ______)

On this __ day of _______, 2016, personally appeared ____________, before me, a Notary Public for the State of_______, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as ________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____
NOTARY PUBLIC FOR THE STATE OF _________
(SEAL) Residing at ____________________________________
My Commission Expires: ________________________

DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY
[Trust Property – Parcel 10]

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY is made by the Montana Environmental Trust Group, LLC (Trust) as of ____________, 2016.

RECITALS

WHEREAS, the Trust is the owner of certain real property (the Subject Property) located in Lewis and Clark County, Montana, more particularly described as:

[insert property description here]

WHEREAS, the Subject Property is within the Upper Blackfoot Mining Complex Facility and the Montana Department of Environmental Quality (DEQ) has determined that releases or threatened releases of hazardous or deleterious substances that may pose an imminent or substantial endangerment to public health, safety or welfare or the environment exist and that these hazardous or deleterious substances have come to be located upon the Subject Property;

WHEREAS, DEQ, under the authority of the Montana Comprehensive Environmental Cleanup and Responsibility Act, §§ 75-10-701 et seq., MCA, has selected a remedy to abate the imminent and substantial endangerment posed by the hazardous or deleterious substances;

WHEREAS, the site-specific cleanup levels selected in the remedy are based upon background concentrations, and those background concentrations may exceed a health-based value for specific land uses;

WHEREAS, within the Subject Property, there are mining-related features that are in difficult to access areas characterized by steep and often heavily timbered slopes with few established roads for access. DEQ's selected remedy for these areas includes warning signs or fencing;

WHEREAS, within the Subject Property, there are sediments that exceed human health and ecological based site-specific cleanup levels in a marsh containing sensitive areas with fens and forested emergent wetlands. These sensitive environments take hundreds of years to form and removal in these areas may result in more of an adverse impact than leaving contaminated sediment in place within the fen/forested emergent wetland areas. The portion of the Subject Property containing those sensitive areas is known as the Western Marsh Area; it has been surveyed and is more particularly described as follows:

[insert surveyed Western Marsh Area property description here]

WHEREAS, the selected remedy requires that the Trust restrict use of the Subject Property in order to mitigate the risk to the public health, safety or welfare or the environment and DEQ requires that such restrictions be recorded as provided for in § 75-10-727, MCA;

NOW, THEREFORE, the Trust hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Western Marsh Area without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than for remediation purposes (including but not limited to monitoring) without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. Within the Western Marsh Area, no sediment or soil may be disturbed in any manner without the express prior written approval of DEQ. This restriction includes, but is not limited to irrigation, drilling, excavation, or construction. It is the Trust's intent that this prohibition be applied as broadly as possible to ensure that there is no use of the Western Marsh Area that may disturb the sediment or soil in order to ensure the integrity and effectiveness of the remedy.

3. DEQ's selected remedy requires the installation and maintenance of warning signs to warn and limit people from coming into contact with the Western Marsh Area. The warning signs must remain intact and visible at all times.

4. Within the Subject Property, those areas with mining-related features containing concentrations of metals above site-specific cleanup levels, referred to as "Mine Feature Areas," have been surveyed and are more particularly described as follows:

   [insert surveyed area(s) property description here]

5. Within the Mine Features Areas, no use of the property shall be allowed without the express prior written approval of DEQ. It is the Trust's intention that this restriction be interpreted as broadly as possible to prohibit any type of use, including but not limited to recreational use, whatsoever to prevent human exposure to concentrations of metals exceeding site-specific cleanup levels.

6. DEQ has required the installation and maintenance of warning signs or fencing at the Mine Feature Areas to prohibit human access to those areas. The warning signs or fencing may not be removed without the express prior written approval of DEQ.

7. No action shall be taken, allowed, suffered, or omitted on the Subject Property if

such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment.

8. The Trust agrees to provide DEQ and its representatives and contractors and all representatives and contractors of any person conducting remedial actions approved by DEQ on the Subject Property access at all reasonable times to the Subject Property.

9. At all times after the Trust conveys its interest in all or any portion of the Subject Property and no matter what person or entity holds title to or is in possession of the Subject Property, the Trust shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein. In addition, if the Trust conveys all or any portion of its interest in the Subject Property, the Trust retains the right and obligation to enforce these Restrictive Covenants as an intended beneficiary.

10. DEQ shall be entitled to enforce these covenants as an intended beneficiary thereof. The Trust specifically agrees that the remedy of "specific performance" shall be available to DEQ in such proceedings.

11. The provisions of this Declaration governing the use restrictions of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of all or any portion of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants.

12. The Trust shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in Helena, Montana.

13. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, (insert name of property owner) has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

Montana Environmental Trust Group, LLC

____

By:

State of ________)
:ss.
County of ______)

On this __ day of ________, 2016, personally appeared _____________, before me, a Notary Public for the State of ________, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same, as _________ of the Montana Environmental Trust Group, LLC.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

____
NOTARY PUBLIC FOR THE STATE OF __________
(SEAL) Residing at ____
My Commission Expires: __________________________

Table B1 UBMC Institutional Controls

IC-1 (Section 35)	IC-2 (Carbonate Mine Area/Parcel 9)	IC-3 (Paymaster Mine Area/Parcel 7)	IC-4 (Parcel 8)	IC-5 (Mike Horse Mine Area/Parcel 1)
UBMC Repository and related infrastructure	repositoryand related infrastructure	repositoryand related infrastructure	Access Restrictions (Sensitive Area - W Upper Marsh)	upper seep (WTP Operation)
Groundwater	groundwater	groundwater		Mike Horse groundwater
	Access Restrictions (Sensitive Area - W Upper Marsh)	adit bulkhead flow control		EU 8 Waste Containment Area
		EU 9B - Construction Restrictions		lower seep (WTP Operation)
		PM-06 Mine Waste Access Restrictions		Mike Horse adit bulkhead plug (WTP flow control)
		JM-01 Mine Waste Access Restrictions		
		Access Restrictions (Sensitive Area - W Upper Marsh)		

IC-6 (WTP/Anaconda Mine Area/Parcel 3)	IC-7 (Capital Mine Area/Parcel 2)	IC-8 (Consolation Mine Area/Parcel 5)	IC-9 (Mary P Mine Area/Parcel 4)	IC-10 (Midnight-Daylight Mine Area/Parcel 6)
WTP	EU 3 Access Restrictions (includes Capital adit plug)	BR-14 access restrictions (SW/adit)	BR-29 Mine Waste Access Restrictions	PC-06 Mine Waste Access Restrictions
EU 1A/1B Access Restrictions	SG-71 Access Restrictions (SW)	SH-37 Mine Waste Access Restrictions		SH-14 Mine Waste Access Restrictions
Anaconda adit bulkhead plug (WTP flow control)	SG-94 Access Restrictions (SW)			SH-37 Mine Waste Access Restrictions
	SG-13/14 Mine Waste Access Restrictions			PC-01 Adit (physical barrier)
	SG-16 Mine Waste Access Restrictions			Access Restrictions (Sensitive Area - E Upper Marsh)
	SG-41 Mine Waste Access Restrictions			Groundwater - E Upper Marsh
	SG-43 Mine Waste Access Restrictions			
	SG-47 Mine Waste Access Restrictions			
	SG-48 Mine Waste Access Restrictions			
	SG-49/50 Mine Waste Access Restrictions			
	SG-51 Mine Waste Access Restrictions			
	SG-71 Mine Waste Access Restrictions			
	SG-93 Mine Waste Access Restrictions			
	SG-94 Mine Waste Access Restrictions			

IC-11 (Parcel 10)
SWG-02 Mine Waste Access Restrictions
Access Restrictions (Sensitive Area - W Upper Marsh)

APPENDIX C. SELECTED REMEDY COST ESTIMATES

Table C1 - Alternatives Comparison for UBMC								
Alternatives	**Protectiveness**	**Compliance w/ERCLs**	**Mitigation of Risk**	**Effectiveness & Reliability**	**Implementability & Practicability**	**Treatment or Resource Recovery Technologies**	**Years to Implement**	**Estimated Present Worth Cost @ 3%**
1 No Action	No	No	No	No	Yes	No	30	$ -
2 Monitored Natural Recovery	Yes (when combined)	Yes (when combined)	Yes (long-term when combined)	Yes, can be effective and reliable when combined with other source control or removal actions.	Yes	No	30	$ 2,545,823
3 Physical Barriers	Yes (when combined)	Yes (when combined)	Yes (eliminates intentional or accidental access) No (doesn't address risk to human health and environment from COCs)	Yes, is effective and reliable for eliminating access to open adits and other physical hazards.	Yes	No	30	$ 193,845
4 Containment (Earthen/Rock Cap)	Yes (when combined)	Yes (when combined)	Yes (mitigates risk caused by direct contact with COCs) No (doesn't protect groundwater from COCs)	Yes, but O&M would be required to maintain the integrity of the cap.	Yes	No	30	$ 16,064,459
5 Removal & On-site Disposal	Yes (when combined)	Yes (when combined)	Yes (mitigates risk of COCs exceeding SSCLs) No (doesn't mitigate all risk from arsenic and lead)	Yes, but construction BMPs may be needed to reduce adverse short-term effects on surface water from the construction activities.	Yes, but removal may be difficult in some locations due to steep terrain, remoteness and inadequate access.	No	30	$ 23,436,794
6 Removal & Off-site Disposal	Yes (when combined)	Yes (when combined)	Yes (mitigates risk of COCs exceeding SSCLs) No (doesn't mitigate all risk from arsenic and lead)	Yes, but construction BMPs may be needed to reduce adverse short-term effects on surface water from the construction activities.	Yes, but removal may be difficult in some locations due to steep terrain, remoteness and inadequate access.	No	30	$ 29,625,091
7 In Situ Neutralization w/Alkaline Amendment	Yes (when combined)	Yes (when combined)	Yes (mitigates risk caused by direct contact with COCs) No (doesn't protect groundwater from COCs)	Yes, but construction BMPs may be needed to reduce adverse short-term effects on surface water from the construction activities.	Yes, but amendment may be difficult in some locations due to steep terrain, remoteness and inadequate access.	Yes - alkaline amendment to soil.	30	$ 4,311,101
8 Ex Situ Neutralization w/Alkaline Amendment	Yes (when combined)	Yes (when combined)	Yes (mitigates risk caused by direct contact with COCs) No (doesn't protect groundwater from COCs)	Yes, but construction BMPs may be needed to reduce adverse short-term effects on surface water from the construction activities.	Yes, but amendment may be difficult in some locations due to steep terrain, remoteness and inadequate access.	Yes - alkaline amendment to soil.	30	$ 2,317,210
9 Monitored Natural Attenuation	Yes (when combined)	Yes (when combined)	Yes (long-term when combined)	Yes, can be effective and reliable when combined with other source control or removal actions.	Yes	No	30	$ 2,311,332
10 Containment (Retention Pond)	Yes (when combined)	Yes (when combined)	Yes (risk exposure downstream of the pond would be mitigated) No (water discharge exceeding the SSCLs may remain on the surface and become concentrated within the retention pond)	Yes, but O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.	Yes, but construction may be difficult in some locations due to steep terrain, remoteness and inadequate access.	No	30	$ 1,116,380

Table C1 - Alternatives Comparison for UBMC								
Alternatives	**Protectiveness**	**Compliance w/ERCLs**	**Mitigation of Risk**	**Effectiveness & Reliability**	**Implementability & Practicability**	**Treatment or Resource Recovery Technologies**	**Years to Implement**	**Estimated Present Worth Cost @ 3%**
11 Hydrologic & Hydraulic Control	Yes (when combined)	Yes (when combined)	There is no mitigation of exposures to risk to human health and the environment under this alternative.	No, but when combined with a PRB, it may reduce the quantity of groundwater that would need to be treated.	Yes	No	30	$ 464,514
12 Inundation	Yes (when combined)	Yes (when combined)	Mitigates the risks to human health and the environment by keeping the adit discharge contained in the adit. Continued risk may be present if new uncontrolled seeps develop.	Yes, is highly effective and reliable in both the short-term and long-term.	Yes	No	30	$ 10,124
13 Active Chemical Reagent*	Yes (when combined)	Yes (when combined)	No mitigation of risk from exposure to contaminated groundwater with this alternative, but if combined with other alternatives, some mitigation of risk may be achieved.	No, but when combined with ceramic microfiltration, has proven to be effective and reliable at the existing WTP.	Yes, it is practicable and implementable in its current configuration.	Yes - sodium hydroxide addition.	30	$ 20,394,855
14 Active Physical/Mechanical Treatment*	Yes (when combined)	Yes (when combined)	No mitigation of risk from exposure to contaminated groundwater with this alternative, but if combined with other alternatives, some mitigation of risk may be achieved.	No, but when combined with alkaline amendment, has proven to be effective and reliable at the existing WTP.	Yes, it is practicable and implementable in its current configuration.	Yes - ceramic microfiltration.	30	$ 20,394,855
15 Passive Chemical Reagent: Permeable Reactive Barrier	Yes (when combined)	Yes (when combined)	Yes, there is mitigation of exposures to risk because concentrations of cadmium and other metals in the groundwater leaving the Carbonate Mine site would be significantly reduced.	Yes, but O&M would be required to maintain the integrity of the remedy and ensure continued performance as designed.	Additional site investigations and pilot studies are needed to ensure optimization of the designs.	Yes - PRB	30	$ 7,827,027
Site-wide Elements**	Yes (when combined)	Yes (when combined)	Yes (when combined)	Yes	Yes	No	30	$ 2,511,941

* **Given the current design of the WTP, it is difficult to segregate chemical treatment costs from physical treatment costs; therefore, for cost estimation purposes, the overall costs were allocated equally.**

** **Site-wide Elements Cost Breakout: Institutional Controls ($25,000) + Engineering Controls ($507,514) + Long-term Monitoring and Maintenance ($1,979,427) = $2,511,941**

TABLE C2: UBMC ROD SELECTED REMEDY COST SUMMARY TABLE

				REMEDIAL ALTERNATIVE COSTS														
	SITE-WIDE ELEMENTS			No Action	PHYSICAL HAZARDS/SOLID MEDIA							SURFACE WATER/GROUNDWATER						
					Monitored Natural Recovery	ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT		Monitored Natural Attenuation	ENGINEERING CONTROLS			TREATMENT		
										In-situ	Ex-situ					Active		Passive
	ICs*	Access Restrictions	Long-term Monitoring and Maintenance**			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Neutralization W/Alkaline Amendment		Containment (Retention Pond)	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
TOTAL COST	$55,000	$154,205	$1,545,552	$0	$827,322	$65,496	$344,955	$1,725,880	$0	$0	$0	$10,830	$41,878	$0	$0	$7,709,400	$7,709,400	$1,830,977

SITE-WIDE ELEMENTS TOTAL $1,754,757

FINAL REMEDY TOTAL $22,020,895

* Based on $5,000 per IC, Assumed total of 11 ICs

** Based on current monitoring annual budget of $70,000; Present Value at 3% discounted over 30 years + Long term monitoring & maintenance of fencing for 30 years.

Table C3 UBMC Institutional Controls

IC-1 (Section 35)	IC-2 (Carbonate Mine Area/Parcel 9)	IC-3 (Paymaster Mine Area/Parcel 7)	IC-4 (Parcel 8)	IC-5 (Mike Horse Mine Area/Parcel 1)
UBMC Repository and related infrastructure	repositoryand related infrastructure	repositoryand related infrastructure	Access Restrictions (Sensitive Area - W Upper Marsh)	upper seep (WTP Operation)
Groundwater	groundwater	groundwater		Mike Horse groundwater
	Access Restrictions (Sensitive Area - W Upper Marsh)	adit bulkhead flow control		EU 8 Waste Containment Area
		EU 9B - Construction Restrictions		lower seep (WTP Operation)
		PM-06 Mine Waste Access Restrictions		Mike Horse adit bulkhead plug (WTP flow control)
		JM-01 Mine Waste Access Restrictions		
		Access Restrictions (Sensitive Area - W Upper Marsh)		

IC-6 (WTP/Anaconda Mine Area/Parcel 3)	IC-7 (Capital Mine Area/Parcel 2)	IC-8 (Consolation Mine Area/Parcel 5)	IC-9 (Mary P Mine Area/Parcel 4)	IC-10 (Midnight-Daylight Mine Area/Parcel 6)
WTP	EU 3 Access Restrictions (includes Capital adit plug)	BR-14 access restrictions (SW/adit)	BR-29 Mine Waste Access Restrictions	PC-06 Mine Waste Access Restrictions
EU 1A/1B Access Restrictions	SG-71 Access Restrictions (SW)	SH-37 Mine Waste Access Restrictions		SH-14 Mine Waste Access Restrictions
Anaconda adit bulkhead plug (WTP flow control)	SG-94 Access Restrictions (SW)			SH-37 Mine Waste Access Restrictions
	SG-13/14 Mine Waste Access Restrictions			PC-01 Adit (physical barrier)
	SG-16 Mine Waste Access Restrictions			Access Restrictions (Sensitive Area - E Upper Marsh)
	SG-41 Mine Waste Access Restrictions			Groundwater - E Upper Marsh
	SG-43 Mine Waste Access Restrictions			
	SG-47 Mine Waste Access Restrictions			
	SG-48 Mine Waste Access Restrictions			
	SG-49/50 Mine Waste Access Restrictions			
	SG-51 Mine Waste Access Restrictions			
	SG-71 Mine Waste Access Restrictions			
	SG-93 Mine Waste Access Restrictions			
	SG-94 Mine Waste Access Restrictions			

IC-11 (Parcel 10)
SWG-02 Mine Waste Access Restrictions
Access Restrictions (Sensitive Area - W Upper Marsh)

EVALUATION AREA EA 1 Upland Waste Areas	SITE-WIDE ELEMENTS				REMEDIAL ALTERNATIVE COSTS						
					No Action	PHYSICAL HAZARDS/SOLID MEDIA					
						ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT	
										In-situ	Ex-situ
	ICs	*IC# Identification	Access Restrictions	Long-term Monitoring and Maintenance		Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Neutralization W/Alkaline Amendment
*Upper Anaconda Mine (EU 1A) Waste Area	$5,000	IC-6	$16,310.47	$10,607.49	$0	N/A	$0	$0	$0	$0	$0
Upper Anaconda Mine (EU 1B) Waste Piles	$0	IC-6	$8,941.78	$8,029.03	$0	N/A	$0	$0	$0	$0	$0
Capital Mine (EU 3) Waste Area	$5,000	IC-7	$7,120.31	$7,391.66	$0	N/A	$0	$0	$0	$0	$0
Carbonate Mine (EU 4) Waste Area	$0		$0.00	$0.00	$0	N/A	$0	$254,686	$0	$0	$0
Edith Mine (EU 5) Waste Area	$0		$0.00	$0.00	$0	N/A	$0	$0	$0	$0	$0
Consolation Mine (EU 6) Waste Area	$0		$0.00	$0.00	$0	N/A	$0	$195,181	$0	$0	$0
Mary P Mine (EU 7) Waste Pile	$0		$0.00	$0.00	$0	N/A	$0	$2,446	$0	$0	$0
Mike Horse Mine (EU 8) Waste Area	$5,000	IC-5	$0.00	$0.00	$0	N/A	$344,955	$305,678	$0	$0	$0
Paymaster Mine (EU 9A) Waste Area - Surface	$0		$0.00	$0.00	$0	N/A	$0	$0	$0	$0	$0
Paymaster Mine (EU 9B) Waste Area - Subsurface	$5,000	IC-3	$0.00	$0.00	$0	N/A	$0	$0	$0	$0	$0
TOTAL COSTS	**$20,000**	**N/A**	**$32,373**	**$26,028**	**$0**	**N/A**	**$344,955**	**$757,990**	**$0**	**$0**	**$0**

*** Table C3 Contains descriptions for each IC. Cost is $5,000 per IC (location), so costs are not duplicated after the first time an IC location is identified in these cost tables.**

EA1 Total: $1,181,346

Note: All ICs are listed in these cost tables except IC-1 (UBMC (Section 35) Repository). A total of 10 ICs are intended to cover the various private properties within the UBMC at an estimated cost of $50,000.

EA1 COST ESTIMATE DETAIL
SITE -WIDE ELEMENTS

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 2,150.50	1	$ 2,151	10% of construction cost
Install Farm Fence - Total	LF	$ 5.50	3,010	$ 16,555	Based on Bald Butte/Great Divide
Upper Anaconda Mine (EU 1A) Waste Area	LF	$ 5.50	1,670	$ 9,185	
Upper Anaconda Mine (EU 1B) Waste Piles	LF	$ 5.50	780	$ 4,290	
Capital Mine (EU 3) Waste Area	LF	$ 5.50	560	$ 3,080	
Carbonate Mine (EU 4) Waste Area	LF	$ 5.50	0	$ -	
Edith Mine (EU 5) Mine Waste	LF	$ 5.50	0	$ -	
Consolation Mine (EU 6) Waste Area	LF	$ 5.50	0	$ -	
Mary P Mine (EU 7) Waste Pile	LF	$ 5.50	0	$ -	
Mike Horse Mine (EU 8) Waste Area	LF	$ 5.50	0	$ -	
Paymaster Mine (EU 9A) Waste Area - Surface	LF	$ 5.50	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	LF	$ 5.50	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	LF	$ 5.50	0	$ -	
Metal Security Gate - Total	EA	$ 1,500.00	3	$ 4,500	Based on Section 35 Bid Tabs
Upper Anaconda Mine (EU 1A) Waste Area	EA	$ 1,500.00	1	$ 1,500	
Upper Anaconda Mine (EU 1B) Waste Piles	EA	$ 1,500.00	1	$ 1,500	
Capital Mine (EU 3) Waste Area	EA	$ 1,500.00	1	$ 1,500	
Carbonate Mine (EU 4) Waste Area	EA	$ 1,500.00	0	$ -	
Edith Mine (EU 5) Mine Waste	EA	$ 1,500.00	0	$ -	
Consolation Mine (EU 6) Waste Area	EA	$ 1,500.00	0	$ -	
Mary P Mine (EU 7) Waste Pile	EA	$ 1,500.00	0	$ -	
Mike Horse Mine (EU 8) Waste Area	EA	$ 1,500.00	0	$ -	
Paymaster Mine (EU 9A) Waste Area - Surface	EA	$ 1,500.00	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	EA	$ 1,500.00	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	EA	$ 1,500.00	0	$ -	
Metal Warning Signs - Total	EA	$ 150.00	3	$ 450	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	EA	$ 150.00	1	$ 150	
Upper Anaconda Mine (EU 1B) Waste Piles	EA	$ 150.00	1	$ 150	
Capital Mine (EU 3) Waste Area	EA	$ 150.00	1	$ 150	
Carbonate Mine (EU 4) Waste Area	EA	$ 150.00	0	$ -	
Edith Mine (EU 5) Mine Waste	EA	$ 150.00	0	$ -	
Consolation Mine (EU 6) Waste Area	EA	$ 150.00	0	$ -	
Mary P Mine (EU 7) Waste Pile	EA	$ 150.00	0	$ -	
Mike Horse Mine (EU 8) Waste Area	EA	$ 150.00	0	$ -	
Paymaster Mine (EU 9A) Waste Area - Surface	EA	$ 150.00	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	EA	$ 150.00	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	EA	$ 150.00	0	$ -	
			Subtotal	$ 23,656	
Contingencies		15%		$ 3,548.33	
			Subtotal	$ 27,204	
Project Management		5%		$ 1,360	
Engineering		6%		$ 1,632	
Construction Management		8%		$ 2,176	
TOTAL				$ 32,373	
			TOTAL CAPITAL COSTS	**$ 32,373**	

LONG TERM MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Security, Fence and Sign Maintenance, Years 1-30	LS	$ 750.00		$ -	Engineers Estimate
Periodic Replacement - Years 15 and 30	LS	$ 11,828.00	1	$ 11,828	1/2 of fence replaced
			Subtotal	$ 11,828	
		30-YEAR NET PRESENT VALUE ANNUAL M&M COSTS		**$27,165**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (ICS + ACCESS RESTRICTIONS + M&M COSTS) **$59,538** Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 1 COSTS										
SITE-WIDE ELEMENTS	**Upper Anaconda Mine (EU 1A) Waste Area**	**Upper Anaconda Mine (EU 1B) Waste Piles**	**Capital Mine (EU 3) Waste Area**	**Carbonate Mine (EU 4) Waste Area**	**Consolation Mine (EU 6) Waste Area**	**Mary P Mine (EU 7) Waste Pile (Prorated @ 10% of Total Cost)**	**Mike Horse Mine (EU 8) Waste Area**	**Paymaster Mine (EU 9B) Waste Area - Subsurface**		**TOTAL**
Access Restrictions										
Construct Fence	$ 9,185	$ 4,290	$ 3,080	$ -	$ -	$ -	$ -	$ -		**$ 16,555**
Install Gates	$ 1,500	$ 1,500	$ 1,500	$ -	$ -	$ -	$ -	$ -		**$ 4,500**
Install Warning Signs	$ 150	$ 150	$ 150	$ -	$ -	$ -	$ -	$ -		**$ 450**
Subtotal	$ 10,835	$ 5,940	$ 4,730	$ -	$ -	$ -	$ -	$ -		**$ 21,505**
Mob/Demob (10%)	$ 1,084	$ 594	$ 473	$ -	$ -	$ -	$ -	$ -		**$ 2,151**
Subtotal	$ 11,919	$ 6,534	$ 5,203	$ -	$ -	$ -	$ -	$ -		**$ 23,656**
Contingencies (15%)	$ 1,788	$ 980	$ 780	$ -	$ -	$ -	$ -	$ -		**$ 3,548**
Subtotal	$ 13,706	$ 7,514	$ 5,983	$ -	$ -	$ -	$ -	$ -		**$ 27,204**
Project Management (5%)	$ 685	$ 376	$ 299	$ -	$ -	$ -	$ -	$ -		**$ 1,360**
Engineering (6%)	$ 822	$ 451	$ 359	$ -	$ -	$ -	$ -	$ -		**$ 1,632**
Construction Administration (8%)	$ 1,097	$ 601	$ 479	$ -	$ -	$ -	$ -	$ -		**$ 2,176**
Total, Capital Cost	$ 16,310	$ 8,942	$ 7,120	$ -	$ -	$ -	$ -	$ -		**$ 32,373**
Long Term Monitoring and Maintenance (M&M)										
Site Security, Fence and Sign Maintenance, Years 1-30 (Annual)	$ 250	$ 250	$ 250	$ -	$ -	$ -	$ -	$ -		**$ 750**
Periodic Replacement - Years 15 and 30	$ 5,418	$ 2,970	$ 2,365	$ -	$ -	$ -	$ -	$ -		**$ 10,753**
Total, 30-yr Present Worth, Long Term M&M (3%)	$ 10,607	$ 8,029	$ 7,392	$ -	$ -	$ -	$ -	$ -		**$ 26,028**
TOTAL CAPITAL COST + M&M	$ 26,918	$ 16,971	$ 14,512	$ -	$ -	$ -	$ -	$ -		**$ 58,401**
TOTAL SITE-WIDE ELEMENTS COSTS WITH 30-YR PRESENT WORTH LONG TERM M&M										**$ 58,401**

EA 1 COSTS			
CONTAINMENT	**Mike Horse Mine (EU 8) Waste Area**		**TOTAL**
Improve/Construct Access Roads	$ 4,500		$ 4,500
Re-Grade Waste Piles, Prep for Cover Soil Placement	$ 42,510		$ 42,510
Load, Haul, Place Vegetative Cover	$ 141,750		$ 141,750
Seed, Fertilize, Mulch	$ 6,000		$ 6,000
Reclaim Cover Soil Borrow Area	$ 4,500		$ 4,500
Subtotal	$ 199,260		$ 199,260
Mob/Demob (10%)	$ 19,926		$ 19,926
Subtotal	$ 219,186		$ 219,186
Contingencies (15%)	$ 32,878		$ 32,878
Subtotal	$ 252,064		$ 252,064
Project Management (5%)	$ 12,603		$ 12,603
Engineering (6%)	$ 15,124		$ 15,124
Construction Administration (8%)	$ 20,165		$ 20,165
Total, Capital Cost	$ 299,956		$ 299,956
Operations and Maintenance (O & M)			
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	$ 250		$ 250
Periodic Repairs - Years 15 and 30 (1/4th remedial cost)	$ 38,063		$ 38,063
Total, 30-yr Present Worth, O & M (3%)	$ 44,999		$ 44,999
TOTAL CAPITAL COST + O & M	$ 344,955		$ 344,955
TOTAL EA1 CONTAINMENT COSTS WITH 30-YR PRESENT WORTH O & M			**$ 344,955**

EA1 COST ESTIMATE DETAIL
CONTAINMENT

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 19,926.00	1	$ 19,926	10% of construction cost
Improve/Construct Access Roads - Total	LF	$ 18.00	250	$ 4,500	Includes Clear/Grub/Log, Reclamation
Upper Anaconda Mine (EU 1A) Waste Area	LF	$ 18.00	0	$ -	
Upper Anaconda Mine (EU 1B) Waste Piles	LF	$ 18.00	0	$ -	
Capital Mine (EU 3) Waste Area	LF	$ 18.00	0	$ -	
Carbonate Mine (EU 4) Waste Area	LF	$ 18.00	0	$ -	
Edith Mine (EU 5) Mine Waste	LF	$ 18.00	0	$ -	
Consolation Mine (EU 6) Waste Area	LF	$ 18.00	0	$ -	
Mary P Mine (EU 7) Waste Pile	LF	$ 18.00	0	$ -	
Mike Horse Mine (EU 8) Waste Area	LF	$ 18.00	250	$ 4,500	
Paymaster Mine (EU 9A) Waste Area - Surface	LF	$ 18.00	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	LF	$ 18.00	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	LF	$ 18.00	0	$ -	
Re-Grade Waste Piles, Prep for Cover Soil Placement - Total	SY	$ 3.00	14,170	$ 42,510	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	SY	$ 3.00	0	$ -	
Upper Anaconda Mine (EU 1B) Waste Piles	SY	$ 3.00	0	$ -	
Capital Mine (EU 3) Waste Area	SY	$ 3.00	0	$ -	
Carbonate Mine (EU 4) Waste Area	SY	$ 3.00	0	$ -	
Edith Mine (EU 5) Mine Waste	SY	$ 3.00	0	$ -	
Consolation Mine (EU 6) Waste Area	SY	$ 3.00	0	$ -	
Mary P Mine (EU 7) Waste Pile	SY	$ 3.00	0	$ -	
Mike Horse Mine (EU 8) Waste Area	SY	$ 3.00	14,170	$ 42,510	
Paymaster Mine (EU 9A) Waste Area - Surface	SY	$ 3.00	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	SY	$ 3.00	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	SY	$ 3.00	0	$ -	
Load, Haul, Place Vegetative Cover - Total	CY	$ 15.00	9,450	$ 141,750	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	CY	$ 15.00	0	$ -	
Upper Anaconda Mine (EU 1B) Waste Piles	CY	$ 15.00	0	$ -	
Capital Mine (EU 3) Waste Area	CY	$ 15.00	0	$ -	
Carbonate Mine (EU 4) Waste Area	CY	$ 15.00	0	$ -	
Edith Mine (EU 5) Mine Waste	CY	$ 15.00	0	$ -	
Consolation Mine (EU 6) Waste Area	CY	$ 15.00	0	$ -	
Mary P Mine (EU 7) Waste Pile	CY	$ 15.00	0	$ -	
Mike Horse Mine (EU 8) Waste Area	CY	$ 15.00	9,450	$ 141,750	
Paymaster Mine (EU 9A) Waste Area - Surface	CY	$ 15.00	0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	CY	$ 15.00	0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	CY	$ 15.00	0	$ -	
Seed, Fertilize, Mulch - Total	AC	$ 2,000.00	3.0	$ 6,000	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	AC	$ 2,000.00	0.0	$ -	
Upper Anaconda Mine (EU 1B) Waste Piles	AC	$ 2,000.00	0.0	$ -	
Capital Mine (EU 3) Waste Area	AC	$ 2,000.00	0.0	$ -	
Carbonate Mine (EU 4) Waste Area	AC	$ 2,000.00	0.0	$ -	
Edith Mine (EU 5) Mine Waste	AC	$ 2,000.00	0.0	$ -	
Consolation Mine (EU 6) Waste Area	AC	$ 2,000.00	0.0	$ -	
Mary P Mine (EU 7) Waste Pile	AC	$ 2,000.00	0.0	$ -	
Mike Horse Mine (EU 8) Waste Area	AC	$ 2,000.00	3.0	$ 6,000	
Paymaster Mine (EU 9A) Waste Area - Surface	AC	$ 2,000.00	0.0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	AC	$ 2,000.00	0.0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	AC	$ 2,000.00	0.0	$ -	
Reclaim Cover Soil Borrow Area - Total	AC	$ 4,500.00	1.0	$ 4,500	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	AC	$ 4,500.00	0.0	$ -	
Upper Anaconda Mine (EU 1B) Waste Piles	AC	$ 4,500.00	0.0	$ -	
Capital Mine (EU 3) Waste Area	AC	$ 4,500.00	0.0	$ -	
Carbonate Mine (EU 4) Waste Area	AC	$ 4,500.00	0.0	$ -	
Edith Mine (EU 5) Mine Waste	AC	$ 4,500.00	0.0	$ -	
Consolation Mine (EU 6) Waste Area	AC	$ 4,500.00	0.0	$ -	
Mary P Mine (EU 7) Waste Pile	AC	$ 4,500.00	0.0	$ -	
Mike Horse Mine (EU 8) Waste Area	AC	$ 4,500.00	1.0	$ 4,500	
Paymaster Mine (EU 9A) Waste Area - Surface	AC	$ 4,500.00	0.0	$ -	
Paymaster Mine (EU 9B) Waste Area - Subsurface	AC	$ 4,500.00	0.0	$ -	
No. 3 Tunnel Mine (EU 10) Waste Area	AC	$ 4,500.00	0.0	$ -	
			Subtotal	$ 219,186	
Contingencies		15%		$ 32,878	
			Subtotal	$ 252,064	
Project Management		5%		$ 12,603	
Engineering		6%		$ 15,124	
Construction Management		8%		$ 20,165	
TOTAL				$ 299,956	
			TOTAL CAPITAL COSTS	$ 299,956	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	LS	$ 250.00	1	$ 250	Engineers Estimate
Periodic Repairs - Years 15 and 30 (1/4th remedial cost, re-cover soil, reveg)	LS	$ 38,062.50	1	$ 38,063	Engineers Estimate
			Subtotal	$ 38,313	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				$ 45,012	Discounted using the rate below

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COSTS) $ 344,968 — Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 1 COSTS						
REMOVAL AND ON-SITE DISPOSAL	Carbonate Mine (EU 4) Waste Area	Consolation Mine (EU 6) Waste Area	Mary P Mine (EU 7) Waste Pile	Mike Horse Mine (EU 8) Waste Area		TOTAL
Improve/Construct Access Roads	$ 3,600	$ 31,500	$ -	$ 9,000		$ 44,100
Excavate, Load, Haul and Place Waste in Repository	$ 120,267	$ 70,311	$ 1,062	$ 142,500		$ 334,140
Load, Haul, Place Vegetative Cover	$ 30,067	$ 17,578	$ 177	$ 35,250		$ 83,071
Seed, Fertilize, Mulch	$ 4,970	$ 2,905	$ 20	$ 6,000		$ 13,895
Reclaim Cover Soil Borrow Area	$ 1,864	$ 1,090	$ 11	$ 1,125		$ 4,089
Subtotal	$ 160,767	$ 123,383	$ 1,270	$ 193,875		$ 479,295
Mob/Demob (10%)	$ 16,077	$ 12,338	$ 127	$ 19,388		$ 47,930
Subtotal	$ 176,844	$ 135,722	$ 1,397	$ 213,263		$ 527,225
Contingencies (15%)	$ 26,527	$ 20,358	$ 210	$ 31,989		$ 79,084
Subtotal	$ 203,370	$ 156,080	$ 1,607	$ 245,252		$ 606,309
Project Management (5%)	$ 10,169	$ 7,804	$ 80	$ 12,263		$ 30,315
Engineering (6%)	$ 12,202	$ 9,365	$ 96	$ 14,715		$ 36,379
Construction Administration (8%)	$ 16,270	$ 12,486	$ 129	$ 19,620		$ 48,505
Total, Capital Cost	$ 242,011	$ 185,735	$ 1,912	$ 291,850		$ 721,507
Operations and Maintenance (O & M)						
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	$ 250	$ 250	$ 25	$ 250		$ 775
Periodic Repairs - Years 15 and 30 (1/5th remedial cost)	$ 7,380	$ 4,315	$ 42	$ 8,475		$ 20,211
Total, 30-yr Present Worth, O & M (3%)	$ 12,675	$ 9,445	$ 534	$ 13,829		$ 36,483
TOTAL CAPITAL COST + O & M	$ 254,686	$ 195,181	$ 2,446	$ 305,678		$ 757,990
TOTAL EA1 REMOVAL AND ON-SITE DISPOSAL COSTS WITH 30-YR PRESENT WORTH O & M						**$ 757,990**

EA1 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 47,929.53	1	$ 47,930	10% of construction cost
Improve/Construct Access Roads - Total	LF	$ 18.00	2,450	$ 44,100	Includes Clear/Grub/Log, Reclamation
Upper Anaconda Mine (EU 1A) Waste Area	LF	$ 18.00	0	$	
Upper Anaconda Mine (EU 1B) Waste Piles	LF	$ 18.00	0	$	
Capital Mine (EU 3) Waste Area	LF	$ 18.00	0	$	
Carbonate Mine (EU 4) Waste Area	LF	$ 18.00	200	$ 3,600	
Edith Mine (EU 5) Mine Waste	LF	$ 18.00	0	$	
Consolation Mine (EU 6) Waste Area	LF	$ 18.00	1,750	$ 31,500	
Mary P Mine (EU 7) Waste Pile	LF	$ 18.00	0	$	
Mike Horse Mine (EU 8) Waste Area	LF	$ 18.00	500	$ 9,000	
Paymaster Mine (EU 9A) Waste Area - Surface	LF	$ 18.00	0	$	
Paymaster Mine (EU 9B) Waste Area - Subsurface	LF	$ 18.00	0	$	
No. 3 Tunnel Mine (EU 10) Waste Area	LF	$ 18.00	0	$	
Excavate, Load, Haul and Place Waste in Repository - Total	CY	$ 15.00	22,276	$ 334,140	Engineer Estimate
Upper Anaconda Mine (EU 1A) Waste Area	CY	$ 15.00	0	$	
Upper Anaconda Mine (EU 1B) Waste Piles	CY	$ 15.00	0	$	
Capital Mine (EU 3) Waste Area	CY	$ 15.00	0	$	
Carbonate Mine (EU 4) Waste Area	CY	$ 15.00	8,018	$ 120,267	
Edith Mine (EU 5) Mine Waste	CY	$ 15.00	0	$	
Consolation Mine (EU 6) Waste Area	CY	$ 15.00	4,687	$ 70,311	
Mary P Mine (EU 7) Waste Pile	CY	$ 15.00	71	$ 1,062	
Mike Horse Mine (EU 8) Waste Area	CY	$ 15.00	9,500	$ 142,500	
Paymaster Mine (EU 9A) Waste Area - Surface	CY	$ 15.00	0	$	
Paymaster Mine (EU 9B) Waste Area - Subsurface	CY	$ 15.00	0	$	
No. 3 Tunnel Mine (EU 10) Waste Area	CY	$ 15.00	0	$	
Load, Haul, Place Vegetative Cover - Total	CY	$ 15.00	5,538	$ 83,071	6 inch cover imported over removal areas
Upper Anaconda Mine (EU 1A) Waste Area	CY	$ 15.00	0	$	
Upper Anaconda Mine (EU 1B) Waste Piles	CY	$ 15.00	0	$	
Capital Mine (EU 3) Waste Area	CY	$ 15.00	0	$	
Carbonate Mine (EU 4) Waste Area	CY	$ 15.00	2,004	$ 30,067	
Edith Mine (EU 5) Mine Waste	CY	$ 15.00	0	$	
Consolation Mine (EU 6) Waste Area	CY	$ 15.00	1,172	$ 17,578	
Mary P Mine (EU 7) Waste Pile	CY	$ 15.00	12	$ 17	
Mike Horse Mine (EU 8) Waste Area	CY	$ 15.00	2,350	$ 35,250	
Paymaster Mine (EU 9A) Waste Area - Surface	CY	$ 15.00	0	$	
Paymaster Mine (EU 9B) Waste Area - Subsurface	CY	$ 15.00	0	$	
No. 3 Tunnel Mine (EU 10) Waste Area	CY	$ 15.00	0	$	
Seed, Fertilize, Mulch - Total	AC	$ 2,000.00	6.9	$ 13,895	Based on Bald Butte
Upper Anaconda Mine (EU 1A) Waste Area	AC	$ 2,000.00	0.0	$	
Upper Anaconda Mine (EU 1B) Waste Piles	AC	$ 2,000.00	0.0	$	
Capital Mine (EU 3) Waste Area	AC	$ 2,000.00	0.0	$	
Carbonate Mine (EU 4) Waste Area	AC	$ 2,000.00	2.5	$ 4,970	
Edith Mine (EU 5) Mine Waste	AC	$ 2,000.00	0.0	$	
Consolation Mine (EU 6) Waste Area	AC	$ 2,000.00	1.5	$ 2,905	
Mary P Mine (EU 7) Waste Pile	AC	$ 2,000.00	0.0	$ 20	
Mike Horse Mine (EU 8) Waste Area	AC	$ 2,000.00	3.0	$ 6,000	
Paymaster Mine (EU 9A) Waste Area - Surface	AC	$ 2,000.00	0.0	$	
Paymaster Mine (EU 9B) Waste Area - Subsurface	AC	$ 2,000.00	0.0	$	
No. 3 Tunnel Mine (EU 10) Waste Area	AC	$ 2,000.00	0.0	$	
Reclaim Cover Soil Borrow Area - Total	AC	$ 4,500.00	0.9	$ 4,089	Based on Bald Butte
Upper Anaconda Mine (EU 1A) Waste Area	AC	$ 4,500.00	0.0	$	
Upper Anaconda Mine (EU 1B) Waste Piles	AC	$ 4,500.00	0.0	$	
Capital Mine (EU 3) Waste Area	AC	$ 4,500.00	0.0	$	
Carbonate Mine (EU 4) Waste Area	AC	$ 4,500.00	0.4	$ 1,864	
Edith Mine (EU 5) Mine Waste	AC	$ 4,500.00	0.0	$	
Consolation Mine (EU 6) Waste Area	AC	$ 4,500.00	0.2	$ 1,090	
Mary P Mine (EU 7) Waste Pile	AC	$ 4,500.00	0.0	$ 11	
Mike Horse Mine (EU 8) Waste Area	AC	$ 4,500.00	0.3	$ 1,129	
Paymaster Mine (EU 9A) Waste Area - Surface	AC	$ 4,500.00	0.0	$	
Paymaster Mine (EU 9B) Waste Area - Subsurface	AC	$ 4,500.00	0.0	$	
No. 3 Tunnel Mine (EU 10) Waste Area	AC	$ 4,500.00	0.0	$	
			Subtotal	$ 527,225	
Contingencies		15%		$ 79,084	
			Subtotal	$ 606,309	
Project Management		5%		$ 30,315	
Engineering		6%		$ 36,379	
Construction Management		8%		$ 48,505	
TOTAL				$ 721,507	
			TOTAL CAPITAL COSTS	**$ 721,507**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	LS	$ 775.00	1	$ 775	Engineers Estimate; O & M costs for the UBMC repository are not included.
Periodic Repairs - Years 15 and 30 (1/5th remedial cost)	LS	$ 20,211.13	1	$ 20,211	Engineers Estimate; O & M costs for the UBMC repository are not included.
			Subtotal	$ 20,986	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$36,490**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) **$757,997** Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EVALUATION AREA	SITE-WIDE ELEMENTS				REMEDIAL ALTERNATIVE COSTS							
EA 2					No Action	GROUNDWATER						
Groundwater						Monitored Natural Attenuation	ENGINEERING CONTROLS			TREATMENT		
										Active		Passive
	ICs	*IC# Identification	Access Restrictions	Long-term Monitoring and Maintenance			Containment (Retention Pond)	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Anaconda Mine (EU 1) Adit Discharge	$0	IC-6	$0	$0	$0	$0	N/A	N/A	N/A	$539,658	$539,658	$0
Carbonate Mine (EU 4) Groundwater	$5,000	IC-2	$0	$0	$0	$0	N/A	$464,514	N/A	$0	$0	$1,830,977
Mike Horse Mine (EU 8) Adit Discharge and Seeps	$0	IC-5	$0	$0	$0	$0	N/A	N/A	N/A	$7,169,742	$7,169,742	$0
Upper Mike Horse Mine Bedrock Groundwater Aquifer	$0	IC-5	$0	$0	$0	$0	N/A	N/A	N/A	$0	$0	N/A
Capital Mine Adit Plug	$0	IC-7	$0	$0	$0	$0	N/A	N/A	$10,124	N/A	N/A	N/A
TOTAL COSTS	**$5,000**	**N/A**	**$0**	**$0**	**$0**	**$0**	**$0**	**$464,514**	**$10,124**	**$7,709,400**	**$7,709,400**	**$1,830,977**

*** Table C3 Contains descriptions for each IC. Cost is $5,000 per IC (location), so costs are not duplicated after the first time an IC location is identified in these cost tables.**

EA2 Total: $17,729,415

EA 2 COSTS								
MONITORED NATURAL ATTENUATION	**Anaconda Mine (EU 1) Adit Discharge**	**Carbonate Mine (EU 4) Groundwater**	**Mike Horse Mine (EU 8) Adit Discharge and Seeps**	**Paymaster Gulch Groundwater Aquifers**	**Upper Mike Horse Mine Bedrock Groundwater Aquifer**	**Capital Mine Adit Plug**		**TOTAL**
Additional Monitoring Well Installation	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Subtotal	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Mob/Demob (10%)	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Subtotal	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Contingencies (15%)	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Subtotal	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Project Management (5%)	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Engineering (6%)	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Construction Administration (8%)	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Total, Capital Cost	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Operations and Maintenance (O & M)								
Semiannual Monitoring -Existing Wells, Sampling, Analysis, Report - Years 1-10	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Annual Monitoring, Years 11-30	$ -	$ -	$ -	$ -	$ -	$ -		
Total, 30-yr Present Worth, O & M (3%)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL CAPITAL COST + O & M	$ -	$ -	$ -	$ -	$ -	$ -		$ -
TOTAL EA2 MNA COSTS WITH 30-YR PRESENT WORTH O & M								$ -

EA2 COST ESTIMATE DETAIL
MONITORED NATURAL ATTENUATION

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization/Demobilization	LS	$ -	1	$ -	10% of construction cost
Well Installation	EA	$ 10,000.00	0	$ -	
			Subtotal	$ -	
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS	**$ -**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Semiannual Monitoring -Existing Wells, Sampling, Analysis, Report - Years 1-10	LS	$ 65,000.00	0	$ -	Based on current budget, increase for add'l wells and semiannual monitoring
Annual Monitoring, Years 11-30	LS	$ 32,500.00	0	$ -	
			Subtotal	$ -	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 1,372,031**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COSTS) $ 1,372,031

Groundwater Monitoring	EA	$65,000.00	0	$0.00	Existing Annual Budget is ~$65K for GW - Double this for MNA
Analysis and Report	EA	$5,000	0	$0.00	
			Annual Cost	$0.00	

EA2 COST ESTIMATE DETAIL
HYDROLOGIC AND HYDRAULIC CONTROL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Carbonate Mine (EU 4) Groundwater					
Mobilization, Bonding, Insurance	LS	$ 21,305.00	1	$ 21,305	10% of construction cost
Surface Water and Sediment Control	LS	$ 9,000.00	1	$ 9,000	General Site BMP's
Install Temporary Stream Channel Diversion	LF	$ 32.00	900	$ 28,800	Based on SSTOU Bid Tabs
Reconstruct Stream	LF	$ 125.00	910	$ 113,750	Based on SSTOU Bid Tabs
Install Sheet Piling Cutoff Wall	LF	$ 250.00	230	$ 57,500	Based on McLaren estimates in 2009
Seed, Fertilize, Mulch	AC	$ 2,000.00	2	$ 4,000	Native seed and fertilizer
			Subtotal	$ 234,355	
Contingencies		15%		$ 35,153	
			Subtotal	$ 269,508	
Project Management		5%		$ 13,475	
Engineering		6%		$ 16,170	
Construction Management		8%		$ 21,561	
TOTAL				$ 320,715	
			TOTAL CAPITAL COSTS	**$ 320,715**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Channel and Reclamation Maintenance, Years 1-5	LS	$ 15,000.00	1	$ 15,000	Engineers Estimate
Channel and Reclamation Maintenance, Years 5-30	LS	$ 5,000.00	1	$ 5,000	Engineers Estimate
			Subtotal	$ 20,000	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 143,799**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COSTS) $ 464,514 Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 2 COSTS				
HYDROLOGIC AND HYDRAULIC CONTROL		Carbonate Mine (EU 4) Groundwater		TOTAL
Surface Water and Sediment Control		$ 9,000		$ 9,000
Install Temporary Stream Channel Diversion		$ 28,800		$ 28,800
Reconstruct Stream		$ 113,750		$ 113,750
Install Sheet Piling Cutoff Wall		$ 57,500		$ 57,500
Seed, Fertilize, Mulch		$ 4,000		$ 4,000
Subtotal		$ 213,050		$ 213,050
Mob/Demob (10%)	10%	$ 21,305		$ 21,305
Subtotal		$ 234,355		$ 234,355
Contingencies (15%)	15%	$ 35,153		$ 35,153
Subtotal		$ 269,508		$ 269,508
Project Management (5%)	5%	$ 13,475		$ 13,475
Engineering (6%)	6%	$ 16,170		$ 16,170
Construction Administration (8%)	8%	$ 21,561		$ 21,561
Total, Capital Cost		$ 320,715		$ 320,715
Operations and Maintenance (O & M)				
Channel and Reclamation Maintenance, Years 1-5		$ 15,000		$ 15,000
Channel and Reclamation Maintenance, Years 5-30		$ 5,000		$ 5,000
Total, 30-yr Present Worth, O & M (3%)	3%	$143,799		$ 143,799
TOTAL CAPITAL COST + O & M		$ 464,514		$ 464,514
TOTAL EA2 HYDROLOGIC AND HYDRAULIC CONTROL COSTS WITH 30-YR PRESENT WORTH O & M				**$ 464,514**

EA2 COSTS			
INUNDATION	**Capital Mine Adit Plug**		**TOTAL**
Capital Mine Adit Plug	$ -		$ -
Subtotal	$ -		$ -
Mob/Demob (10%)	$ -		$ -
Subtotal	$ -		$ -
Contingencies (15%)	$ -		$ -
Subtotal	$ -		$ -
Project Management (5%)	$ -		$ -
Engineering (6%)	$ -		$ -
Construction Administration (8%)	$ -		$ -
Total, Capital Cost	$ -		$ -
Operations and Maintenance (O & M)			
Site Inspection, Maintenance and Repairs, Year 1	$ 5,000		$ 5,000
Periodic Repairs - Years 15 and 30	$ 5,000		$ 5,000
Total, 30-yr Present Worth, O & M (3%)	$ 10,124		$ 10,124
TOTAL CAPITAL COST + O & M	$ 10,124		$ 10,124
TOTAL EA2 INUNDATION COSTS WITH 30-YR PRESENT WORTH O & M			**$ 10,124**

EA2 COST ESTIMATE DETAIL
INUNDATION

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Capital Mine Adit Plug					Already in place
			Subtotal	$ -	
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS	**$ -**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspection, Maintenance and Repairs, Year 1	LS	$ 5,000.00	1	$ 5,000	Engineers Estimate
Periodic Repairs - Years 15 and 30	LS	$ 5,000.00	1	$ 5,000	Engineers Estimate
			Subtotal	$ 10,000	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 10,124**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 10,124

EA2 COST ESTIMATE DETAIL
ACTIVE TREATMENT - PHYSICAL/MECHANICAL (CERAMIC MICROFILTRATION)

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ -	1	$	10% of construction cost
Preliminary Design and Detailed Site Investigations					
Anaconda Mine (EU 1) Adit Discharge	LS	$ 1.00	0	$	Already in Place
Carbonate Mine (EU 4) Groundwater - Total				$	
Detailed Site Characterization at Removal site	LS	$ 23,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 23,000.00	0	$	Batch & Column; Implementation and reporting
Computer Modeling (CSM)	LS	$ 10,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 17,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 85,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Mike Horse Mine (EU 8) Adit Discharge and Seeps	LS	$ 1.00	0	$	Already in Place
Paymaster Gulch Groundwater Aquifers - Total				$	
Detailed Site Characterization	LS	$ 25,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 25,000.00	0	$	Batch & Column; Implementation and Reporting
Computer Modeling (CSM)	LS	$ 11,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 18,500.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 92,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Upper Mike Horse Mine Bedrock Groundwater Aquifer - Total				$	
Detailed Site Characterization	LS	$ 40,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 40,000.00	0	$	Batch & Column; Implementation and Reporting
Computer Modeling (CSM)	LS	$ 17,500.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 30,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 150,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Construct Capture and Conveyance System					
Carbonate Mine (EU 4) Groundwater - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	
Paymaster Gulch Groundwater Aquifers - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	
Upper Mike Horse Mine Bedrock Groundwater Aquifer - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	

EA2 COST ESTIMATE DETAIL
ACTIVE TREATMENT - PHYSICAL/MECHANICAL (CERAMIC MICROFILTRATION

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Expansion of WTP		$ 1,602,690.00		$	
Carbonate Mine (EU 4) Groundwater	LS	$ 420,470.00	0	$	Proportion of 1/2 existing WTP, based on flow
Paymaster Gulch Groundwater Aquifers	LS	$ 455,060.00	0	$	Proportion of 1/2 existing WTP, based on flow
Upper Mike Horse Mine Bedrock Groundwater Aquifer	LS	$ 727,160.00	0	$	Proportion of 1/2 existing WTP, based on flow
			Subtotal	$ -	
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS	**$ -**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Exist WTP Annual Operational Costs	LS	$ 312,678.00	1	$ 312,678	2013 WTP Budget - DEQ - Divided in half for using only half of the process
Incremental Increase in WTP Annual Costs - Carbonate	LS	$ 80,727.77	0	$ -	Proportion based on flow rate
Incremental Increase in WTP Annual Costs - Paymaster	LS	$ 87,367.17	0	$ -	Proportion based on flow rate
Incremental Increase in WTP Annual Costs - UMH	LS	$ 139,609.32	0	$ -	Proportion based on flow rate
Annual Maintenance of pipelines and pump stations	LS	$ -	1	$ -	5% initial construction
Periodic Replacement of Parts and Equipment - New Collection Systems, Years 15 and 30	LS	$ -	1	$ -	15% initial construction
Periodic Replacement of Parts and Equipment - Existing Collection Systems, Years 15 and 30	LS	$ 1,500,000.00	1	$ 1,500,000	Engineer Estimate
			Subtotal	$ 1,812,678	
			30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS	**$ 7,709,400**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ **7,709,400** Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA2 COST ESTIMATE DETAIL
ACTIVE TREATMENT - PHYSICAL/MECHANICAL (CERAMIC MICROFILTRATION

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ -	1	$	10% of construction cost
Preliminary Design and Detailed Site Investigations					
Anaconda Mine (EU 1) Adit Discharge	LS	$ 1.00	0	$	Already in Place
Carbonate Mine (EU 4) Groundwater - Total				$	
Detailed Site Characterization at Removal site	LS	$ 23,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 23,000.00	0	$	Batch & Column; Implementation and reporting
Computer Modeling (CSM)	LS	$ 10,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 17,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 85,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Mike Horse Mine (EU 8) Adit Discharge and Seeps	LS	$ 1.00	0	$	Already in Place
Paymaster Gulch Groundwater Aquifers - Total				$	
Detailed Site Characterization	LS	$ 25,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 25,000.00	0	$	Batch & Column; Implementation and Reporting
Computer Modeling (CSM)	LS	$ 11,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 18,500.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 92,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Upper Mike Horse Mine Bedrock Groundwater Aquifer - Total				$	
Detailed Site Characterization	LS	$ 40,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 40,000.00	0	$	Batch & Column; Implementation and Reporting
Computer Modeling (CSM)	LS	$ 17,500.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 30,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 150,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Construct Capture and Conveyance System					
Carbonate Mine (EU 4) Groundwater - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	
Paymaster Gulch Groundwater Aquifers - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	
Upper Mike Horse Mine Bedrock Groundwater Aquifer - Total				$	
Install Sheet Pile Cutoff	LF	$ 250.00	0	$	
Construct Interception Trench	LF	$ 200.00	0	$	600 feet x 6 feet x 120 feet
Install Extraction Wells	EA	$ 12,000.00	0	$	$100/feet, 120 feet deep
Construct Pumping Station	LS	$ 60,000.00	0	$	
Construct Conveyance Pipeline	LF	$ 50.00	0	$	

EA2 COST ESTIMATE DETAIL
ACTIVE TREATMENT - PHYSICAL/MECHANICAL (CERAMIC MICROFILTRATION

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Expansion of WTP		$ 1,602,690.00		$	
Carbonate Mine (EU 4) Groundwater	LS	$ 420,470.00	0	$	Proportion of 1/2 existing WTP, based on flow
Paymaster Gulch Groundwater Aquifers	LS	$ 455,060.00	0	$	Proportion of 1/2 existing WTP, based on flow
Upper Mike Horse Mine Bedrock Groundwater Aquifer	LS	$ 727,160.00	0	$	Proportion of 1/2 existing WTP, based on flow
			Subtotal	$ -	
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS $		

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Exist WTP Annual Operational Costs	LS	$ 312,678.00	1	$ 312,678	2013 WTP Budget - DEQ - Divided in half for using only half of the process
Incremental Increase in WTP Annual Costs - Carbonate	LS	$ 80,727.77	0	$ -	Proportion based on flow rate
Incremental Increase in WTP Annual Costs - Paymaster	LS	$ 87,367.17	0	$ -	Proportion based on flow rate
Incremental Increase in WTP Annual Costs - UMH	LS	$ 139,609.32	0	$ -	Proportion based on flow rate
Annual Maintenance of pipelines and pump stations	LS	$ -	1	$ -	5% initial construction
Periodic Replacement of Parts and Equipment - New Collection Systems, Years 15 and 30	LS	$ -	1	$ -	15% initial construction
Periodic Replacement of Parts and Equipment - Existing Collection Systems, Years 15 and 30	LS	$ 1,500,000.00	1	$ 1,500,000	Engineer Estimate
			Subtotal	$ 1,812,678	
			30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS $	7,709,400	Discounted using the rate below

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 7,709,400 — Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 2 COSTS			
PASSIVE TREATMENT (PRB)	**Carbonate Mine (EU 4) Groundwater**		**TOTAL**
Preliminary Design and Detailed Site Investigations	$ 158,000		$ 158,000
Construct PRB Reactor	$ 225,000		$ 225,000
Subtotal	$ 383,000		$ 383,000
Mob/Demob (10%)	$ 38,300		$ 38,300
Subtotal	$ 421,300		$ 421,300
Contingencies (15%)	$ 63,195		$ 63,195
Subtotal	$ 484,495		$ 484,495
Project Management (5%)	$ 24,225		$ 24,225
Engineering (6%)	$ 29,070		$ 29,070
Construction Administration (8%)	$ 38,760		$ 38,760
Total, Capital Cost	$ 576,549		$ 576,549
Operations and Maintenance (O & M)			
Environmental and System Performance Monitoring	$ 13,000		$ 13,000
Barrier Replacement	$ 34,000		$ 34,000
Water Disposal/Onsite	$ 2,000		$ 2,000
Misc. Support and Administrative	$ 15,000		$ 15,000
Total, 30-yr Present Worth, O & M (3%)	$ 1,254,428		$ 1,254,428
TOTAL CAPITAL COST + O & M	$ 1,830,977		$ 1,830,977
TOTAL EA2 COST WITH 30-YR PRESENT WORTH O & M			**$ 1,830,977**

EA2 COST ESTIMATE DETAIL
PASSIVE TREATMENT - CHEMICAL REAGENT (PRB)

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 38,300.00	1	$ 38,300	10% of construction cost
Preliminary Design and Detailed Site Investigations					
Anaconda Mine (EU 1) Adit Discharge - Total				$	
Detailed Site Characterization	LS	$ 20,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 20,000.00	0	$	Batch & Column; Implementation andReporting
Computer Modeling (CSM)	LS	$ 8,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 15,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 65,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Carbonate Mine (EU 4) Groundwater - Total				$ 158,000	
Detailed Site Characterization at Removal site	LS	$ 23,000.00	1	$ 23,000	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 23,000.00	1	$ 23,000	Batch & Column; Implementation and Reporting
Computer Modeling (CSM)	LS	$ 10,000.00	1	$ 10,000	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 17,000.00	1	$ 17,000	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 85,000.00	1	$ 85,000	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Mike Horse Mine (EU 8) Adit Discharge and Seeps - Total				$	
Detailed Site Characterization	LS	$ 35,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 35,000.00	0	$	Batch & Column; Implementation and reporting
Computer Modeling (CSM)	LS	$ 15,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 25,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 95,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access
Paymaster Gulch Alluvial Aquifer - Total				$	
Detailed Site Characterization	LS	$ 23,000.00	0	$	Ground based EM (Resistivity) Survey; Subsurface Mapping; Environmental Sampling (Solids and Water Analysis, Interpreting, and Reporting)
Lab Based Treatability Studies	LS	$ 23,000.00	0	$	Batch & Column; Implementation and reporting
Computer Modeling (CSM)	LS	$ 10,000.00	0	$	Hydrological / Hydrogeological; Biogeochemical
Preliminary Engineering Design	LS	$ 17,000.00	0	$	Prepare, Review, and Approve; Preliminary Regulatory Compliance / Permitting
Pilot-Scale Testing	LS	$ 85,000.00	0	$	Study Design and Documentation; Implementation (Procure, Install and Monitor); Integrated Data Access

EA2 COST ESTIMATE DETAIL
PASSIVE TREATMENT - CHEMICAL REAGENT (PRB)

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Construct PRB Reactor					
Anaconda Mine (EU 1) Adit Discharge					
Installation	LS	$ 78,000.00	0	$	Using Biopolymer Trenching; Continuous Wall Option or Funnel and Gate Option
Carbonate Mine (EU 4) Groundwater					
Installation	LS	$ 225,000.00	1	$ 225,000	Using Biopolymer Trenching; Continuous Wall Option or Funnel and Gate Option
Mike Horse Mine (EU 8) Adit Discharge and Seeps					
Installation	LS	$ 871,500.00	0	$	Using Biopolymer Trenching; Continuous Wall Option or Funnel and Gate Option
Paymaster Gulch Alluvial Aquifer					
Installation	LS	$ 42,720.00	0	$	Using Biopolymer Trenching; Continuous Wall Option or Funnel and Gate Option
			Subtotal	$ 421,300	
Contingencies		15%		$ 63,195	
			Subtotal	$ 484,495	
Project Management		5%		$ 24,225	
Engineering		6%		$ 29,070	
Construction Management		8%		$ 38,760	
TOTAL				$ 576,549	
			TOTAL CAPITAL COSTS $	**576,549**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Environmental and System Performance Monitoring	LS	$ 13,000.00	1	$ 13,000	$13,000 each
Barrier Replacement	LS	$ 34,000.00	1	$ 34,000	$34,000 each
Water Disposal/Onsite	LS	$ 2,000.00	1	$ 2,000	$2,000 each
Misc. Support and Administrative	LS	$ 15,000.00	1	$ 15,000	$15,000 each
			Subtotal	$ 64,000	
			30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS $	**1,254,428**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST; $ 1,830,977

EVALUATION AREA	SITE-WIDE ELEMENTS				REMEDIAL ALTERNATIVE COSTS													
EA 3					No Action	PHYSICAL HAZARDS/SOLID MEDIA							SURFACE WATER					
Surface Water and Sediment						Monitored Natural Recovery	ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT		ENGINEERING CONTROLS			TREATMENT		
											In-situ	Ex-situ				Active		Passive
	ICs	*IC# Identification	Access Restrictions	Long-term Monitoring and Maintenance			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Neutralization W/Alkaline Amendment	Containment (Retention Pond)	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Blackfoot River (EU13)	$0.00		$0.00	$0.00	$0.00	$545,031	N/A	N/A	$0	$0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stevens Creek	$0.00		$0.00	$0.00	$0.00	$148,500	N/A	N/A	$0	$0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paymaster Creek	$0.00		$0.00	$0.00	$0.00	$0	N/A	N/A	$99,483	$0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary above WTP	$0.00		$0.00	$0.00	$0.00	$62,480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mine Feature BR-14 Discharge Seep, or Spring	$5,000.00	IC-8	$5,796	$6,928	$0.00	$0.00	N/A	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Mine Feature SG-71 Discharge Seep, or Spring	$0.00	IC-7	$5,796	$6,928	$0.00	$0.00	N/A	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Mine Feature SG-94 Discharge Seep, or Spring	$0.00	IC-7	$5,570	$6,849	$0.00	$0.00	N/A	N/A	$0	$0	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Historic Paymaster Adit Discharge	$0.00		$0	$0	$0.00	$0.00	N/A	N/A	N/A	N/A	N/A	N/A	$41,878	N/A	N/A	N/A	N/A	N/A
TOTAL COSTS	**$5,000**	**N/A**	**$17,161**	**$20,705**	**$0**	**$756,011**	**$0**	**$0**	**$99,483**	**$0**	**$0**	**$0**	**$41,878**	**$0**	**$0**	**$0**	**$0**	**$0**

*** Table C3 Contains descriptions for each IC. Cost is $5,000 per IC (location), so costs are not duplicated after the first time an IC location is identified in these cost tables.**

EA3 Total: $940,238

EA 3 COSTS					
SITE-WIDE ELEMENTS	**Mine Feature BR-14 Discharge Seep, or Spring**	**Mine Feature SG-71 Discharge Seep, or Spring**	**Mine Feature SG-94 Discharge Seep, or Spring**		**TOTAL**
Institutional Controls	$ -	$ -	$ -		
Access Restrictions					
Construct Fence	$ 2,200	$ 2,200	$ 2,200		**$ 6,600**
Install Gates	$ 1,500	$ 1,500	$ 1,500		**$ 4,500**
Install Warning Signs	$ 150	$ 150	$ -		**$ 300**
Subtotal	$ 3,850	$ 3,850	$ 3,700		**$ 11,400**
Mob/Demob (10%)	$ 385	$ 385	$ 370		**$ 1,140**
Subtotal	$ 4,235	$ 4,235	$ 4,070		**$ 12,540**
Contingencies (15%)	$ 635	$ 635	$ 611		**$ 1,881**
Subtotal	$ 4,870	$ 4,870	$ 4,681		**$ 14,421**
Project Management (5%)	$ 244	$ 244	$ 234		**$ 721**
Engineering (6%)	$ 292	$ 292	$ 281		**$ 865**
Construction Administration (8%)	$ 390	$ 390	$ 374		**$ 1,154**
Total, Access Restrictions	$ 5,796	$ 5,796	$ 5,570		**$ 17,161**
Long-term Monitoring and Maintenance					
Site Security, Fence and Sign Maintenance, Years 1-30 (Annual)	$ 250	$ 250	$ 250		**$ 750**
Periodic Replacement - Years 15 and 30	$ 1,925	$ 1,925	$ 1,850		**$ 5,700**
Total, 30-yr Present Worth, Long-term M&M (3%)	$ 6,928	$ 6,928	$ 6,849		**$ 20,705**
TOTAL ACCESS RESTRICTIONS + LONG-TERM M&M	$ 12,724	$ 12,724	$ 12,419		**$ 37,866**
TOTAL SITE-WIDE ELEMENTS COSTS WITH 30-YR PRESENT WORTH LONG-TERM M&M					**$ 37,866**

EA3 COST ESTIMATE DETAIL
SITE-WIDE ELEMENTS

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 1,155.00	1	$ 1,155	10% of construction cost
Install Farm Fence - Total	LF	$ 5.50	1,200	$ 6,600	Based on Bald Butte/Great Divide
Mine Feature BR-01 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	LF	$ 5.50	400	$ 2,200	
Mine Feature PBBS Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	LF	$ 5.50	400	$ 2,200	
Mine Feature SG-94 Discharge Seep, or Spring	LF	$ 5.50	400	$ 2,200	
Mine Feature SG-98 Discharge Seep, or Spring	LF	$ 5.50	0	$ -	
Historic Paymaster Adit Discharge	LF	$ 5.50	0	$ -	
Metal Security Gate - Total	EA	$ 1,500.00	3	$ 4,500	Based on Section 35 Bid Tabs
Mine Feature BR-01 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	EA	$ 1,500.00	1	$ 1,500	
Mine Feature PBBS Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	EA	$ 1,500.00	1	$ 1,500	
Mine Feature SG-94 Discharge Seep, or Spring	EA	$ 1,500.00	1	$ 1,500	
Mine Feature SG-98 Discharge Seep, or Spring	EA	$ 1,500.00	0	$ -	
Historic Paymaster Adit Discharge	EA	$ 1,500.00	0	$ -	
Metal Warning Signs - Total	EA	$ 150.00	3	$ 450	Engineer Estimate
Mine Feature BR-01 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	EA	$ 150.00	1	$ 150	
Mine Feature PBBS Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	EA	$ 150.00	1	$ 150	
Mine Feature SG-94 Discharge Seep, or Spring	EA	$ 150.00	1	$ 150	
Mine Feature SG-98 Discharge Seep, or Spring	EA	$ 150.00	0	$ -	
Historic Paymaster Adit Discharge	EA	$ 150.00	0	$ -	
			Subtotal	$ 12,705	
Contingencies		15%		$ 1,906	
			Subtotal	$ 14,611	
Project Management		5%		$ 731	
Engineering		6%		$ 877	
Construction Management		8%		$ 1,169	
TOTAL				$ 17,387	
			TOTAL CAPITAL COSTS	**$ 17,387**	

LONG-TERM MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Security, Fence and Sign Maintenance, Years 1-30	LS	$ 750.00	1	$ 750	Engineers Estimate
Periodic Replacement - Years 15 and 30	LS	$ 3,300.00	1	$ 3,300	1/2 of fence replaced
			Subtotal	**$ 4,050**	
		30-YEAR NET PRESENT VALUE ANNUAL M&M COSTS		**$ 18,178**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + M&M COST) $ 35,565

Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 3 COSTS					
MONITORED NATURAL RECOVERY	**Blackfoot River (EU13)**	**Stevens Creek**	**Unnamed Tributary above WTP**		**TOTAL**
Subtotal	$ -	$ -	$ -		$ -
Mob/Demob (10%)	$ -	$ -	$ -		$ -
Subtotal	$ -	$ -	$ -		$ -
Contingencies (15%)	$ -	$ -	$ -		$ -
Subtotal	$ -	$ -	$ -		$ -
Project Management (5%)	$ -	$ -	$ -		$ -
Engineering (6%)	$ -	$ -	$ -		$ -
Construction Administration (8%)	$ -	$ -	$ -		$ -
Total, Capital Cost	$ -	$ -	$ -		$ -
Operations and Maintenance (O& M)					
Semiannual Surface Water, Sediment Sampling, Analysis and Reporting, Years 1-10	$ 38,750	$ 10,000	$ 5,000		$ 53,750
Annual Monitoring Years 11-30	$ 19,375	$ 5,000	$ 2,500		$ 26,875
Total, 30-yr Present Worth, O & M (3%)	$ 545,031	$ 148,500	$ 62,480		$ 756,011
TOTAL CAPITAL COST + O & M	$ 545,031	$ 148,500	$ 62,480		$ 756,011
TOTAL EA3 MNR COSTS WITH 30-YR PRESENT WORTH O & M					**$ 756,011**

EA3 COST ESTIMATE DETAIL
MONITORED NATURAL RECOVERY

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
			Subtotal	$ -	
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS $	-	

MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Semiannual Surface Water, Sediment Sampling, Analysis and Reporting, Years 1-10	LS	$53,750.00	1	$ 53,750	Based on current costs and increased to account for add'l stations and semiannual monitoring
Annual Monitoring Years 11-30	LS	$26,875.00	1	$ 26,875	
			Subtotal	$ 80,625	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS $				756,011	Discounted using the rate below

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (ICS + ACCESS RESTRICTIONS + O & M COSTS) $ 756,011

Surface Water and Sediment Monitoring	EA	$41,241.00	2	$82,482.00	Existing Annual Budget is ~$65K for SW/Sed. Add locations at Stevens, Shave.Porcupine, Unnamed Trib and make this semiannual (high + low flow)
Analysis and Report	EA	$5,000	1	$5,000.00	
			Annual Cost	$87,482.00	

EA 3 COSTS			
REMOVAL AND ON-SITE DISPOSAL	Paymaster Creek		TOTAL
Floodplain Survey	$ 2,500		$ 2,500
Sampling and Analysis Plan	$ 5,000		$ 5,000
Surface Water and Sediment Control	$ 5,000		$ 5,000
Dewatering	$ -		$ -
Improve/Construct Access Roads	$ -		$ -
Excavate, Load, Haul and Place Waste in Repository	$ 450		$ 450
Load, Haul, Place Stream Substrate	$ 750		$ 750
Reconstruct Stream	$ 24,000		$ 24,000
Seed, Fertilize, Mulch	$ 1,250		$ 1,250
Subtotal	$ 38,950		$ 38,950
Mob/Demob (10%)	$ 3,895		$ 3,895
Subtotal	$ 42,845		$ 42,845
Contingencies (15%)	$ 6,427		$ 6,427
Subtotal	$ 49,272		$ 49,272
Project Management (5%)	$ 2,464		$ 2,464
Engineering (6%)	$ 2,956		$ 2,956
Construction Administration (8%)	$ 3,942		$ 3,942
Total, Capital Cost	$ 58,633		$ 58,633
Operations and Maintenance (O & M)			
Site Inspections, Vegetation Maintenance and Repairs, Years 1-5	$ 4,000		$ 4,000
Site Inspections, Vegetation Maintenance and Repairs, Years 6-30	$ 1,500		$ 1,500
Total, 30-yr Present Worth, O & M (3%)	$ 40,850		$ 40,850
TOTAL CAPITAL COST + O & M	$ 99,483		$ 99,483
TOTAL EA3 REMOVAL AND ON-SITE DISPOSAL COSTS WITH 30-YR PRESEN			**$ 99,483**

EA3 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 3,895.00	1	$ 3,895	10% of construction cost
Floodplain Survey - Total				$ 2,500	
Blackfoot River (EU13)	LS	$ 15,000.00	0	$ -	Engineer Estimate
Stevens Creek	LS	$ 5,000.00	0	$ -	
Shave Creek	LS	$ 2,500.00	0	$ -	
Paymaster Creek	LS	$ 2,500.00	1	$ 2,500	
Sampling and Analysis Plan - Total				$ 5,000	
Blackfoot River (EU13)	LS	$ 40,000.00	0	$ -	Engineer Estimate
Stevens Creek	LS	$ 10,000.00	0	$ -	
Shave Creek	LS	$ 5,000.00	0	$ -	
Paymaster Creek	LS	$ 5,000.00	1	$ 5,000	
Surface Water and Sediment Control - Total				$ 5,000	
Blackfoot River (EU13)	LS	$ 200,000.00	0	$ -	Engineer Estimate - General Site BMPs
Stevens Creek	LS	$ 10,000.00	0	$ -	
Shave Creek	LS	$ 5,000.00	0	$ -	
Paymaster Creek	LS	$ 5,000.00	1	$ 5,000	
Dewatering - Total			0	$ -	Engineer Estimate
Blackfoot River (EU13)	CY	$ 2.50	0	$ -	
Stevens Creek	CY	$ 2.50	0	$ -	
Improve/Construct Access Roads - Total	LF	$ 18.00	0	$ -	Includes Clear/Grub/Log, Reclamation
Blackfoot River (EU13)	LF	$ 18.00	0	$ -	
Stevens Creek	LF	$ 18.00	0	$ -	
Porcupine Creek	LF	$ 18.00	0	$ -	
Paymaster Creek	LF	$ 18.00	0	$ -	
Shave Creek	LF	$ 18.00	0	$ -	
Unnamed Tributary above WTP	LF	$ 18.00	0	$ -	
Mine Feature BR-01 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Historic Paymaster Adit Discharge	LF	$ 18.00	0	$ -	

EA3 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Excavate, Load, Haul and Place Waste in Repository - Total	CY	$ 15.00	30	$ 450	Engineer Estimate
Blackfoot River (EU13)	CY	$ 15.00	0	$ -	Volume estimated from 2012 Floodplain Study Report; includes 0.5 feet over-excavation
Stevens Creek	CY	$ 20.00	0	$ -	
Porcupine Creek	CY	$ 15.00	0	$ -	
Paymaster Creek	CY	$ 15.00	30	$ 450	
Shave Creek	CY	$ 15.00	0	$ -	
Unnamed Tributary above WTP	CY	$ 15.00	0	$ -	
Mine Feature BR-01 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	CY	$ 25.00	0	$ -	
Historic Paymaster Adit Discharge	CY	$ 25.00	0	$ -	
Load, Haul, Place Stream Substrate - Total	CY	$ 15.00	30	$ 750	Gravel and cobble substrate to rebuild disturbed areas
Blackfoot River (EU13)	CY	$ 25.00	0	$ -	
Stevens Creek	CY	$ 30.00	0	$ -	
Porcupine Creek	CY	$ 25.00	0	$ -	
Paymaster Creek	CY	$ 25.00	30	$ 750	
Shave Creek	CY	$ 25.00	0	$ -	
Unnamed Tributary above WTP	CY	$ 25.00	0	$ -	
Mine Feature BR-01 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	CY	$ 35.00	0	$ -	
Historic Paymaster Adit Discharge	CY	$ 35.00	0	$ -	
Reconstruct Stream - Total			200	$ 24,000	
Blackfoot River (EU13)	LF	$ 120.00	0	$ -	Engineers Estimate, Bid Tabs for similar jobs, Partial Reconstruction only 10% of length.
Stevens Creek	LF	$ 120.00	0	$ -	
Porcupine Creek	LF	$ 120.00	0	$ -	
Paymaster Creek	LF	$ 120.00	200	$ 24,000	
Shave Creek	LF	$ 120.00	0	$ -	
Unnamed Tributary above WTP	LF	$ 120.00	0	$ -	
Mine Feature BR-01 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	

EA3 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mine Feature SG-94 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	LF	$ 120.00	0	$ -	
Historic Paymaster Adit Discharge	LF	$ 120.00	0	$ -	

EA3 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Seed, Fertilize, Mulch - Total	AC	$ 2,500.00	0.5	$ 1,250	Based on Bald Butte
Blackfoot River (EU13)	AC	$ 2,500.00	0.0	$ -	
Stevens Creek	AC	$ 2,500.00	0.0	$ -	
Porcupine Creek	AC	$ 2,500.00	0.0	$ -	
Paymaster Creek	AC	$ 2,500.00	0.5	$ 1,250	
Shave Creek	AC	$ 2,500.00	0.0	$ -	
Unnamed Tributary above WTP	AC	$ 2,500.00	0.0	$ -	
Mine Feature BR-01 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Historic Paymaster Adit Discharge	AC	$ 2,500.00	0.0	$ -	
			Subtotal	$ 42,845	
Contingencies		15%		$ 6,427	
			Subtotal	$ 49,272	
Project Management		5%		$ 2,464	
Engineering		6%		$ 2,956	
Construction Management		8%		$ 3,942	
TOTAL				$ 58,633	
			TOTAL CAPITAL COSTS	**$ 58,633**	

MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-5	LS	$ 4,000.00	1	$ 4,000	Engineers Estimate
Site Inspections, Vegetation Maintenance and Repairs, Years 6-30	LS	$ 1,500.00	1	$ 1,500	Engineers Estimate
			Subtotal	$ 5,500	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 40,850**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 99,483

EA 3 COSTS					
CONTAINMENT (RETENTION POND)	**Historic Paymaster Adit Discharge**			**TOTAL**	
Improve/Construct Access Roads	$	-		$	-
Construct Retention Pond	$	17,130		$	17,130
Seed, Fertilize, Mulch	$	1,106		$	1,106
Subtotal	$	18,236		$	18,236
Mob/Demob (10%)	$	1,824		$	1,824
Subtotal	$	20,060		$	20,060
Contingencies (15%)	$	3,009		$	3,009
Subtotal	$	23,069		$	23,069
Project Management (5%)	$	1,153		$	1,153
Engineering (6%)	$	1,384		$	1,384
Construction Administration (8%)	$	1,845		$	1,845
Total, Capital Cost	$	27,452		$	27,452
Operations and Maintenance (O & M)					
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	$	409		$	409
Periodic Repairs - Years 15 and 30 (1/3rd remedial cost pond construct and reveg)	$	6,082		$	6,082
Total, 30-yr Present Worth, O & M (3%)	$	14,426		$	14,426
TOTAL CAPITAL COST + O & M	$	41,878		$	41,878
TOTAL EA3 CONTAINMENT (RETENTION) COSTS WITH 30-YR PRESENT WORT				**$**	**41,878**

EA3 COST ESTIMATE DETAIL
CONTAINMENT (RETENTION POND)

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 1,823.61	1	$ 1,824	10% of construction cost
Improve/Construct Access Roads - Total	LF	$ 18.00	0	$ -	Includes Clear/Grub/Log, Reclamation
Mine Feature BR-01 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	LF	$ 18.00	0	$ -	
Historic Paymaster Adit Discharge	LF	$ 18.00	0	$ -	
Construct Retention Pond - Total	EA	$ 17,130.00	1	$ 17,130	Engineer Estimate
Mine Feature BR-01 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	EA	$ 17,130.00	0	$ -	
Historic Paymaster Adit Discharge	EA	$ 17,130.00	1	$ 17,130	
Seed, Fertilize, Mulch - Total	AC	$ 2,500.00	0.4	$ 1,106	Engineer Estimate
Mine Feature BR-01 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature BR-14 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PBBS Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PC-11 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature PC-22 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SH-43 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-55 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-71 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-94 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Mine Feature SG-98 Discharge Seep, or Spring	AC	$ 2,500.00	0.0	$ -	
Historic Paymaster Adit Discharge	AC	$ 2,500.00	0.4	$ 1,106	
			Subtotal	$ 20,060	
Contingencies		15%		$ 3,009	
			Subtotal	$ 23,069	
Project Management		5%		$ 1,153	
Engineering		6%		$ 1,384	
Construction Management		8%		$ 1,845	
TOTAL				$ 27,452	
			TOTAL CAPITAL COSTS	**$ 27,452**	

EA3 COST ESTIMATE DETAIL
CONTAINMENT (RETENTION POND)

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES

MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	LS	$ 409.00	1	$ 409	Engineers Estimate
Periodic Repairs - Years 15 and 30 (1/3rd remedial cost pond construct and reveg)	LS	$ 6,082.00	1	$ 6,082	Engineers Estimate
			Subtotal	$ 6,491	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 14,426**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ **41,878** Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EVALUATION AREA EA 4	SITE-WIDE ELEMENTS				REMEDIAL ALTERNATIVE COSTS															
						PHYSICAL HAZARDS/SOLID MEDIA							SURFACE WATER/GROUNDWATER						
							ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT			ENGINEERING CONTROLS			TREATMENT		
											In-situ	Ex-situ					Active		Passive
Upper Marsh	ICs	*IC# Identification	Access Restrictions	Long-term Monitoring and Maintenance	No Action	Monitored Natural Recovery	Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Neutralization W/Alkaline Amendment	Monitored Natural Attenuation	Containment (Retention Pond)	Hydrologic and Hydraulic Control	Inundation	Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Eastern Area	$5,000	IC-4	$0	$0	$0	$0	N/A	$0	$4,465,125	$0	N/A	N/A	$154,719	N/A	N/A	N/A	N/A	N/A	N/A
Western Area	$0	IC-4	$0	$0	$0	$182,849	N/A	$0	$0	$0	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL COSTS	$5,000	N/A	$0	$0	$0	$71,311**	$0	$0	$312,559**	$0	$0	$0	$10,830**	$0	$0	$0	$0	$0	$0

* Table C3 Contains descriptions for each IC. Cost is $5,000 per IC (location), so costs are not duplicated after the first time an IC location is identified in these cost tables.

** Total costs for the Eastern Area are based on private land portion (7% of the area). Total costs of the Western Area are based on private land portion (39% of the area).

EA4 Total: $399,700

EA 4 COSTS				
MONITORED NATURAL RECOVERY	**Eastern Area**	**Western Area**		**TOTAL**
Subtotal	$ -	$ -		$ -
Mob/Demob (10%)	$ -	$ -		$ -
Subtotal	$ -	$ -		$ -
Contingencies (15%)	$ -	$ -		$ -
Subtotal	$ -	$ -		$ -
Project Management (5%)	$ -	$ -		$ -
Engineering (6%)	$ -	$ -		$ -
Construction Administration (8%)	$ -	$ -		$ -
Total, Capital Cost	$ -	$ -		$ -
Operations and Maintenance (O & M)				
Semiannual Surface Water, Sediment Sampling, Analysis and Reporting, Years 1-10	$ -	$ 13,000		$ 13,000
Annual Monitoring Years 11-30	$ -	$ 6,500		$ 6,500
Total, 30-yr Present Worth, O & M (3%)	$ -	$ 182,849		$ 182,849
TOTAL CAPITAL COST + O & M	$ -	$ 182,849		$ 182,849
TOTAL EA4 MNR COSTS WITH 30-YR PRESENT WORTH O & M				**$ 182,849**

EA4 COST ESTIMATE DETAIL
MONITORED NATURAL RECOVERY*

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS	**$ -**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Semiannual Surface Water, Sediment Sampling, Analysis and Reporting, Years 1-10	LS	$13,000.00	1	$ 13,000	Based on current costs and increased to account for add'l stations and semiannual monitoring
Annual Monitoring Years 11-30	LS	$6,500.00	1	$ 6,500	
			Subtotal	$ 19,500	
			30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS	**$ 182,849**	**Discounted using the rate below**

* Surface water in the marsh is considered part of EA4 and is evaluated independent of the surface water for EA3.

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 182,849

Surface Water and Sediment Monitoring	EA	$12,000.00	1	$12,000.00	Existing Annual Budget is ~$65K for SW/Sed. Add locations above, below, and in the middle of upper marsh and make this semiannual (high + low flow)
Analysis and Report	EA	$2,000	1	$2,000.00	
			Annual Cost	$14,000.00	

EA 4 COSTS				
REMOVAL AND ON-SITE DISPOSAL	**Eastern Area**	**Western Area**		**TOTAL**
Permitting	$ 20,000	$ -		$ 20,000
Surface Water and Sediment Control	$ 40,000	$ -		$ 40,000
Dewatering	$ 451,726	$ -		$ 451,726
Improve/Construct Access Roads	$ 27,000	$ -		$ 27,000
Excavate, Load, Haul and Place Sediment in Repository	$ 1,355,178	$ -		$ 1,355,178
Load, Haul, Place Clean Backfill/Vegetative Cover	$ 677,589	$ -		$ 677,589
Revegetate Floodplain Areas	$ 223,996	$ -		$ 223,996
Revegetate Cover Soil Borrow Area	$ 34,999	$ -		$ 34,999
Subtotal	$ 2,830,488	$ -		$ 2,830,488
Mob/Demob (10%)	$ 283,049	$ -		$ 283,049
Subtotal	$ 3,113,537	$ -		$ 3,113,537
Contingencies (15%)	$ 467,030	$ -		$ 467,030
Subtotal	$ 3,580,567	$ -		$ 3,580,567
Project Management (5%)	$ 179,028	$ -		$ 179,028
Engineering (6%)	$ 214,834	$ -		$ 214,834
Construction Administration (8%)	$ 286,445	$ -		$ 286,445
Total, Capital Cost	$ 4,260,875	$ -		$ 4,260,875
Operations and Maintenance (O & M)				
Site Inspections, Vegetation Maintenance and Repairs, Years 1-5	$ 20,000	$ -		$ 20,000
Site Inspections, Vegetation Maintenance and Repairs, Years 6-30	$ 7,500	$ -		$ 7,500
Total, 30-yr Present Worth, O & M (3%)	$ 204,250	$ -		$ 204,250
TOTAL CAPITAL COST + O & M	$ 4,465,125	$ -		$ 4,465,125
TOTAL EA4 REMOVAL AND ON-SITE DISPOSAL COSTS WITH 30-YR PRESENT WORTH O & M				**$ 4,465,125**

EA4 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 283,048.79	1	$ 283,049	10% of construction cost
Permitting	LS	$ 20,000.00	1	$ 20,000	Engineer Estimate
Surface Water and Sediment Control	LS	$ 40,000.00	1	$ 40,000	Engineer Estimate
Dewatering - Total	CY	$ 5.00	90,345	$ 451,726	Engineer Estimate
Eastern Area	CY	$ 5.00	90,345	$ 451,726	
Western Area	CY	$ 5.00	0	$ -	
Improve/Construct Access Roads - Total	LF	$ 18.00	1,500	$ 27,000	Includes Clear/Grub/Log, Reclamation
Eastern Area	LF	$ 18.00	1,500	$ 27,000	
Western Area	LF	$ 18.00	0	$ -	
Excavate, Load, Haul and Place Sediment in Repository - Total	CY	$ 15.00	90,345	$ 1,355,178	Engineer Estimate
Eastern Area	CY	$ 15.00	90,345	$ 1,355,178	
Western Area	CY	$ 15.00	0	$ -	
Load, Haul, Place Clean Backfill/Vegetative Cover - Total	CY	$ 15.00	45,173	$ 677,589	Not all areas returned to grade
Eastern Area	CY	$ 15.00	45,173	$ 677,589	
Western Area	CY	$ 15.00	0	$ -	
Revegetate Floodplain Areas - Total	AC	$ 8,000.00	28	$ 223,996	
Eastern Area	AC	$ 8,000.00	28	$ 223,996	
Western Area	AC	$ 8,000.00	0	$ -	
Revegetate Cover Soil Borrow Area - Total	AC	$ 2,500.00	14.0	$ 34,999	Based on Bald Butte
Eastern Area	AC	$ 2,500.00	14.0	$ 34,999	
Western Area	AC	$ 2,500.00	0.0	$ -	
			Subtotal	$ 3,113,537	
Contingencies		15%		$ 467,030	
			Subtotal	$ 3,580,567	
Project Management		5%		$ 179,028	
Engineering		6%		$ 214,834	
Construction Management		8%		$ 286,445	
TOTAL				$ 4,260,875	
			TOTAL CAPITAL COSTS	**$ 4,260,875**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-5	LS	$ 20,000.00	1	$ 20,000	Engineers Estimate; O & M costs for the Section 35 repository are not included.
Site Inspections, Vegetation Maintenance and Repairs, Years 6-30	LS	$ 7,500.00	1	$ 7,500	Engineers Estimate; O & M costs for the Section 35 repository are not included.
			Subtotal	$ 27,500	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 204,250**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 4,465,125

EA 4 COSTS				
MONITORED NATURAL ATTENUATION	**Eastern Area**	**Western Area**		**TOTAL**
Subtotal	$ -	$ -		$ -
Mob/Demob (10%)	$ -	$ -		$ -
Subtotal	$ -	$ -		$ -
Contingencies (15%)	$ -	$ -		$ -
Subtotal	$ -	$ -		$ -
Project Management (5%)	$ -	$ -		$ -
Engineering (6%)	$ -	$ -		$ -
Construction Administration (8%)	$ -	$ -		$ -
Total Capital Cost	$ -	$ -		$ -
Operations and Maintenance (O & M)				
Semiannual Groundwater Sampling, Analysis and Reporting, Years 1-10	$ 11,000	$ -		$ 11,000
Annual Monitoring Years 11-30	$ 5,500	$ -		$ 5,500
Total, 30-yr Present Worth, O & M (3%)	$ 154,719	$ -		$ 154,719
TOTAL CAPITAL COST + O & M	$ 154,719	$ -		$ 154,719
TOTAL EA4 MNA COSTS WITH 30-YR PRESENT WORTH O & M				**$ 154,719**

EA4 COST ESTIMATE DETAIL
MONITORED NATURAL ATTENUATION - GROUNDWATER*

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Contingencies		15%		$ -	
			Subtotal	$ -	
Project Management		5%		$ -	
Engineering		6%		$ -	
Construction Management		8%		$ -	
TOTAL				$ -	
			TOTAL CAPITAL COSTS	**$ -**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Semiannual Groundwater Sampling, Analysis and Reporting, Years 1-10	LS	$ 11,000.00	1	$ 11,000	Based on current costs and adjusted for 4 wells and semiannual monitoring
Annual Monitoring Years 11-30	LS	$ 5,500.00	1	$ 5,500	Reduce to annual monitoring
			Subtotal	$ 16,500	
30-YEAR NET PRESENT VALUE ANNUAL O & M COSTS				**$ 154,719**	**Discounted using the rate below**

* Groundwater in the marsh is considered part of EA4 and is evaluated independent of the groundwater for EA2.

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O & M COST) $ 154,719

Groundwater Monitoring	EA	$10,000.00	2	$20,000.00	Existing Annual Budget is ~$65K for GW sitewide. Estimate includes 4 existing wells - EDMW-2, PDGW-101, PMGW-117, LCMW-1. Monitor semiannually.
Analysis and Report	EA	$2,000	1	$2,000.00	
			Annual Cost	$22,000.00	

EVALUATION AREA EA 5	SITE-WIDE ELEMENTS				REMEDIAL ALTERNATIVE COSTS						
					No Action	PHYSICAL HAZARDS/SOLID MEDIA					
						ENGINEERING CONTROLS/LAND DISPOSAL				TREATMENT	
										In-situ	Ex-situ
Mining-related Features	ICs	*IC# Identification	Access Restrictions	Long-term Monitoring and Maintenance		Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	Neutralization W/Alkaline Amendment	Neutralization W/Alkaline Amendment
BR-14, BR-39	$0.00	IC-8	$0	$0	$0.00	N/A	$0	$178,498	$0	$0	N/A
BR-29	$5,000.00	IC-9	$5,645	$7,855	$0.00	N/A	$0	$0	$0	$0	N/A
PC-01	$5,000.00	IC-10	$0	$0	$0.00	$65,496	N/A	N/A	N/A	N/A	N/A
PC-06	$0.00	IC-10	$5,464	$7,792	$0.00	N/A	$0	$0	$0	$0	N/A
PM-04, PM-06, JM-01	$0.00	IC-3	$8,580	$12,803	$0.00	N/A	$0	$43,030	$0	$0	N/A
SH-29, SH-37	$0.00	IC-8	$5,893	$11,862	$0.00	N/A	$0	$103,142	$0	$0	N/A
SH-13, SH-14	$0.00	IC-10	$8,276	$12,696	$0.00	$0	$0	$231,177	$0	$0	N/A
SG-13/14, SG-16, SG-43	$0.00	IC-7	$22,919	$17,820	$0.00	N/A	$0	$0	$0	$0	N/A
SG-41, SG-47, SG-48, SG-49/50 SG-51, SG-71, SG-93, SG-94	$0.00	IC-7	$29,941	$39,878	$0.00	N/A	$0	$0	$0	$0	N/A
SWG-02	$0.00	IC-2	$17,951	$16,082	$0.00	N/A	$0	$0	$0	$0	N/A
TOTAL COSTS	**$10,000**	**N/A**	**$104,671**	**$126,789**	**$0**	**$65,496**	**$0**	**$555,848**	**$0**	**$0**	**$0**

*** Table C3 Contains descriptions for each IC. Cost is $5,000 per IC (location), so costs are not duplicated after the first time an IC location is identified in these cost tables.**

EA5 Total: $862,803

EA 5 COSTS										
	MINING-RELATED FEATURES									
	Blackfoot River	*Pass Creek*	*Paymaster Gulch*	*Shave Gulch*		*Stevens Gulch*		*Swamp Gulch*		
SITE-WIDE ELEMENT	**BR-29**	**PC-06**	**PM-06, JM-01**	**SH-37**	**SH-14**	**SG-13/14, SG-16 SG-43**	**SG-41, SG-47 SG-48, SG-49/50 SG-51, SG-71, SG-93, SG-94**	**SWG-01**		**TOTAL**
Access Restrictions										
Construct Fence	$ 2,100	$ 1,980	$ 2,400	$ 2,265	$ 3,848	$ 10,275	$ 6,690	$ 10,275		**$ 39,833**
Install Gates	$ 1,500	$ 1,500	$ 3,000	$ 1,500	$ 1,500	$ 4,500	$ 12,000	$ 1,500		**$ 27,000**
Install Warning Signs	$ 150	$ 150	$ 300	$ 150	$ 150	$ 450	$ 1,200	$ 150		**$ 2,700**
Subtotal	$ 3,750	$ 3,630	$ 5,700	$ 3,915	$ 5,498	$ 15,225	$ 19,890	$ 11,925		**$ 69,533**
Mob/Demob (10%)	$ 375	$ 363	$ 570	$ 392	$ 550	$ 1,523	$ 1,989	$ 1,193		**$ 6,953**
Subtotal	$ 4,125	$ 3,993	$ 6,270	$ 4,307	$ 6,047	$ 16,748	$ 21,879	$ 13,118		**$ 76,486**
Contingencies (15%)	$ 619	$ 599	$ 941	$ 646	$ 907	$ 2,512	$ 3,282	$ 1,968		**$ 11,473**
Subtotal	$ 4,744	$ 4,592	$ 7,211	$ 4,952	$ 6,954	$ 19,260	$ 25,161	$ 15,085		**$ 87,959**
Project Management (5%)	$ 237	$ 230	$ 361	$ 248	$ 348	$ 963	$ 1,258	$ 754		**$ 4,398**
Engineering (6%)	$ 285	$ 276	$ 433	$ 297	$ 417	$ 1,156	$ 1,510	$ 905		**$ 5,278**
Construction Administration (8%)	$ 380	$ 367	$ 577	$ 396	$ 556	$ 1,541	$ 2,013	$ 1,207		**$ 7,037**
Total, Capital Cost	$ 5,645	$ 5,464	$ 8,580	$ 5,893	$ 8,276	$ 22,919	$ 29,941	$ 17,951		**$ 104,671**
Long-Term Monitoring and Maintenance (M & M)										
Site Security, Fence and Sign Maintenance, Years 1-30 (Annual)	$ 300	$ 300	$ 500	$ 500	$ 500	$ 500	$ 1,500	$ 500		**$ 4,600**
Periodic Replacement - Years 15 and 30	$ 1,875	$ 1,815	$ 2,850	$ 1,958	$ 2,749	$ 7,613	$ 9,945	$ 5,963		**$ 34,766**
Total, 30-yr Present Worth, Long-Term M&M (3%)	$ 7,855	$ 7,792	$ 12,803	$ 11,862	$ 12,696	$ 17,820	$ 39,878	$ 16,082		**$ 126,789**
TOTAL EA5 SITE-WIDE ELEMENTS WITH 30-YR PRESENT WORTH LONG-TERM M&M										**$ 231,459**

EA5 COST ESTIMATE DETAIL
SITE-WIDE ELEMENTS

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
ACCESS RESTRICTIONS					
Mobilization, Bonding, Insurance	LS	$ 6,953.25	1	$ 6,953	10% of construction cost
Install Farm Fence - Total	LF	$ 7.50	5,311	$ 39,833	Based on Bald Butte/Great Divide
BR-29	LF	$ 7.50	280	$ 2,100	
PC-06	LF	$ 7.50	264	$ 1,980	
PM-06, JM-01	LF	$ 7.50	320	$ 2,400	
SH-37	LF	$ 7.50	302	$ 2,265	
SH-14	LF	$ 7.50	513	$ 3,848	
SG-13/14, SG-16, SG-43	LF	$ 7.50	1,370	$ 10,275	
SG-41, SG-47, SG-48, SG-49/50 SG-51, SG-71, SG-93, SG-94	LF	$ 7.50	892	$ 6,690	
SWG-02	LF	$ 7.50	1,370	$ 10,275	
Metal Security Gate - Total	EA	$ 1,500.00	18	$ 27,000	Based on Section 35 Bid Tabs
BR-29	EA	$ 1,500.00	1	$ 1,500	
PC-06	EA	$ 1,500.00	1	$ 1,500	
PM-06, JM-01	EA	$ 1,500.00	2	$ 3,000	
SH-37	EA	$ 1,500.00	1	$ 1,500	
SH-14	EA	$ 1,500.00	1	$ 1,500	
SG-13/14, SG-16, SG-43	EA	$ 1,500.00	3	$ 4,500	
SG-41, SG-47, SG-48, SG-49/50 SG-51, SG-71, SG-93, SG-94	EA	$ 1,500.00	8	$ 12,000	
SWG-02	EA	$ 1,500.00	1	$ 1,500	
Metal Warning Signs - Total	EA	$ 150.00	18	$ 2,700	Engineer Estimate
BR-29	EA	$ 150.00	1	$ 150	
PC-06	EA	$ 150.00	1	$ 150	
PM-06, JM-01	EA	$ 150.00	2	$ 300	
SH-37	EA	$ 150.00	1	$ 150	
SH-14	EA	$ 150.00	1	$ 150	
SG-13/14, SG-16, SG-43	EA	$ 150.00	3	$ 450	
SG-41, SG-47, SG-48, SG-49/50 SG-51, SG-71, SG-93, SG-94	EA	$ 150.00	8	$ 1,200	
SWG-02	EA	$ 150.00	1	$ 150	
			Subtotal	$ 76,486	
Contingencies		15%		$ 11,472.86	
			Subtotal	$ 87,959	
Project Management		5%		$ 4,397.93	
Engineering		6%		$ 5,277.52	
Construction Management		8%		$ 7,036.69	
TOTAL				$ 104,671	
			TOTAL CAPITAL COSTS	**$ 104,671**	

MONITORING AND MAINTENANCE (M & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Security, Fence and Sign Maintenance, Years 1-30	LS	$ 4,600.00	1	$ 4,600	Engineers Estimate
Periodic Replacement - Years 15 and 30	LS	$ 34,766.00	1	$ 34,766	1/2 of fence replaced
			Subtotal	$ 39,366	
	30-YEAR NET PRESENT VALUE ANNUAL M&M COSTS			**126,800**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (ICS + ACCESS RESTRICTIONS + M&M COST) **$231,471** Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 5 COSTS				
		Pass Creek		**TOTAL**
PHYSICAL BARRIER		PC-01		
Install Adit Closure		$ 30,000		$ 30,000
Plug Well		$ -		$ -
Subtotal		$ 30,000		$ 30,000
Mob/Demob (10%)	10%	$ 3,000		$ 3,000
Subtotal		$ 33,000		$ 33,000
Contingencies (15%)	15%	$ 4,950		$ 4,950
Subtotal		$ 37,950		$ 37,950
Project Management (5%)	5%	$ 1,898		$ 1,898
Engineering (6%)	6%	$ 2,277		$ 2,277
Construction Administration (8%)	8%	$ 3,036		$ 3,036
Total, Capital Cost		$ 45,161		$ 45,161
Operations and Maintenance (O & M)				
Site Inspection and Maintenance, Years 1-30		$ 500		$ 500
Periodic Replacement - Years 15 and 30		$ 10,000		$ 10,000
	9/16/2014	$ -		
	9/16/2029	$ 10,000		$ 10,000
	9/12/2044	$ 10,000		$ 10,000
Total, 30-yr Present Worth, O&M (3%)	3%	$ 20,335		$ 20,335
TOTAL CAPITAL COST + O&M		$ 65,496		$ 65,496
TOTAL EA5 PHYSICAL BARRIERS COSTS WITH 30-YR PRESENT WORTH O&M				**$ 65,496**

EA5 COST ESTIMATE DETAIL
PHYSICAL BARRIER

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 3,000.00	1	$ 3,000	10% of construction cost
Install Adit Closure	EA	$ 30,000.00	1	$ 30,000	Based on Bald Butte/Great Divide
PC-01	EA	$ 30,000.00	1	$ 30,000	Incl. transportation and handling of
			Subtotal	$ 33,000	
Contingencies		15%		$ 4,950	
			Subtotal	$ 37,950	
Project Management		5%		$ 1,898	
Engineering		6%		$ 2,277	
Construction Management		8%		$ 3,036	
TOTAL				$ 45,161	
			TOTAL CAPITAL COSTS	**$ 45,161**	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspection and Maintenance, Years 1-30	LS	$ 500.00	1	$ 500	Engineers Estimate
Periodic Replacement - Years 15 and 30	LS	$ 10,000.00	1	$ 10,000	Engineers Estimate
			Subtotal	$ 10,500	
	30-YEAR NET PRESENT VALUE ANNUAL O&M COSTS			**$ 20,339**	**Discounted using the rate below**

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O&M COST) $ 65,499

Value for the EA as a whole is slightly different than value calculated by summing individual sites within the EA due to compounding rounding error.

EA 5 COSTS						
	MINING-RELATED FEATURES					
	Blackfoot River	*Paymaster Gulch*	*Shave Gulch*			
REMOVAL AND ON-SITE DISPOSAL	BR-14, BR-39	PM-04	SH-29	SH-13		TOTAL
Improve/Construct Access Roads	$ 50,400	$ 11,250	$ 25,200	$ 22,284		$ 109,134
Excavate, Load, Haul and Place Waste in Repository	$ 30,480	$ 1,590	$ 1,875	$ 84,000		$ 117,945
Load, Haul, Place Vegetative Cover	$ 18,814	$ 4,125	$ 21,795	$ 28,080		$ 72,814
Seed, Fertilize, Mulch	$ 4,665	$ 990	$ 5,400	$ 6,900		$ 17,955
Reclaim Cover Soil Borrow Area	$ 1,166	$ 149	$ 675	$ 900		$ 2,890
Subtotal	$ 105,524	$ 18,104	$ 54,945	$ 142,164		$ 320,737
Mob/Demob (10%)	$ 10,552	$ 1,810	$ 5,495	$ 14,216		$ 32,074
Subtotal	$ 116,077	$ 19,914	$ 60,440	$ 156,380		$ 352,811
Contingencies (15%)	$ 17,412	$ 2,987	$ 9,066	$ 23,457		$ 52,922
Subtotal	$ 133,488	$ 22,901	$ 69,505	$ 179,837		$ 405,732
Project Management (5%)	$ 6,674	$ 1,145	$ 3,475	$ 8,992		$ 20,287
Engineering (6%)	$ 8,009	$ 1,374	$ 4,170	$ 10,790		$ 24,344
Construction Administration (8%)	$ 10,679	$ 1,832	$ 5,560	$ 14,387		$ 32,459
Total, Capital Cost	$ 158,851	$ 27,252	$ 82,711	$ 214,007		$ 482,821
Operations and Maintenance (O & M)						
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	$ 750	$ 750	$ 750	$ 500		$ 2,750
Periodic Repairs - Years 15 and 30 (1/5th remedial cost)	$ 4,696	$ 1,023	$ 5,439	$ 6,996		$ 18,154
Total, 30-yr Present Worth, O&M (3%)	$ 19,647	$ 15,778	$ 20,430	$ 17,171		$ 73,026
TOTAL CAPITAL COST + O&M	$ 178,498	$ 43,030	$ 103,142	$ 231,177		$ 555,848
TOTAL EA5 REMOVAL AND ON-SITE DISPOSAL COSTS WITH 30-YR PRESENT WORTH O&M						$ 555,848

EA5 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Mobilization, Bonding, Insurance	LS	$ 32,073.70	1	$ 32,074	10% of construction cost
Improve/Construct Access Roads - Total	LF	$ 18.00	6,063	$ 109,134	Includes Clear/Grub/Log, Reclamation
BR-14, BR-39	LF	$ 18.00	2,800	$ 50,400	
PM-04	LF	$ 18.00	625	$ 11,250	
SH-29	LF	$ 18.00	1,400	$ 25,200	
SH-13	LF	$ 18.00	1,238	$ 22,284	
Excavate, Load, Haul and Place Waste in Repository - Total	CY	$ 15.00	7,863	$ 117,945	Engineer Estimate
BR-14, BR-39	CY	$ 15.00	2,032	$ 30,480	
PM-04	CY	$ 15.00	106	$ 1,590	
SH-29	CY	$ 15.00	125	$ 1,875	
SH-13	CY	$ 15.00	5,600	$ 84,000	
Load, Haul, Place Vegetative Cover - Total	CY	$ 15.00	4,854	$ 72,814	6 inch cover imported over removal areas
BR-14, BR-39	CY	$ 15.00	1,254	$ 18,814	
PM-04	CY	$ 15.00	275	$ 4,125	
SH-29	CY	$ 15.00	1,453	$ 21,795	
SH-13	CY	$ 15.00	1,872	$ 28,080	
Seed, Fertilize, Mulch - Total	AC	$ 3,000	6.0	$ 17,955	Based on Bald Butte
BR-14, BR-39	AC	$ 3,000	1.6	$ 4,665	
PM-04	AC	$ 3,000	0.3	$ 990	
SH-29	AC	$ 3,000	1.8	$ 5,400	
SH-13	AC	$ 3,000	2.3	$ 6,900	
Reclaim Cover Soil Borrow Area - Total	AC	$ 4,500	0.6	$ 2,890	Based on Bald Butte
BR-14, BR-39	AC	$ 4,500	0.3	$ 1,166	
PM-04	AC	$ 4,500	0.0	$ 149	
SH-29	AC	$ 4,500	0.2	$ 675	
SH-13	AC	$ 4,500	0.2	$ 900	
			Subtotal	$ 352,811	
Contingencies		15%		$ 52,922	
			Subtotal	$ 405,732	
Project Management		5%		$ 20,287	
Engineering		6%		$ 24,344	
Construction Management		8%		$ 32,459	
TOTAL				$ 482,821	
			TOTAL CAPITAL COSTS	$ 482,821	

OPERATIONS AND MAINTENANCE (O & M) COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
Site Inspections, Vegetation Maintenance and Repairs, Years 1-30	LS	$ 2,750.00	1	$ 2,750	Engineers Estimate
Periodic Repairs - Years 15 and 30 (1/5th remedial cost)	LS	$ 18,153.66	1	$ 18,154	Engineers Estimate
			Subtotal	$ 20,904	
			30-YEAR NET PRESENT VALUE ANNUAL O&M COSTS	$ 73,032	Discounted using the rate below

3% Assumed Discount Rate

30-YEAR PRESENT VALUE (CAPITAL + O&M COST) $ 555,854 Value for the EA as a whole is slightly different than value calculated by summing individual sites

EA5 COST ESTIMATE DETAIL
REMOVAL AND ON-SITE DISPOSAL

CAPITAL COSTS

DESCRIPTION	UNIT	UNIT COST	ESTIMATED QUANTITY	TOTAL PRICE	NOTES
					within the EA due to compounding rounding error.

APPENDIX D. PRO-UCL CALCULATIONS

SECTION D1: SWAMP GULCH SURFACE WATER

SECTION D2: ARSENIC AND LEAD IN EDITH MINE WASTE AREA SOILS

PRO UCL CALCULATIONS FOR SWAMP GULCH SURFACE WATER (BRSW-14)

Section D1

ProUCL for Swamp Gulch Surface Water

The data sets for copper, iron, manganese, and zinc showed either Approximate Normal or Not Normal distributions, using 95% confidence limits with 95% coverage. This caused UTL calculations for these metals to be quite elevated, often above the maximum detection level. Therefore, the calculations were re-run using 95% confidence with 90% coverage in order to provide UTL values that were more reasonable. Due to the two approaches using two different coverages, there are two sets of calculations that follow. The first set includes the metals (aluminum, arsenic, cadmium, and lead) that didn't require a reduction in coverage and were run at 95% confidence limits and 95% coverage. The second set includes the metals (copper, iron, manganese, and zinc) that did require a reduction in coverage and were run at 95% confidence limits and 90% coverage.

Background Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	6/10/2015 11:33:34 AM
From File	Polished_data_file.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
Different or Future K Observations	1
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Total Number of Observations	15	Number of Missing Observations	0
Number of Distinct Observations	7		
Number of Detects	4	Number of Non-Detects	11
Number of Distinct Detects	3	Number of Distinct Non-Detects	4
Minimum Detect	0.051	Minimum Non-Detect	0.05
Maximum Detect	0.27	Maximum Non-Detect	0.2
Variance Detected	0.0149	Percent Non-Detects	73.33%
Mean Detected	0.157	SD Detected	0.122
Mean of Detected Logged Data	-2.158	SD of Detected Logged Data	0.945

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.566	d2max (for USL)	2.409

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.763	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	0.0786	SD	0.072
95% UTL95% Coverage	0.263	95% KM UPL (t)	0.21
90% KM Percentile (z)	0.171	95% KM Percentile (z)	0.197
99% KM Percentile (z)	0.246	95% KM USL	0.252

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.0957	SD	0.074
95% UTL95% Coverage	0.286	95% UPL (t)	0.23
90% Percentile (z)	0.191	95% Percentile (z)	0.218
99% Percentile (z)	0.268	95% USL	0.274

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.674	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.661	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.341	**Kolmogorov-Smirnoff GOF**

	A–E	E	F	G–K	K	L
51	5% K-S Critical Value		0.399	Detected data appear Gamma Distributed at 5% Significance Level		
52	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**					
53						
54	**Gamma Statistics on Detected Data Only**					
55	k hat (MLE)		1.798	k star (bias corrected MLE)		0.616
56	Theta hat (MLE)		0.0871	Theta star (bias corrected MLE)		0.254
57	nu hat (MLE)		14.38	nu star (bias corrected)		4.929
58	MLE Mean (bias corrected)		0.157			
59	MLE Sd (bias corrected)		0.199	95% Percentile of Chisquare (2k)		4.392
60						
61	**Gamma ROS Statistics using Imputed Non-Detects**					
62	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs					
63	GROS may not be used when kstar of detected data is small such as < 0.1					
64	For such situations, GROS method tends to yield inflated values of UCLs and BTVs					
65	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates					
66	Minimum		0.01	Mean		0.0552
67	Maximum		0.27	Median		0.01
68	SD		0.0868	CV		1.572
69	k hat (MLE)		0.715	k star (bias corrected MLE)		0.617
70	Theta hat (MLE)		0.0772	Theta star (bias corrected MLE)		0.0895
71	nu hat (MLE)		21.46	nu star (bias corrected)		18.5
72	MLE Mean (bias corrected)		0.0552	MLE Sd (bias corrected)		0.0703
73	95% Percentile of Chisquare (2k)		4.395	90% Percentile		0.143
74	95% Percentile		0.197	99% Percentile		0.327
75	**The following statistics are computed using Gamma ROS Statistics on Imputed Data**					
76	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**					
77		WH	HW		WH	HW
78	95% Approx. Gamma UTL with 95% Coverage	0.346	0.372	95% Approx. Gamma UPL	0.204	0.206
79	95% Gamma USL	0.312	0.331			
80						
81	**The following statistics are computed using gamma distribution and KM estimates**					
82	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**					
83	k hat (KM)		1.192	nu hat (KM)		35.77
84		WH	HW		WH	HW
85	95% Approx. Gamma UTL with 95% Coverage	0.264	0.264	95% Approx. Gamma UPL	0.188	0.185
86	95% Gamma USL	0.246	0.246			
87						
88	**Lognormal GOF Test on Detected Observations Only**					
89	Shapiro Wilk Test Statistic		0.747	**Shapiro Wilk GOF Test**		
90	5% Shapiro Wilk Critical Value		0.748	Data Not Lognormal at 5% Significance Level		
91	Lilliefors Test Statistic		0.307	**Lilliefors GOF Test**		
92	5% Lilliefors Critical Value		0.443	Detected Data appear Lognormal at 5% Significance Level		
93	**Detected Data appear Approximate Lognormal at 5% Significance Level**					
94						
95	**Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects**					
96	Mean in Original Scale		0.0576	Mean in Log Scale		-3.59!
97	SD in Original Scale		0.0851	SD in Log Scale		1.211
98	95% UTL95% Coverage		0.611	95% BCA UTL95% Coverage		0.27
99	95% Bootstrap (%) UTL95% Coverage		0.27	95% UPL (t)		0.247
100	90% Percentile (z)		0.129	95% Percentile (z)		0.2

99% Percentile (z)	0.457	95% USL	0.506

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-2.768	95% KM UTL (Lognormal)95% Coverage	0.264
KM SD of Logged Data	0.56	95% KM UPL (Lognormal)	0.174
95% KM Percentile Lognormal (z)	0.158	95% KM USL (Lognormal)	0.242

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.0957	Mean in Log Scale	-2.598
SD in Original Scale	0.074	SD in Log Scale	0.743
95% UTL95% Coverage	0.5	95% UPL (t)	0.287
90% Percentile (z)	0.193	95% Percentile (z)	0.252
99% Percentile (z)	0.419	95% USL	0.445

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	15	95% UTL with95% Coverage	0.27
Approximate f	0.789	Confidence Coefficient (CC) achieved by UTL	0.537
95% UPL	0.27	95% USL	0.27
95% KM Chebyshev UPL	0.403		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Arsenic

General Statistics

Total Number of Observations	13	Number of Missing Observations	2
Number of Distinct Observations	4		
Number of Detects	0	Number of Non-Detects	13
Number of Distinct Detects	0	Number of Distinct Non-Detects	4
Minimum Detect	N/A	Minimum Non-Detect	0.002
Maximum Detect	N/A	Maximum Non-Detect	0.02
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Arsenic was not processed!

Barium

General Statistics

Total Number of Observations	5	Number of Missing Observations	4
Number of Distinct Observations	1		
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	1
Minimum Detect	N/A	Minimum Non-Detect	0.2
Maximum Detect	N/A	Maximum Non-Detect	0.2
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Barium was not processed!

Cadmium

General Statistics

Total Number of Observations	15	Number of Missing Observations	0
Number of Distinct Observations	3		
Number of Detects	1	Number of Non-Detects	14
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.005	Minimum Non-Detect	0.001
Maximum Detect	0.005	Maximum Non-Detect	0.008
Variance Detected	N/A	Percent Non-Detects	93.33%
Mean Detected	0.005	SD Detected	N/A
Mean of Detected Logged Data	-5.298	SD of Detected Logged Data	N/A

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cadmium was not processed!

Chromium

General Statistics

Total Number of Observations	5	Number of Missing Observations	4
Number of Distinct Observations	1		
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	1
Minimum Detect	N/A	Minimum Non-Detect	0.01
Maximum Detect	N/A	Maximum Non-Detect	0.01
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Chromium was not processed!

Cobalt

General Statistics

Total Number of Observations	5	Number of Missing Observations	4
Number of Distinct Observations	1		
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	1
Minimum Detect	N/A	Minimum Non-Detect	0.05
Maximum Detect	N/A	Maximum Non-Detect	0.05
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cobalt was not processed!

Lead

General Statistics

Total Number of Observations	15	Number of Missing Observations	0
Number of Distinct Observations	6		
Number of Detects	5	Number of Non-Detects	10
Number of Distinct Detects	4	Number of Distinct Non-Detects	4
Minimum Detect	0.003	Minimum Non-Detect	0.002
Maximum Detect	0.028	Maximum Non-Detect	0.01
Variance Detected	1.1570E-4	Percent Non-Detects	66.67%
Mean Detected	0.0152	SD Detected	0.0108
Mean of Detected Logged Data	-4.457	SD of Detected Logged Data	0.9

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.566	d2max (for USL)	2.409

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.885	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	0.00646	SD	0.00831
95% UTL95% Coverage	0.0278	95% KM UPL (t)	0.021
90% KM Percentile (z)	0.0171	95% KM Percentile (z)	0.020
99% KM Percentile (z)	0.0258	95% KM USL	0.0265

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.0067	SD	0.00855
95% UTL95% Coverage	0.0286	95% UPL (t)	0.0223
90% Percentile (z)	0.0177	95% Percentile (z)	0.0208
99% Percentile (z)	0.0266	95% USL	0.0273

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.367	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.684	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2	k star (bias corrected MLE)	0.933
Theta hat (MLE)	0.0076	Theta star (bias corrected MLE)	0.0163
nu hat (MLE)	20	nu star (bias corrected)	9.33
MLE Mean (bias corrected)	0.0152		
MLE Sd (bias corrected)	0.0157	95% Percentile of Chisquare (2k)	5.731

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.003	Mean	0.0117
Maximum	0.028	Median	0.01
SD	0.00628	CV	0.536
k hat (MLE)	4.69	k star (bias corrected MLE)	3.796
Theta hat (MLE)	0.0025	Theta star (bias corrected MLE)	0.00309
nu hat (MLE)	140.7	nu star (bias corrected)	113.9
MLE Mean (bias corrected)	0.0117	MLE Sd (bias corrected)	0.00602
95% Percentile of Chisquare (2k)	14.92	90% Percentile	0.0198
95% Percentile	0.0231	99% Percentile	0.03

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.031	0.0319	95% Approx. Gamma UPL	0.0237	0.02
95% Gamma USL	0.0294	0.0301			

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

k hat (KM)	0.603	nu hat (KM)	18.08

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.0324	0.0338	95% Approx. Gamma UPL	0.0205	0.0204
95% Gamma USL	0.0296	0.0305			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.00565	Mean in Log Scale	-6.352
SD in Original Scale	0.00906	SD in Log Scale	1.602
95% UTL95% Coverage	0.106	95% BCA UTL95% Coverage	0.028
95% Bootstrap (%) UTL95% Coverage	0.028	95% UPL (t)	0.0321
90% Percentile (z)	0.0136	95% Percentile (z)	0.0243
99% Percentile (z)	0.0724	95% USL	0.0826

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-5.606	95% KM UTL (Lognormal)95% Coverage	0.0411
KM SD of Logged Data	0.941	95% KM UPL (Lognormal)	0.0203
95% KM Percentile Lognormal (z)	0.0173	95% KM USL (Lognormal)	0.0354

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.0067	Mean in Log Scale	-5.585
SD in Original Scale	0.00855	SD in Log Scale	1.048
95% UTL95% Coverage	0.0553	95% UPL (t)	0.0253
90% Percentile (z)	0.0144	95% Percentile (z)	0.0211
99% Percentile (z)	0.043	95% USL	0.0469

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	15	95% UTL with95% Coverage	0.028
Approximate f	0.789	Confidence Coefficient (CC) achieved by UTL	0.537
95% UPL	0.028	95% USL	0.028
95% KM Chebyshev UPL	0.0439		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Mercury

General Statistics

Total Number of Observations	8	Number of Missing Observations	1
Number of Distinct Observations	2		
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	2
Minimum Detect	N/A	Minimum Non-Detect	2.0000E-[illegible]
Maximum Detect	N/A	Maximum Non-Detect	5.0000E-4
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Mercury was not processed!

Molybdenum

General Statistics

Total Number of Observations	8	Number of Missing Observations	1
Number of Distinct Observations	2		
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	2
Minimum Detect	N/A	Minimum Non-Detect	0.02
Maximum Detect	N/A	Maximum Non-Detect	0.05
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Molybdenum was not processed!

Nickel

General Statistics

Total Number of Observations	5	Number of Missing Observations	4
Number of Distinct Observations	2		
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	2
Minimum Detect	N/A	Minimum Non-Detect	0.02
Maximum Detect	N/A	Maximum Non-Detect	0.04
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Nickel was not processed!

Selenium

General Statistics

Total Number of Observations	8	Number of Missing Observations	1
Number of Distinct Observations	2		
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	2
Minimum Detect	N/A	Minimum Non-Detect	0.005
Maximum Detect	N/A	Maximum Non-Detect	0.02
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Selenium was not processed!

Silver

General Statistics

Total Number of Observations	8	Number of Missing Observations	1
Number of Distinct Observations	3		
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	3
Minimum Detect	N/A	Minimum Non-Detect	3.0000E-4
Maximum Detect	N/A	Maximum Non-Detect	0.01
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Silver was not processed!

	Background Statistics for Data Sets with Non-Detects	
User Selected Options		
Date/Time of Computation	6/10/2015 10:48:24 AM	
From File	Polished_data_file.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
Coverage	90%	
Different or Future K Observations	1	
Number of Bootstrap Operations	2000	

Copper

General Statistics			
Total Number of Observations	15	Number of Missing Observations	0
Number of Distinct Observations	7		
Number of Detects	4	Number of Non-Detects	11
Number of Distinct Detects	4	Number of Distinct Non-Detects	4
Minimum Detect	0.005	Minimum Non-Detect	0.005
Maximum Detect	0.15	Maximum Non-Detect	0.022
Variance Detected	0.00493	Percent Non-Detects	73.33%
Mean Detected	0.0448	SD Detected	0.0702
Mean of Detected Logged Data	-4.012	SD of Detected Logged Data	1.47

Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.068	d2max (for USL)	2.409

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.675	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.424	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution			
Mean	0.0157	SD	0.036
95% UTL90% Coverage	0.0901	95% KM UPL (t)	0.0811
90% KM Percentile (z)	0.0618	95% KM Percentile (z)	0.0749
99% KM Percentile (z)	0.0994	95% KM USL	0.102

DL/2 Substitution Background Statistics Assuming Normal Distribution			
Mean	0.015	SD	0.0375
95% UTL90% Coverage	0.0926	95% UPL (t)	0.0832
90% Percentile (z)	0.0631	95% Percentile (z)	0.0767
99% Percentile (z)	0.102	95% USL	0.105
DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons			

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.607	Anderson-Darling GOF Test
5% A-D Critical Value	0.674	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.408	Kolmogorov-Smirnoff GOF

	A	B	C	D	E	F	G	H	I	J	K	L
51					5% K-S Critical Value	0.407	Data Not Gamma Distributed at 5% Significance Level					
52	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
53												
54	Gamma Statistics on Detected Data Only											
55					k hat (MLE)	0.671					k star (bias corrected MLE)	0.33
56					Theta hat (MLE)	0.0666					Theta star (bias corrected MLE)	0.134
57					nu hat (MLE)	5.372					nu star (bias corrected)	2.676
58					MLE Mean (bias corrected)	0.0448						
59					MLE Sd (bias corrected)	0.0774					95% Percentile of Chisquare (2k)	2.954
60												
61	Gamma ROS Statistics using Imputed Non-Detects											
62	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
63	GROS may not be used when kstar of detected data is small such as < 0.1											
64	For such situations, GROS method tends to yield inflated values of UCLs and BTVs											
65	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
66					Minimum	0.005					Mean	0.0193
67					Maximum	0.15					Median	0.01
68					SD	0.0362					CV	1.879
69					k hat (MLE)	1.143					k star (bias corrected MLE)	0.959
70					Theta hat (MLE)	0.0169					Theta star (bias corrected MLE)	0.0201
71					nu hat (MLE)	34.28					nu star (bias corrected)	28.76
72					MLE Mean (bias corrected)	0.0193					MLE Sd (bias corrected)	0.0197
73					95% Percentile of Chisquare (2k)	5.83					90% Percentile	0.0448
74					95% Percentile	0.0586					99% Percentile	0.0906
75	The following statistics are computed using Gamma ROS Statistics on Imputed Data											
76	Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods											
77					WH	HW					WH	HW
78				95% Approx. Gamma UTL with 90% Coverage	0.0673	0.0636				95% Approx. Gamma UPL	0.0576	0.054
79				95% Gamma USL	0.0824	0.0788						
80												
81	The following statistics are computed using gamma distribution and KM estimates											
82	Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods											
83					k hat (KM)	0.19					nu hat (KM)	5.69
84					WH	HW					WH	HW
85				95% Approx. Gamma UTL with 90% Coverage	0.0704	0.0661				95% Approx. Gamma UPL	0.0494	0.0454
86				95% Gamma USL	0.0741	0.0699						
87												
88	Lognormal GOF Test on Detected Observations Only											
89					Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test					
90					5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level					
91					Lilliefors Test Statistic	0.339	Lilliefors GOF Test					
92					5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level					
93	Detected Data appear Lognormal at 5% Significance Level											
94												
95	Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects											
96					Mean in Original Scale	0.0124					Mean in Log Scale	-6.96
97					SD in Original Scale	0.0383					SD in Log Scale	2.253
98					95% UTL90% Coverage	0.0994					95% BCA UTL90% Coverage	0.15
99					95% Bootstrap (%) UTL90% Coverage	0.15					95% UPL (t)	0.0567
100					90% Percentile (z)	0.0169					95% Percentile (z)	0.0383

99% Percentile (z)	0.178	95% USL	0.214

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-4.946	95% KM UTL (Lognormal)90% Coverage	0.043
KM SD of Logged Data	0.87	95% KM UPL (Lognormal)	0.0346
95% KM Percentile Lognormal (z)	0.0298	95% KM USL (Lognormal)	0.0579

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.015	Mean in Log Scale	-5.162
SD in Original Scale	0.0375	SD in Log Scale	1.056
95% UTL90% Coverage	0.0509	95% UPL (t)	0.0391
90% Percentile (z)	0.0222	95% Percentile (z)	0.0326
99% Percentile (z)	0.0669	95% USL	0.073

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	15	95% UTL with90% Coverage	0.15
Approximate f	1.667	Confidence Coefficient (CC) achieved by UTL	0.794
95% UPL	0.15	95% USL	0.15
95% KM Chebyshev UPL	0.178		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Iron

General Statistics

Total Number of Observations	15	Number of Missing Observations	0
Number of Distinct Observations	14		
Number of Detects	14	Number of Non-Detects	1
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	0.092	Minimum Non-Detect	0.18
Maximum Detect	3.155	Maximum Non-Detect	0.18
Variance Detected	0.785	Percent Non-Detects	6.667%
Mean Detected	0.605	SD Detected	0.886
Mean of Detected Logged Data	-1.208	SD of Detected Logged Data	1.125

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.068	d2max (for USL)	2.409

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.633	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.355	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level					
Kaplan Meier (KM) Background Statistics Assuming Normal Distribution					
Mean	0.573		SD	0.834	
95% UTL90% Coverage	2.297		95% KM UPL (t)	2.09	
90% KM Percentile (z)	1.642		95% KM Percentile (z)	1.944	
99% KM Percentile (z)	2.513		95% KM USL	2.581	
DL/2 Substitution Background Statistics Assuming Normal Distribution					
Mean	0.571		SD	0.864	
95% UTL90% Coverage	2.358		95% UPL (t)	2.143	
90% Percentile (z)	1.678		95% Percentile (z)	1.992	
99% Percentile (z)	2.581		95% USL	2.653	
DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons					
Gamma GOF Tests on Detected Observations Only					
A-D Test Statistic	1.309		**Anderson-Darling GOF Test**		
5% A-D Critical Value	0.767		Data Not Gamma Distributed at 5% Significance Level		
K-S Test Statistic	0.245		**Kolmogrov-Smirnoff GOF**		
5% K-S Critical Value	0.237		Data Not Gamma Distributed at 5% Significance Level		
Data Not Gamma Distributed at 5% Significance Level					
Gamma Statistics on Detected Data Only					
k hat (MLE)	0.836		k star (bias corrected MLE)	0.705	
Theta hat (MLE)	0.724		Theta star (bias corrected MLE)	0.859	
nu hat (MLE)	23.41		nu star (bias corrected)	19.73	
MLE Mean (bias corrected)	0.605				
MLE Sd (bias corrected)	0.721		95% Percentile of Chisquare (2k)	4.785	
Gamma ROS Statistics using Imputed Non-Detects					
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs					
GROS may not be used when kstar of detected data is small such as < 0.1					
For such situations, GROS method tends to yield inflated values of UCLs and BTVs					
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates					
Minimum	0.01		Mean	0.566	
Maximum	3.155		Median	0.18	
SD	0.868		CV	1.534	
k hat (MLE)	0.699		k star (bias corrected MLE)	0.604	
Theta hat (MLE)	0.809		Theta star (bias corrected MLE)	0.937	
nu hat (MLE)	20.98		nu star (bias corrected)	18.11	
MLE Mean (bias corrected)	0.566		MLE Sd (bias corrected)	0.728	
95% Percentile of Chisquare (2k)	4.336		90% Percentile	1.469	
95% Percentile	2.03		99% Percentile	3.388	
The following statistics are computed using Gamma ROS Statistics on Imputed Data					
Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods					
	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	2.55	2.7	95% Approx. Gamma UPL	2.118	2.19
95% Gamma USL	3.232	3.536			
The following statistics are computed using gamma distribution and KM estimates					

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

k hat (KM)	0.473		nu hat (KM)	14.19	
	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	2.727	2.823	95% Approx. Gamma UPL	1.931	1.928
95% Gamma USL	2.869	2.988			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.573	Mean in Log Scale	-1.269
SD in Original Scale	0.863	SD in Log Scale	1.109
95% UTL90% Coverage	2.787	95% BCA UTL90% Coverage	3.155
95% Bootstrap (%) UTL90% Coverage	3.155	95% UPL (t)	2.115
90% Percentile (z)	1.165	95% Percentile (z)	1.743
99% Percentile (z)	3.712	95% USL	4.069

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-1.267	95% KM UTL (Lognormal)90% Coverage	2.583
KM SD of Logged Data	1.072	95% KM UPL (Lognormal)	1.978
95% KM Percentile Lognormal (z)	1.642	95% KM USL (Lognormal)	3.723

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.571	Mean in Log Scale	-1.288
SD in Original Scale	0.864	SD in Log Scale	1.127
95% UTL90% Coverage	2.839	95% UPL (t)	2.144
90% Percentile (z)	1.17	95% Percentile (z)	1.762
99% Percentile (z)	3.799	95% USL	4.17

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	15	95% UTL with90% Coverage	3.155
Approximate f	1.667	Confidence Coefficient (CC) achieved by UTL	0.794
95% UPL	3.155	95% USL	3.155
95% KM Chebyshev UPL	4.326		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Zinc

	A–E	F	G–K	L
251	General Statistics			
252	Total Number of Observations	15	Number of Missing Observations	0
253	Number of Distinct Observations	11		
254	Number of Detects	7	Number of Non-Detects	8
255	Number of Distinct Detects	6	Number of Distinct Non-Detects	5
256	Minimum Detect	0.0091	Minimum Non-Detect	0.008
257	Maximum Detect	0.584	Maximum Non-Detect	0.02
258	Variance Detected	0.0454	Percent Non-Detects	53.33%
259	Mean Detected	0.102	SD Detected	0.213
260	Mean of Detected Logged Data	-3.542	SD of Detected Logged Data	1.478
261				
262	Critical Values for Background Threshold Values (BTVs)			
263	Tolerance Factor K (For UTL)	2.068	d2max (for USL)	2.409
264				
265	Normal GOF Test on Detects Only			
266	Shapiro Wilk Test Statistic	0.511	Shapiro Wilk GOF Test	
267	5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
268	Lilliefors Test Statistic	0.463	Lilliefors GOF Test	
269	5% Lilliefors Critical Value	0.335	Data Not Normal at 5% Significance Level	
270	Data Not Normal at 5% Significance Level			
271				
272	Kaplan Meier (KM) Background Statistics Assuming Normal Distribution			
273	Mean	0.0523	SD	0.143
274	95% UTL90% Coverage	0.347	95% KM UPL (t)	0.312
275	90% KM Percentile (z)	0.235	95% KM Percentile (z)	0.287
276	99% KM Percentile (z)	0.384	95% KM USL	0.396
277				
278	DL/2 Substitution Background Statistics Assuming Normal Distribution			
279	Mean	0.0509	SD	0.148
280	95% UTL90% Coverage	0.357	95% UPL (t)	0.32
281	90% Percentile (z)	0.241	95% Percentile (z)	0.294
282	99% Percentile (z)	0.395	95% USL	0.408
283	DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons			
284				
285	Gamma GOF Tests on Detected Observations Only			
286	A-D Test Statistic	1.125	Anderson-Darling GOF Test	
287	5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
288	K-S Test Statistic	0.365	Kolmogrov-Smirnoff GOF	
289	5% K-S Critical Value	0.327	Data Not Gamma Distributed at 5% Significance Level	
290	Data Not Gamma Distributed at 5% Significance Level			
291				
292	Gamma Statistics on Detected Data Only			
293	k hat (MLE)	0.503	k star (bias corrected MLE)	0.382
294	Theta hat (MLE)	0.204	Theta star (bias corrected MLE)	0.267
295	nu hat (MLE)	7.037	nu star (bias corrected)	5.355
296	MLE Mean (bias corrected)	0.102		
297	MLE Sd (bias corrected)	0.165	95% Percentile of Chisquare (2k)	3.228
298				
299	Gamma ROS Statistics using Imputed Non-Detects			
300	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0091	Mean	0.0531
Maximum	0.584	Median	0.01
SD	0.147	CV	2.776
k hat (MLE)	0.536	k star (bias corrected MLE)	0.473
Theta hat (MLE)	0.0991	Theta star (bias corrected MLE)	0.112
nu hat (MLE)	16.07	nu star (bias corrected)	14.19
MLE Mean (bias corrected)	0.0531	MLE Sd (bias corrected)	0.0772
95% Percentile of Chisquare (2k)	3.707	90% Percentile	0.145
95% Percentile	0.208	99% Percentile	0.363

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	0.229	0.211	95% Approx. Gamma UPL	0.186	0.169
95% Gamma USL	0.296	0.28			

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

k hat (KM)	0.135		nu hat (KM)	4.037	
	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	0.263	0.247	95% Approx. Gamma UPL	0.176	0.158
95% Gamma USL	0.279	0.263			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.0488	Mean in Log Scale	-5.116
SD in Original Scale	0.149	SD in Log Scale	1.895
95% UTL90% Coverage	0.302	95% BCA UTL90% Coverage	0.584
95% Bootstrap (%) UTL90% Coverage	0.584	95% UPL (t)	0.188
90% Percentile (z)	0.068	95% Percentile (z)	0.135
99% Percentile (z)	0.493	95% USL	0.576

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-4.197	95% KM UTL (Lognormal)90% Coverage	0.153
KM SD of Logged Data	1.121	95% KM UPL (Lognormal)	0.116
95% KM Percentile Lognormal (z)	0.0951	95% KM USL (Lognormal)	0.224

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.0509	Mean in Log Scale	-4.426
SD in Original Scale	0.148	SD in Log Scale	1.317
95% UTL90% Coverage	0.182	95% UPL (t)	0.131
90% Percentile (z)	0.0647	95% Percentile (z)	0.104

	A B C D E	F	G H I J K	L
351	99% Percentile (z)	0.256	95% USL	0.285
352	DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.			
353				
354	**Nonparametric Distribution Free Background Statistics**			
355	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
356				
357	**Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)**			
358	Order of Statistic, r	15	95% UTL with90% Coverage	0.584
359	Approximate f	1.667	Confidence Coefficient (CC) achieved by UTL	0.794
360	95% UPL	0.584	95% USL	0.584
361	95% KM Chebyshev UPL	0.694		
362				
363	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			
364	data set free of outliers and consists of observations collected from clean unimpacted locations.			
365	The use of USL tends to provide a balance between false positives and false negatives provided the data			
366	represents a background data set and when many onsite observations need to be compared with the BTV.			
367				
368	**Manganese**			
369				
370	**General Statistics**			
371	Total Number of Observations	15	Number of Missing Observations	0
372	Number of Distinct Observations	10		
373	Number of Detects	8	Number of Non-Detects	7
374	Number of Distinct Detects	8	Number of Distinct Non-Detects	3
375	Minimum Detect	0.01	Minimum Non-Detect	0.008
376	Maximum Detect	0.509	Maximum Non-Detect	0.015
377	Variance Detected	0.0295	Percent Non-Detects	46.67%
378	Mean Detected	0.113	SD Detected	0.172
379	Mean of Detected Logged Data	-3.083	SD of Detected Logged Data	1.421
380				
381	**Critical Values for Background Threshold Values (BTVs)**			
382	Tolerance Factor K (For UTL)	2.068	d2max (for USL)	2.409
383				
384	**Normal GOF Test on Detects Only**			
385	Shapiro Wilk Test Statistic	0.68	**Shapiro Wilk GOF Test**	
386	5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level	
387	Lilliefors Test Statistic	0.284	**Lilliefors GOF Test**	
388	5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level	
389	**Detected Data appear Approximate Normal at 5% Significance Level**			
390				
391	**Kaplan Meier (KM) Background Statistics Assuming Normal Distribution**			
392	Mean	0.0642	SD	0.129
393	95% UTL90% Coverage	0.33	95% KM UPL (t)	0.298
394	90% KM Percentile (z)	0.229	95% KM Percentile (z)	0.276
395	99% KM Percentile (z)	0.363	95% KM USL	0.374
396				
397	**DL/2 Substitution Background Statistics Assuming Normal Distribution**			
398	Mean	0.0628	SD	0.134
399	95% UTL90% Coverage	0.339	95% UPL (t)	0.306
400	90% Percentile (z)	0.234	95% Percentile (z)	0.283

99% Percentile (z)	0.374	95% USL	0.385

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.522	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.306	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.671	k star (bias corrected MLE)	0.503
Theta hat (MLE)	0.169	Theta star (bias corrected MLE)	0.226
nu hat (MLE)	10.74	nu star (bias corrected)	8.043
MLE Mean (bias corrected)	0.113		
MLE Sd (bias corrected)	0.16	95% Percentile of Chisquare (2k)	3.855

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0651
Maximum	0.509	Median	0.01
SD	0.133	CV	2.037
k hat (MLE)	0.584	k star (bias corrected MLE)	0.512
Theta hat (MLE)	0.112	Theta star (bias corrected MLE)	0.127
nu hat (MLE)	17.52	nu star (bias corrected)	15.35
MLE Mean (bias corrected)	0.0651	MLE Sd (bias corrected)	0.0911
95% Percentile of Chisquare (2k)	3.899	90% Percentile	0.175
95% Percentile	0.248	99% Percentile	0.427

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	0.3	0.299	95% Approx. Gamma UPL	0.246	0.24
95% Gamma USL	0.386	0.398			

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

k hat (KM)	0.25		nu hat (KM)	7.489	
	WH	HW		WH	HW
95% Approx. Gamma UTL with 90% Coverage	0.348	0.356	95% Approx. Gamma UPL	0.234	0.228
95% Gamma USL	0.369	0.38			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.92	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.0611	Mean in Log Scale	-4.856
SD in Original Scale	0.135	SD in Log Scale	2.28
95% UTL90% Coverage	0.868	95% BCA UTL90% Coverage	0.509
95% Bootstrap (%) UTL90% Coverage	0.509	95% UPL (t)	0.492
90% Percentile (z)	0.145	95% Percentile (z)	0.331
99% Percentile (z)	1.565	95% USL	1.89

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-3.893	95% KM UTL (Lognormal)90% Coverage	0.3
KM SD of Logged Data	1.301	95% KM UPL (Lognormal)	0.217
95% KM Percentile Lognormal (z)	0.173	95% KM USL (Lognormal)	0.468

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.0628	Mean in Log Scale	-4.134
SD in Original Scale	0.134	SD in Log Scale	1.544
95% UTL90% Coverage	0.39	95% UPL (t)	0.266
90% Percentile (z)	0.116	95% Percentile (z)	0.203
99% Percentile (z)	0.581	95% USL	0.661

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	15	95% UTL with90% Coverage	0.509
Approximate f	1.667	Confidence Coefficient (CC) achieved by UTL	0.794
95% UPL	0.509	95% USL	0.509
95% KM Chebyshev UPL	0.643		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

	Site_Code	Sample_Date	pH (LAB)	Aluminum	D_Aluminur	Arsenic	D_Arsenic	Barium	D_Barium	Cadmium	D_Cadmiun
2	BRSW-14	8/12/1991 12:00 AM	7.4	0.2	0	0.02	0			0.008	0
3	BRSW-14	9/12/1991 12:00 AM	7.5	0.27	1	0.02	0			0.008	0
4	BRSW-14	11/12/1991 12:00 AM	7.7	0.2	0	0.02	0			0.008	0
5	BRSW-14	4/15/1992 12:00 AM	7.8	0.2	0	0.008	0	0.2	0	0.005	0
6	BRSW-14	5/4/1992 12:00 AM	7.6	0.2	0	0.008	0	0.2	0	0.005	0
7	BRSW-14	5/18/1992 12:00 AM	7.8	0.2	0	0.008	0	0.2	0	0.005	0
8	BRSW-14	6/2/1992 12:00 AM	7.8	0.2	0	0.008	0	0.2	0	0.005	0
9	BRSW-14	6/2/1993 12:00 AM	6.5	0.254	1					0.005	1
10	BRSW-14	10/27/1993 12:00 AM	7.7	0.1	0	0.003	0	0.2	0	0.001	0
11	BRSW-14	5/17/1994 12:00 AM	7.6	0.17	0					0.001	0
12	BRSW-14	10/25/1994 12:00 AM	7.5	0.051	1	0.002	0			0.001	0
13	BRSW-14	5/2/1995 12:00 AM	7.7	0.051	1	0.002	0			0.001	0
14	BRSW-14	10/23/1995 12:00 AM	7.9	0.05	0	0.002	0			0.001	0
15	BRSW-14	5/20/1996 12:00 AM	7.8	0.05	0	0.002	0			0.001	0
16	BRSW-14	10/22/1996 12:00 AM	7.6	0.05	0	0.002	0			0.001	0

	L	M	N	O	P	Q	R	S	T	U	V	W
1	Chromium	D_Chromiur	Cobalt	D_Cobalt	Copper	D_Copper	Iron	D_Iron	Lead	D_Lead	Manganese	D_Mangane
2					0.011	1	0.35	1	0.01	0	0.021	1
3					0.022	0	1.7	1	0.025	1	0.099	1
4					0.008	0	0.21	1	0.01	0	0.01	[illegible]
5	0.01	0	0.05	0	0.008	0	0.134	1	0.005	0	0.008	[illegible]
6	0.01	0	0.05	0	0.008	0	0.125	1	0.005	0	0.008	0
7	0.01	0	0.05	0	0.008	0	0.451	1	0.01	1	0.043	1
8	0.01	0	0.05	0	0.008	0	0.092	1	0.005	0	0.008	0
9					0.15	1	3.155	1	0.028	1	0.509	1
10	0.01	0	0.05	0	0.01	0	0.159	1	0.003	0	0.015	0
11					0.005	1	0.18	0	0.002	0	0.011	1
12					0.013	1	1.381	1	0.01	1	0.194	1
13					0.005	0	0.29	1	0.003	0	0.01	0
14					0.005	0	0.096	1	0.003	1	0.01	0
15					0.005	0	0.18	1	0.003	0	0.01	0
16					0.005	0	0.15	1	0.003	0	0.02	1

	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	Mercury	D_Mercury	Molybdenun	D_Molybde	Nickel	D_Nickel	Selenium	D_Seleniun	Silver	D_Silver	Zinc	D_Zinc
2	0.0005	0	0.02	0			0.02	0	0.008	0	0.018	0
3	0.0005	0	0.02	0			0.02	0	0.008	0	0.008	0
4	0.0005	0	0.02	0			0.02	0	0.008	0	0.014	1
5	0.0005	0	0.05	0	0.02	0	0.005	0	0.01	0	0.008	0
6	0.0005	0	0.05	0	0.02	0	0.005	0	0.01	0	0.0091	1
7	0.0005	0	0.05	0	0.02	0	0.005	0	0.01	0	0.045	1
8	0.0005	0	0.05	0	0.02	0	0.005	0	0.01	0	0.008	0
9											0.584	1
10	0.0002	0	0.05	0	0.04	0	0.005	0	0.0003	0	0.02	0
11											0.011	1
12											0.042	1
13											0.011	1
14											0.012	0
15											0.01	0
16											0.01	0

PRO UCL ARSENIC AND LEAD FOR EDITH MINE WASTE AREA SOILS

Section D2

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/14/2015 10:58:35 AM
From File	UBMC2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	54	Number of Distinct Observations	20
Number of Detects	34	Number of Non-Detects	20
Number of Distinct Detects	18	Number of Distinct Non-Detects	8
Minimum Detect	8	Minimum Non-Detect	7
Maximum Detect	85	Maximum Non-Detect	18
Variance Detects	163.6	Percent Non-Detects	37.04%
Mean Detects	19.32	SD Detects	12.79
Median Detects	17.5	CV Detects	0.662
Skewness Detects	4.302	Kurtosis Detects	22.07
Mean of Logged Detects	2.852	SD of Logged Detects	0.423

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.562	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	15.68	Standard Error of Mean	1.563
SD	11.18	95% KM (BCA) UCL	18.47
95% KM (t) UCL	18.29	95% KM (Percentile Bootstrap) UCL	18.67
95% KM (z) UCL	18.25	95% KM Bootstrap t UCL	19.92
90% KM Chebyshev UCL	20.37	95% KM Chebyshev UCL	22.49
97.5% KM Chebyshev UCL	25.44	99% KM Chebyshev UCL	31.23

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.352	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.174	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.151	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.73	k star (bias corrected MLE)	4.333
Theta hat (MLE)	4.085	Theta star (bias corrected MLE)	4.46
nu hat (MLE)	321.7	nu star (bias corrected)	294.6
MLE Mean (bias corrected)	19.32	MLE Sd (bias corrected)	9.283

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.966	nu hat (KM)	212.3
Approximate Chi Square Value (212.32, α)	179.6	Adjusted Chi Square Value (212.32, β)	178.8
95% Gamma Approximate KM-UCL (use when n>=50)	18.53	95% Gamma Adjusted KM-UCL (use when n<50)	18.62

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	13.98
Maximum	85	Median	12
SD	12.52	CV	0.895
k hat (MLE)	1.001	k star (bias corrected MLE)	0.958
Theta hat (MLE)	13.97	Theta star (bias corrected MLE)	14.6
nu hat (MLE)	108.1	nu star (bias corrected)	103.4
MLE Mean (bias corrected)	13.98	MLE Sd (bias corrected)	14.28
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (103.43, α)	80.97	Adjusted Chi Square Value (103.43, β)	80.42
95% Gamma Approximate UCL (use when n>=50)	17.86	95% Gamma Adjusted UCL (use when n<50)	17.98

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.132	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15.47	Mean in Log Scale	2.595
SD in Original Scale	11.37	SD in Log Scale	0.499
95% t UCL (assumes normality of ROS data)	18.06	95% Percentile Bootstrap UCL	18.21
95% BCA Bootstrap UCL	19.18	95% Bootstrap t UCL	19.81
95% H-UCL (Log ROS)	17.26		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.616	95% H-UCL (KM -Log)	17.34
KM SD (logged)	0.478	95% Critical H Value (KM-Log)	1.871
KM Standard Error of Mean (logged)	0.0709		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	14.67	Mean in Log Scale	2.49
SD in Original Scale	11.85	SD in Log Scale	0.606
95% t UCL (Assumes normality)	17.37	95% H-Stat UCL	17.06

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
101												
102	Suggested UCL to Use											
103					95% KM (BCA) UCL	18.47						
104												
105	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
106	Recommendations are based upon data size, data distribution, and skewness.											
107	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
108	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
109												

CEA1-3-COMP 3 (0-6")	85	
CEA1-3-400 (0-6")	28	
WEA1-400 (0-6")	28	
CEA1-3-00 (0-6")	28	
CEA1-3-350 (0-6")	26	
CEA1-3-COMP 1 (0-6")	25	
CEA1-3-COMP 2 (0-6")	22	
CEA1-3-850 (0-6")	21	
WEA1-350 (0-6")	20	
CEA1-3-250 (0-6")	20	
WEA1-300 (0-6")	20	
WEA1-250 (0-6")	19	
CEA1-3-550 (0-6")	19	
CEA1-3-200 (0-6")	19	
WEA1-00 (0-6")	19	
EEA2-50 (0-6")	18	U
CEA1-3-50 (0-6")	18	
EEA2-300 (0-6")	18	
CEA1-3-750 (0-6")	17	U
CEA1-3-100 (0-6")	17	
WEA1-150 (0-6")	17	
EEA1-400 (0-6")	17	U
EEA1-500 (0-6")	17	U
CEA1-3-650 (0-6")	16	
WEA1-450 (0-6")	16	U
CEA1-3-150 (0-6")	16	U
EEA1-50 (0-6")	15	
EEA1-450 (0-6")	15	U
CEA1-3-800 (0-6")	15	U
WEA1-COMP 1 (0-6")	15	
WEA1-200 (0-6")	15	U
WEA1-COMP 2 (0-6")	14	U
EEA1-350 (0-6")	14	
CEA1-3-700 (0-6")	14	U
WEA1-500 (0-6")	14	U
EEA2-COMP 1 (0-6")	14	
CEA1-3-300 (0-6")	14	
WEA1-550 (0-6")	14	U
EEA2-200 (0-6")	13	JM74
CEA1-3-600 (0-6")	12	
EEA2-100 (0-6")	12	U
EEA1-00 (0-6")	12	
EEA1-300 (0-6")	12	
WEA1-100 (0-6")	12	U
CEA1-3-450 (0-6")	12	U
EEA2-150 (0-6")	11	JM74
EEA1-150 (0-6")	11	

CEA1-3-500 (0-6")	11	
EEA1-250 (0-6")	10	
EEA1-100 (0-6")	9	U
EEA1-COMP 1 (0-6")	9	U
EEA2-250 (0-6")	8	
EEA2-00 (0-6")	7	U
EEA1-200 (0-6")	7	U

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/14/2015 12:10:29 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	54	Number of Distinct Observations	52
		Number of Missing Observations	0
Minimum	21	Mean	139.9
Maximum	1380	Median	101.5
SD	183.8	Std. Error of Mean	25.01
Coefficient of Variation	1.314	Skewness	6.019

Normal GOF Test

Shapiro Wilk Test Statistic	0.427	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	181.8	95% Adjusted-CLT UCL (Chen-1995)	202.9
		95% Modified-t UCL (Johnson-1978)	185.2

Gamma GOF Test

A-D Test Statistic	2.128	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.123	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.817	k star (bias corrected MLE)	1.729
Theta hat (MLE)	76.99	Theta star (bias corrected MLE)	80.93
nu hat (MLE)	196.3	nu star (bias corrected)	186.7
MLE Mean (bias corrected)	139.9	MLE Sd (bias corrected)	106.4
		Approximate Chi Square Value (0.05)	156.1
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	155.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	167.3	95% Adjusted Gamma UCL (use when n<50)	168.2

	A–E	F	G–K	L
51	Lognormal GOF Test			
52	Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
53	5% Shapiro Wilk P Value	0.00993	Data Not Lognormal at 5% Significance Level	
54	Lilliefors Test Statistic	0.157	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level	
56	**Data Not Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	3.045	Mean of logged Data	4.641
60	Maximum of Logged Data	7.23	SD of logged Data	0.709
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	162.5	90% Chebyshev (MVUE) UCL	174.6
64	95% Chebyshev (MVUE) UCL	193.7	97.5% Chebyshev (MVUE) UCL	220.1
65	99% Chebyshev (MVUE) UCL	272.1		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data do not follow a Discernible Distribution (0.05)**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	181	95% Jackknife UCL	181.8
72	95% Standard Bootstrap UCL	180.7	95% Bootstrap-t UCL	248.3
73	95% Hall's Bootstrap UCL	345.4	95% Percentile Bootstrap UCL	183.9
74	95% BCA Bootstrap UCL	222.3		
75	90% Chebyshev(Mean, Sd) UCL	214.9	95% Chebyshev(Mean, Sd) UCL	248.9
76	97.5% Chebyshev(Mean, Sd) UCL	296.1	99% Chebyshev(Mean, Sd) UCL	388.7
77				
78	**Suggested UCL to Use**			
79	95% Chebyshev (Mean, Sd) UCL	248.9		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
84	For additional insight the user may want to consult a statistician.			
85				

A1-3-COMP 3 (0	1380	
CEA1-3-400 (0-6"	324	
A1-3-COMP 1 (0	284	
WEA1-00 (0-6")	246	
WEA1-400 (0-6"	242	
CEA1-3-850 (0-6"	224	
EEA2-50 (0-6")	213	
CEA1-3-750 (0-6"	202	
A1-3-COMP 2 (0	198	
EEA1-400 (0-6")	164	
WEA1-450 (0-6"	158	
CEA1-3-150 (0-6"	153	
EEA1-500 (0-6")	150	
WEA1-350 (0-6"	143	
CEA1-3-800 (0-6"	136	
CEA1-3-250 (0-6"	135	
EEA1-450 (0-6")	132	
WEA1-500 (0-6"	123	
CEA1-3-700 (0-6"	122	
CEA1-3-00 (0-6"	121	
WEA1-550 (0-6"	121	
EEA2-200 (0-6")	120	JM10
EA1-COMP 2 (0-	117	
EEA2-300 (0-6")	116	
WEA1-200 (0-6"	114	
CEA1-3-100 (0-6"	110	
WEA1-150 (0-6"	102	
CEA1-3-200 (0-6"	101	
WEA1-250 (0-6"	99	
EA1-COMP 1 (0-	98	
WEA1-300 (0-6"	97	
CEA1-3-550 (0-6"	96	
EA2-COMP 1 (0-	95	
CEA1-3-50 (0-6"	94	
EEA2-100 (0-6")	91	
WEA1-100 (0-6"	90	
CEA1-3-450 (0-6"	87	
EEA1-350 (0-6")	86	
CEA1-3-350 (0-6"	83	
CEA1-3-300 (0-6"	82	
EEA1-50 (0-6")	78	
CEA1-3-600 (0-6"	77	
EEA1-00 (0-6")	77	
EEA2-150 (0-6")	76	JM10
CEA1-3-650 (0-6"	75	
CEA1-3-500 (0-6"	64	
EEA1-300 (0-6")	54	

EA1-COMP 1 (0-	36	
EEA1-100 (0-6")	35	
EEA1-250 (0-6")	31	
EEA2-250 (0-6")	29	
EEA1-200 (0-6")	27	
EEA2-00 (0-6")	26	
EEA1-150 (0-6")	21	

APPENDIX E. MINING-RELATED FEATURE

AC = Anaconda Creek BR = Blackfoot River PC = Pass Creek PM = Paymaster Gulch JM = Jumbo Mine/Paymaster
PBBS = Porcupine Gulch SH = Shave Gulch SG = Stevens Gulch SWG = Swamp Gulch

SITE ID	SITE TYPE	ESTIMATED VOLUME OF WASTE MATERIAL (cy)	WATER OBSERVED	DISTANCE TO NEAREST OBSERVED SURFACE WATER (ft)	PROXIMITY TO EXISTING ACCESS[1]	SAMPLE COLLECTED[2] OBSERVED WATER	SAMPLE COLLECTED[2] SEDIMENT	SAMPLE COLLECTED[2] WASTE AREA	RI COMMENTS/NOTES/HAZARDS	FS EVALUATION NOTES
BR-14	Collapsed adit with waste rock, and discharge, seep, or spring	2,000	X (discharge or seep)	--	Moderate	--	--	--	Collapsed adit with leaking water that is pooled near entrance supporting vegetation. Collapsed tipple and woody debris is present. Mined rock difficult to distinguish from road fill slope and has been graded for structure footings. Adit seepage may be of poor quality for wildlife use.	Located along a reclaimed old road grade approximately 900 ft upgradient from floodplain. Very steep slopes and may require reopening the road and removing some vegetation. Located in a highly mineralized geology zone. A surface water feature was not observed at the time of the inventory. Interaction of the adit seep with surface water was not observed.
BR-29	Collapsed adit with waste rock	280	--	--	Difficult	--	--	--	Collapsed adit and rock pile located in center of gully that may be a seasonal drainage (dry at time of visit). Some potential for impact to surface water during flooding or high run-off events.	Located approximately 350 ft uphill from Mary P Mine in heavy timber on steep slopes, in highly mineralized area. No photos. Unable to verify water; seasonal runoff channel. No proximity to existing roads making access difficult.
BR-39	Collapsed adit with waste rock	32	X (Unnamed tributary to Blackfoot River)	5	Moderate	**BTSW-101 (SW) Chronic: Cd, Zn Acute: Zn**	--	**BTWA-101 (0-6) (As, Pb, Mn, Zn)**	Caved adit and waste pile along edge of unnamed creek. No impacts to vegetation were observed and bushes grew from rock pile.	Located approximately 700 ft uphill from WTP, may be accessible by old road grade. Very steep slopes and may require reopening the road and removing some vegetation. Located in a highly mineralized geology zone. Surface water sample collected from unnamed tributary to Blackfoot River.
PC-01	Physical hazard - open adit (well)	--	X (well)	--	Difficult	PCSW-102 (GW) PCSW-103 (SW) PCSW-104 (SW)	PCSE-103 (0-2) PCSE-104 (0-2)	PCWA-102 (0-6)	Collapsed adit with timber and associated rock pile. A shallow, square, timber-framed "shaft" is nearby with dimensions 5x5x2 ft (possible drinking water well), filled with water.	Located approximately 500 ft east of highway on a steep forested slope. Sediment and surface water samples PCSW-103/104 are located upstream and downstream of the site. Water sample PCSW-102 was collected from an adit seep.
PC-06	Collapsed adit with waste rock	1,700	--	--	Difficult	--	--	--	Collapsed adit portal with large non-vegetated mined rock dump and scattered timbers and metal debris. Mined rock appears phytotoxic and may present metal mobility hazard.	Located approximately 1 mile up Pass Creek Road on a steep heavily timbered slope. May be accessible through old road grades but is in a remote location.
PM-04	Disturbed area	106	--	--	Moderate	--	--	--	Exploratory pit. Possible tailings and metal mobility or phytotoxicity from rock pile.	Located 200 ft south of upper edge of Paymaster Repository road and 450 ft upgradient from Paymaster Creek. Disturbed area with no other signs of mining activities and no roads to the site. Moderate slope above the repository would make access possible, but would need to construct an access road.
PM-06	Disturbed area	423	--	--	Difficult	--	--	--	Two trenches located near digout. Possible tailings. Possible metal mobility or phytotoxicity from rock pile.	Located 500 ft south of upper edge of Paymaster Repository road and 400 ft upslope from Paymaster Creek, on a steep slope with heavy timber not close to any existing roads for easy accessibility. A disturbed area with no other signs of mining activities and no roads to the site.

AC = Anaconda Creek BR = Blackfoot River PC = Pass Creek PM = Paymaster Gulch JM = Jumbo Mine/Paymaster
PBBS = Porcupine Gulch SH = Shave Gulch SG = Stevens Gulch SWG = Swamp Gulch

SITE ID	SITE TYPE	ESTIMATED VOLUME OF WASTE MATERIAL (cy)	WATER OBSERVED	DISTANCE TO NEAREST OBSERVED SURFACE WATER (ft)	PROXIMITY TO EXISTING ACCESS[1]	SAMPLE COLLECTED[2] OBSERVED WATER	SAMPLE COLLECTED[2] SEDIMENT	SAMPLE COLLECTED[2] WASTE AREA	RI COMMENTS/NOTES/HAZARDS	FS EVALUATION NOTES
JM-01	Disturbed area	542	--	--	Difficult	--	--	--	Adit trench and waste pile onsite. Possible metal mobility or phytotoxicity from rock pile.	Located 0.2 miles from Paymaster wetland cells on forested slopes, may be accessible by reclaimed old road grade. Would require reopening the road and removing over 40 years of tree and shrub growth.
SH-13	Collapsed adit with waste rock	5,600	--	--	Moderate	--	--	--	Little to no vegetation on mined rock or near toe. Faint sulfur smell was detected. Possible metal mobility and acid generation from mined rock. Rock is impacting vegetation.	Located 0.75 miles up Pass Creek Shave Gulch ridgeline road, 90 ft downslope from old road grade, 0.2 miles upgradient from Shave Creek. Slope is steep, with heavy timber, and no maintained roads. Area surrounding the site is vegetated with trees and shrubs.
SH-14	Collapsed adit with waste rock	8,000	--	--	Difficult	--	--	--	Very large mined rock dump and possibly three collapsed adits. Two collapsed wooden structures. Sulfur smell and impacted vegetation extending 75 ft below rock pile. Erosion channel cut into ground below rock pile but area is far from surface water. Possible metal mobility and acid generation from mined rock. Rock is impacting vegetation.	Located 1 mile from Mike Horse Mine Road along Pass Creek Shave Gulch ridgeline unmaintained road and 0.25 miles from nearest road grade. Site is 0.3 miles upgradient from Shave Creek. Vegetation is observed from site photo, and area surrounding the site is vegetated with trees and shrubs.
SH-29	Collapsed adit with waste rock	125	--	--	Moderate	--	--	--	Collapsed Upper Consolation adit. With up to 7 small prospect pits nearby. Possible metal mobility or phytotoxicity from rock pile	Located 0.5 ft along existing accessible road and additional 0.1 miles upslope without any roads, near Consolation Mine. Vegetation is observed from site photo, and area surrounding the site is vegetated with heavy timber and shrubs.
SH-37	Collapsed adit with waste rock	55	--	--	Difficult	--	--	--	Rock pile located at head of seasonal drainage/run-off channel. Channel was dry at time of visit. Potential for impacts to surface water when seasonal run-off channel is flowing.	Located 0.5 ft along existing accessible road and additional 0.2 miles along unmaintained road grade, near Consolation Mine. Located 900 ft upslope from bottom of Shave Gulch Road and 1000 ft from Shave Creek, on steep timbered slope, near Consolation Mine. Remote location, not in close proximity to any old road grades. Vegetation is observed in site photo. Site is located in seasonal runoff channel but no evidence of runoff during inventory.
SG-13/14	Disturbed area	5,551	--	--	Difficult	--	--	--	Large waste rock pile up to 20 ft deep and trench. Possible metal mobility or phytotoxicity from rock pile.	Located 1.8 miles from Meadow Creek road on unmaintained access roads and 0.25 miles from Stevens Creek, on the ridge top between Stevens Gulch and Mike Horse Mine. Site is located on very steep timbered slopes with no maintained roads. Features SG-13 and SG-14 have the same field GPS location in the RI and were combined as one feature for the FS.
SG-16	Disturbed area	333	--	--	Difficult	--	--	--	Trench above possible adit location with large rock piles associated with both sites. Possible metal mobility or phytotoxicity from rock pile.	Located 1.8 miles from Meadow Creek road on unmaintained access roads and 0.20 miles upslope from Stevens Creek. Located near the ridgetop between Stevens Gulch and Mike Horse Mine on steep timbered slopes.

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PBBS = Porcupine Gulch SH = Shave Gulch SG = Stevens Gulch SWG = Swamp Gulch

SITE ID	SITE TYPE	ESTIMATED VOLUME OF WASTE MATERIAL (cy)	WATER OBSERVED	DISTANCE TO NEAREST OBSERVED SURFACE WATER (ft)	PROXIMITY TO EXISTING ACCESS[1]	SAMPLE COLLECTED[2] OBSERVED WATER	SAMPLE COLLECTED[2] SEDIMENT	SAMPLE COLLECTED[2] WASTE AREA	RI COMMENTS/NOTES/HAZARDS	FS EVALUATION NOTES
SG-41	Disturbed area	2,444	--	--	Difficult	--	--	--	Exploratory trench with possible tailings. Possible metal mobility or phytotoxicity from excavated rock and/or tailings.	Located 1.6 miles from Meadow Creek road on unmaintained access roads and 150 ft from Stevens Creek Steep slopes in heavy timber.
SG-43	Disturbed area	778	--	--	Difficult	--	--	--	Exploratory pit with possible tailings. Photo 78 of ridge to the NE, no mining activity evident. Numerous roadcuts. Possible metal mobility or phytotoxicity from rock pile.	Located 1.8 miles from Meadow Creek road on unmaintained access roads and 600 ft from Stevens Creek, near the ridge top between Stevens Gulch and Mike Horse Mine. Site is located on very steep timbered slopes with no maintained roads.
SG-47	Collapsed adit with waste rock	278	X (Stevens Creek)	0	Difficult	--	--	--	Potential adit location. Tailings material in creek. Open Adit. Potential metal loading to creek.	Located 1.5 miles up Stevens Gulch from Meadow Creek road on unmaintained access road. Slope is very steep with no accessible roads and heavy timber. Waste rock pile in contact with an intermittent portions of Stevens Creek, based on site photos; tailings are not evident in photo. This feature is no longer an open adit and is collapsed.
SG-48	Collapsed adit with waste rock	28	X (Stevens Creek)	0	Difficult	--	--	--	Adit in rock face adjacent to creek. Tailings material in creek. Open Adit. Potential metal loading to creek.	Located 1 mile up Stevens Gulch, 20 ft east of nearest road grade. Slope is very steep with no accessible roads and heavy timber. Area is vegetated with trees, shrubs, and plants. Waste rock pile may be in contact with an intermittent portions of Stevens Creek, based on site photos. Tailings are not evident. This feature is no longer an open adit and is collapsed.
SG-49/50	Collapsed adit with waste rock	999	X (ephemeral creek)	0	Difficult	--	--	--	Mined rock associated with adit SG-51. Located adjacent to ephemeral creek. Possible metal mobility or phytotoxicity from rock pile.	Located 1.4 miles up Stevens Gulch 200 ft from Stevens Creek on unmaintained access road. Slope is steep with unmaintained roads and heavy timber. Waste rock pile may be in contact with an intermittent portions of ephemeral creek, based on site photos. This feature is no longer an open adit and is collapsed. The area surrounding the collapsed opening is covered with moss, plant litter, and shrubs. Adit is associated with SG-50, not SG-51; features SG-49 and SG-50 are related and combined as one feature for FS.
SG-51	Disturbed area	370	X (Stevens Creek)	0	Difficult	--	--	--	Large cutslope with rock pushed into creek. Possible metal mobility or sediment loading from fill material.	Located 1.5 miles up Stevens Gulch from Meadow Creek road on unmaintained roads in close proximity to Stevens Creek. Slope is very steep with no accessible roads and heavy timber. Based on site photos, this looks like a disturbed area and the surroundings areas are vegetated. Photos do not show rock pushed into the creek.
SG-71	Collapsed adit with waste rock, and discharge, seep, or spring	463	X (spring)	70 (from Stevens Creek)	Difficult	--	--	--	Spring at possible adit location 70 ft from creek. Water has pooled and is 6 inches deep. Vegetation is in good condition adjacent to pond.	Located 1.3 miles up Stevens Gulch road along west side of draw from Meadow Creek road, and an additional 200 ft downgradient from road grade, 80 ft upgradient of Stevens Creek. Slope is steep, with heavy timber, and no maintained roads. Trees are growing around the site.

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PBBS = Porcupine Gulch SH = Shave Gulch SG = Stevens Gulch SWG = Swamp Gulch

SITE ID	SITE TYPE	ESTIMATED VOLUME OF WASTE MATERIAL (cy)	WATER OBSERVED	DISTANCE TO NEAREST OBSERVED SURFACE WATER (ft)	PROXIMITY TO EXISTING ACCESS[1]	SAMPLE COLLECTED[2] OBSERVED WATER	SAMPLE COLLECTED[2] SEDIMENT	SAMPLE COLLECTED[2] WASTE AREA	RI COMMENTS/NOTES/HAZARDS	FS EVALUATION NOTES
SG-93	Surface Water/Sediment	--	X (Stevens Creek)	50	Difficult	**SGSW-101 (SW)** **Chronic: Cu, Pb** **Acute: Cu** SGSW-102 (SW)	**SGSE-102 (0-6)** **As, Cd, Cu, Pb, Zn**	SGWA-101	--	Located 1.4 miles up Stevens Gulch from Meadow Creek Road on unmaintained road, waste pile is 200 ft upgradient from Stevens Creek on unmaintained access road. Slope is steep with heavy timber.
SG-94	Disturbed area with discharge, seep, or spring	500 [3]	X (spring)	--	Difficult	**SGSW-103 (SW)** **Chronic: Cd, Cu, Zn** **Acute: Cu, Zn** **SGSW-104 (SW)** **HH: As, Fe** **Chronic: Fe, Zn** **Acute: Zn**	**SGSE-103 (0-2)** **As, Cd, Cu, Pb, Zn** **SGSE-104 (0-2)** **As**	SGWA-102	Iron precipitate cone-forming spring. Actually located about 250 ft downslope of SG-94 location.	Located 1.4 miles up Stevens Gulch from Meadow Creek road on unmaintained roads in close proximity to Stevens Creek. Slope is very steep with no accessible roads and heavy timber. Located 200 ft east of nearest road grade. This feature is a spring in a highly mineralized area, and not in close proximity to any surface water.
SWG-02	Disturbed area	244		--	Difficult	--	--	--	Possible tailings in rock piles. Excavated rock may present metal mobility or other phytotoxicity hazard.	Located 300 ft northeast of the Meadow Creek Road to WTP on steep slopes with heavy timber. This site is not accessible by any road grades. Area has established vegetation including shrubs and trees.

Notes: cy: cubic yard. ft: feet. gmp: gallons per minute

[1]**Access Definitions**

Easy - Located close to existing road.

Moderate - Located close to old road grade on mild slopes with less timber.

Difficult - Remotely located due to inaccessibility (steep timber slopes or unmaintained roads), may be in proximity to other mine features that are difficult to access.

[2] Sample identification listed for areas where sample was collected. **Bold** text indicates that sample exceeded SSCLs.

[3] Volume was not recorded in field notes and is an estimation.

[4] Volume was estimated based on area from Table 12 of Remedial Investigation (RI).