Technical Memorandum:

Summary of

Response Action alternatives and Recommended Response Actions

For the National Forest System Lands of the Upper Blackfoot Mining Complex Site

Including the

Upland Waste Areas, Groundwater, Surface Water and Sediment, Upper Marsh, and Mining related Features Evaluation Areas

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Prepared for:

USDA Forest Service, Region One
In Coordination with
Montana Department of Environmental Quality, Remediation Division, Site Response Section
and
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1.0 Introduction

The Forest Service has prepared this ***Technical Memorandum of Response Action Alternatives and Recommended Response Actions for the National Forest System Lands of the Upper Blackfoot Mining Complex Site (UBMC), including the Upland Waste Areas, Groundwater, Surface Water and Sediment, Upper Marsh and Mining Related Features Evaluation Areas*** in conjunction with the development of the State of Montana's Proposed Plan for the UBMC site. This memorandum accompanies and tiers to the Draft Final Feasibility Study Report (FS) for the UBMC prepared for the Montana Department of Environmental Quality (Pioneer, 2015), and the Final Remedial Investigation Report (RI), Upper Blackfoot Mining Complex (Tetra Tech, January 2013a). This Technical Memorandum includes a summary of the remedial action alternatives as they apply to the federal lands administered by the Forest Service. It also includes the Preferred Response Alternatives for contamination on federal lands for public review and comment. The Preferred Response Alternatives for the federal lands are largely consistent with the alternatives included in the State of Montana's Proposed Final Cleanup for the Upper Blackfoot Mining Complex Site Superfund Facility (October, 2015).

This Technical Memorandum is prepared to satisfy the federal requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; 42 USC 9604) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40CFR Part 300). Response actions -- as explained in the U.S. Environmental Protection Agency's (EPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* -- are implemented to respond to "the cleanup or removal of released hazardous substances from the environment … as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment…" (EPA, 1993). This site is on the State of Montana's list of priority cleanup sites under the Comprehensive Environmental Cleanup and Responsibility Act (CECRA).

The project site is located in Lewis and Clark County, Montana, about 16 miles east of the community of Lincoln, Montana. The project area is located in mountainous terrain at an elevation of about 5,700 feet above sea level at the headwaters of the Upper Blackfoot River, including Beartrap Creek, Mike Horse Creek, and the Upper Blackfoot River and its tributaries in Township 15 North, Range 6 West, Sections 20, 21, 28 and 29 (Figure 1).

1.2 Purpose and Objectives

The purpose of this Technical Memorandum is to provide a summary of the mining related impacts on the federal lands of the site, identify the potential response actions, and the process and rationale for evaluating the potential response actions (alternatives) designed to address the mining-related impacts at this site. To the extent practical, these response action options will be described, discussed and evaluated within the larger context of all of the lands of the site including the private lands of the site as defined and evaluated in the RI, FS and Proposed Plan prepared by the Montana Department of Environmental Quality (DEQ). To do this, the Technical Memorandum adopts and is consistent with the identification and description of the "Evaluation Areas" as described on pages 38-86 in the FS and the range of "Remedial Alternatives" as described in the Proposed Plan on pages 56-74, as well as the conceptual restoration plan by the Montana Department of Justice Natural Resource Damage Program Conceptual Restoration Plan (NRDP, 2011).

The objective of this Technical Memorandum is to present the response alternatives that may be used to reduce or eliminate potential human health and ecological risks posed by the mining-related features on the federal lands of the site, and to present the summary of the comparative analysis of these alternatives based on their relative effectiveness, implementability and costs. Restoration activities on federal lands are assumed to occur within the identified alternatives' scope and costs as they are known, to date. And finally, this document presents the agency's recommended response action for each contaminant feature. After public comment on this Technical Memorandum and the agency recommended response actions, the Forest Service will issue a decision for the selected response actions for the federal lands of this site.

1.3 Report Organization

As discussed above, this report tiers to and adopts the evaluations previously conducted and presented by Montana DEQ and NRDP for all of the lands, including the federal lands, of this site and thus does not intend to reproduce herein the plethora of site information for the federal lands portion that already exists in these documents.

Section 2.0 includes a brief history of the site and regulatory history and decisions as they relate to the federal lands of the site.

Section 3.0 includes a summary of the contamination found on federal lands.

Section 4.0 summarizes the Human Health and Ecological Risk Assessments prepared for the site as they relate to federal lands.

Section 5.0 identifies the response action objectives for the federal lands of the site in context with the other lands of the site.

Section 6.0 summarizes the alternative response options and provides a comparison of these response options for the contamination on federal lands, including effectiveness, implementability and costs as well as compliance with ARARs

Section 7.0 identifies the proposed response actions

Section 8.0 is the References for this report.

2.0 Site History

2.1 Site History Overview

The site history described below is a summary focusing mostly on the activities associated with the federal lands of the site, however, the intermingled landownership pattern of the site precludes an exclusive discussion. Additional site historical information is found in the RI (DEQ, 2013) and in the Administrative Record File for the project located at the Lincoln Ranger District and at the DEQ.

The project area is part of the Heddleston Mining District in the vicinity of the Upper Blackfoot River and its headwaters tributaries. It was first prospected and mined in the late 1800's and miners took gold and high grade lead-silver ores from the area mines during the early years. The preponderance of the mining districts' products were base metals such as lead and zinc. The Mike Horse Mine was discovered in 1898, and became the largest of many mines in the mining district including the Anaconda, Carbonate, Edith, Paymaster, Capital, and others. All were underground mines that resulted in the placing of metal laden waste rock on the surface. Some of the underground mines intersected underground waters which now drain at the surface in varying amounts with varying contaminants. In 1941, the Mike Horse dam was constructed across Beartrap Creek to contain and impound the tailings generated from the flotation mill. Beartrap Creek was diverted to keep water out of the valley bottom where the tailings were being deposited. In the mid-1940's, ASARCO became the corporate successor to the Mike Horse Mining and Milling Company. Sufficient ore was produced to keep the mine and mill operating steadily until the early 1950's. After that it was operated sporadically until 1964, when a large scale exploration drilling project was begun by The Anaconda Company. In 1981, The Anaconda Company terminated its lease of the property and returned the site to ASARCO.

During the operating periods, the waste rock dumps (lower grade and uneconomic wastes) were generated and accumulated in piles adjacent to Mike Horse Creek, Beartrap Creek and the Upper Blackfoot River. Mill tailings, the fine grained product that results after processing of the ore through the Mike Horse mine flotation mill, were slurried from the mill located in Upper Mike Horse Creek into Beartrap Creek which resulted in the development of a tailings pile in the valley bottom of Beartrap Creek. Other smaller amounts of milled tailings were created and disposed of in other places in the drainage, and some waste dumps have eroded and resulted in sedimentation into streams.

In 1975, heavy rains resulted in a slope failure which plugged the Beartrap Creek diversion ditch and damaged the diversion structure. High creek waters flowed onto the tailings impoundment causing a failure of the pile which resulted in the erosion of a significant amount of the tailings into Beartrap Creek and the Upper Blackfoot River. Deposits of these washed out tailing have also been characterized within the removal area. The flood waters also eroded waste dumps located within drainage bottoms. The result of this and previous high water events is the placement and continuous erosion of mine wastes into the affected tributary streams and the Blackfoot River. In 1975, The Anaconda Company built a more substantial dam to repair the breach in the tailings impoundment. By 1981, the Anaconda Company had gone bankrupt and the Mike Horse project area mining claims and private property reverted back to ASARCO and The Anaconda Company was purchased by the Atlantic Richfield Company (ARCO).

2.2 Regulatory History Overview

ASARCO and ARCO initiated reclamation on the private lands at the UBMC site in 1993 and continued reclamation activities on a voluntary basis through 1998 under agreement with the State of Montana. This included removal of wastes from several mines and placing them in onsite repositories, construction of a water treatment and wetlands system, and monitoring activities. In 1999 ASARCO petitioned the Montana Board of Environmental Review for adoption of temporary water quality standards in portions of streams at the site. ASARCO developed a conceptual plan for mitigation of all water quality limiting factors (Hydrometrics, 2000). The Upper Blackfoot Mining Complex site (UBMC) was added to the Montana DEQ list of priority sites under their Comprehensive Environmental Cleanup and Responsibility Act (CECRA) in 1991.

In 2002 ASARCO entered into an Administrative Order on Consent with the Forest Service to prepare an Engineering Evaluation and Cost Analysis (EE/CA) to develop removal action alternatives for mining-related contamination on certain federal lands within the UBMC area. The federal lands included the Mike Horse dam and impounded tailings, Lower Mike Horse Creek below the Mike Horse mine, Beartrap Creek below the Mike Horse dam, and the Upper Blackfoot River from its junction with Beartrap Creek downstream to the private land in Section 21 (Figure 2).

The EE/CA included public involvement on Technical Memorandums for specific components of the project as well as on the Draft EE/CA that was issued in August, 2006. The EE/CA was finalized in July, 2007 (Hydrometrics, 2007) and the Forest Service issued an Action Memorandum (decision) in July, 2007. The selected action identified in the Action Memorandum included removal of the Mike Horse dam and impounded tailings, and removal of wastes from the Beartrap Creek, Mike Horse Creek and Blackfoot River streams and floodplains and placement of these wastes into the Paymaster Repository site located on nearby ASARCO owned lands (USDA, 2007). In August of 2005, ASARCO filed for Chapter 11 bankruptcy. DEQ, the Montana Department of Justice through its Natural Resource Damage Program (NRDP), and the Forest Service 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 and United States with approximately $40 million. As part of these settlements, DEQ dismissed the state court action. Also part of the bankruptcy settlement agreement, DEQ, NRDP and the Forest Service entered into a Watershed Restoration Agreement (Agreement) whereby DEQ would utilize the settlement funds to conduct implementation of the Forest Service's Action Memorandum non-time critical response actions, and any restoration actions under oversight by the Forest Service. An underlying tenet of the Agreement is the agencies agreed to take a site-wide approach to clean up the UBMC site in order to maximize efficiencies and provide for more holistic cleanup (Watershed Restoration Agreement, 2008).

In 2009, the State, United States, and ASARCO entered into a second settlement agreement whereby ASARCO's UBMC real property holdings, and water treatment plant and repository maintenance obligations were transferred to a Montana trust (Trust), along with approximately $10 million in funding. The Trust is the current owner of most of the UBMC private lands (Figure 2).

In 2009, DEQ initiated design level investigations at the Forest Services' selected Paymaster Repository site. When technical issues were discovered with the Paymaster repository site, other potential repository sites were identified and evaluated in a Repository Siting Study that was issued for public comment (Pioneer Technical Services, 2011). Amendment #1 to the Action Memorandum, was issued by the Forest Service in July 2012 identifying the Section 35 repository site as the preferred repository site for the wastes on federal land of the UBMC site (USDA Forest Service, 2012). The State of Montana concurred with the selected repository site making it available for placement of wastes from both federal and private lands of the site.

In 2011, NRDP issued its Conceptual Restoration Plan for the Upper Blackfoot Mining Complex for public comment (NRDP, 2011). NRDP began implementation of its restoration plan in conjunction with DEQ interim actions in 2015 with initiation of restoration of Upper Beartrap Creek. Consistent with the WRA, DEQ and NRDP will be coordinating with the Forest Service on the remedial and restoration actions on the federal lands with the Forest Service.

2.3 Remedial Investigation and Feasibility Study

In 2007, DEQ initiated a Remedial Investigation (RI) for the lands not included in the USFS Action Memorandum. The RI included collection of field data during the fall of 2007, summer of 2008 and fall of 2011 in order to adequately assess the nature and extent of contamination within the UBMC site. The RI was completed and a final RI Report was published in January, 2013 (Tetra Tech, 2013a). In 2013, DEQ began to develop, screen, and evaluate remedial action alternatives in a Feasibility Study (FS). Using the RI characterization, DEQ developed and screened a list of remedial action technologies and the 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. In February, 2015, DEQ completed the Draft Final Feasibility Study Report for the UBMC site (Pioneer, 2015). This report was prepared to develop, screen and evaluate remedial action alternatives for the UBMC areas not already included in the removal actions authorized by the USFS and other State responses. The Draft FS alternatives include both private and federal lands of the site.

2.4 Tie Between State and Federal Response Actions

The RI (Tetra Tech, 2013a) and Draft FS (Pioneer, 2015) that have been prepared for the site include the results of the data gathering and analysis as well as alternative response actions for both the private and federal lands of the UBMC site that were not included in EE/CA and Action Memorandum of 2007. Essentially, the focus of the EE/CA and Action Memorandum of 2007 was the Mike Horse dam, impounded tailings, and floodplain areas of the headwaters and upper Blackfoot River downstream to the eastern half of Section 21 near the Edith Mine (Figure 2). However, the RI and FS identified that mining related issues and wastes have accumulated on Forest Service lands in the Blackfoot River floodplain and marsh areas downstream of Section 21 and in upland areas that were not included in the 2007 decision. In addition, the RI and FS identified contamination in surface and groundwater, stream sediments, and in soil wastes. Thus, this memorandum summarizes the federal lands portion of the waste and contaminant issues identified during the State's RI and FS efforts, in anticipation of coordinated State/Federal response decisions.

2.5 Threatened and Endangered Species

The US Fish and Wildlife Service (FWS) has provided a list of the current Threatened and Endangered species and critical habitat occurring within the UBMC area (USFWS letter to DEQ November 14, 2014, and December 14, 2014). These include the threatened bull trout, Canada lynx and grizzly bear. The area includes designated critical habitat for bull trout and Canada lynx. . The Northern Continental Divide Ecosystem grizzly bear recovery zone boundary is State Highway 200. In addition, grizzly bears are present in the area, and are known to frequent the area during fall. FWS is providing ongoing consultation regarding these species and their critical habitat as well as for trust species included within their other statutory authorities. Their consultation information is incorporated into this Technical Memorandum evaluations and recommended actions in a conceptual way with the intention of informing the cleanup decision. Some of the specific recommendations of FWS can only be addressed during design level activities.

3.0 Contamination Characterization

The RI included a detailed investigation of the nature and extent of contamination on 11 principal mining operations and areas within the UBMC, including sampling methodologies, identification of contaminants of concern and analytical results of the sampling of all types of contaminated media. Only a portion of these features are located on federal lands. The following is a summary description of the site characterization findings of the Remedial Investigation (DEQ, 2013) for these features located on federal lands. More complete descriptions of these areas and features are found in the Feasibility Study (Pioneer, 2015) on pages 37-81 and in the UBMC Proposed Plan pages 28-34 (DEQ, 2015).

3.1 Types of Contaminated Media and Hazards

Elevated metals are present in soil, sediment, groundwater and surface water at the UBMC due to the leaching of metals from mined waste rock, milled tailings, discharge of metal-laden groundwater from adits, exposure of a near surface ore body by exploration activities, and from areas of naturally high mineralization. The interaction of water from precipitation has mobilized the metals from the source media into surrounding media. Contaminants of concern (COCs) were identified and they include eight metals that exceed representative background concentrations, Montana water quality standards, literature-based screening levels for various human or ecological receptors, or exceed site specific cleanup levels (SSCLs) developed in the Human Health and Ecological Risk Assessments. COCs include aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc.

Groundwater

The UBMC has a network of groundwater monitoring wells that have been sampled for many years and analyzed in the RI. The results of these sampling activities indicates that groundwater contamination occurs in the UBMC area including elevated levels of metal contaminants, reduced pH, lower dissolved oxygen levels, and increased dissolved solids and sulfate concentrations (Tetra Tech, 2013a). Contaminated shallow aquifers intersect with and contaminate surface waters or remain at depth in a complex system. Mike Horse Creek and Beartrap Creek downstream of the impounded tailings have shallow groundwater contamination.

Some of the collapsed mine workings have seeps or discharges that exceed water quality standards. Metal contaminants may include cadmium, copper, lead and zinc.

Soil/Mine Wastes

Surface soil samples have been collected from upland waste rock piles, mixed waste floodplain deposits, and at the surface in the marsh of the UBMC area. In addition, background soil samples have been collected for comparison purposes to establish background metals concentrations. Many of the sampled features have soil metal concentrations exceeding background levels and screening levels. The most frequent ecological screening level exceedences are for arsenic, copper, lead and zinc. Floodplain soils have a somewhat broader suite of metal exceedences including arsenic, cadmium, copper, lead, manganese and zinc (Tetra Tech, 2013a). The most concerning of the issues with soil media is whether or not the soil will leach metals if exposed to precipitation as that is an indicator that metals may leach from the material and contaminate groundwater.

Surface Water

Surface water quality sampling at numerous locations has occurred at the UBMC site for many years. Samples are evaluated to determine whether or not the water exceeds standards for human health and or aquatic life. In general, water quality improves and metals concentrations decrease the further downstream you go. Surface water quality impairment with exceedences of human health and ecological standards occurs in Beartrap Creek, Mike Horse Creek, the Blackfoot River above the marsh, and in discharges from mines (Tetra Tech, 2013a).

Sediment

Sediment sampling is differentiated from other soil sampling in that sediment sampling refers to the sediments found in wet environments such as on streambeds and within the marsh area. Marsh area sediments are discussed separately below. Streambed sediments have accumulated as a result of erosion of upstream or nearby waste sources. Similarly to surface water, elevated levels of metal contaminants in streambed sediments decrease from upstream to downstream.

Marsh sediments

Marsh sediments have been divided into two areas, an eastern area of about 28 acres (Upper Marsh) and a western area of about 34.3 acres (Lower Marsh) (Figure 5). The division occurs where an old exploration drill road bisects the marsh by acting as a low berm. The drill road provided a containment feature for initial deposition of tailings and other sediments during the 1975 flood event and during other annual flow events. Data suggests the Upper Marsh is also receiving elevated metals from weathering of adjacent bedrock which includes known mineralization. Sediments from the eastern marsh area and in the vicinity of Swamp Gulch are potentially acid generating (DEQ, 2015).

Flora and Fauna

Environmental sampling has been performed to determine the level of ecologicgal risk posed by the site contaminants into the food chain. Environmental sampling included plants, invertebrates, and small mammals and an analysis of potential uptake of metals by other organisms that may consume these was performed. Generally, analysis results indicate that terrestrial mammals and invertebrates have a low risk of excessive contaminant uptake. However, evaluation of stream collected samples shows that the ecological risk to aquatic invertebrates is profound with drastic changes in macroinvertebrate populations depending upon the sampling location. Ultimately it appears that invertebrates are exposed to bioavailable forms of metals in the streams and are bioaccumulating metals (Tetra Tech, 2013a).

Physical Hazards

Physical safety hazards from collapsing mine workings or exposed mine openings, primarily adits, occur within the site. Some of these features could allow human entry and present safety hazards to the public (Pioneer, 2015). These features are identified for response action in this document, in conjunction with a contamination issue and without a contamination issue. The decision on a safety issue without a contamination issue on federal lands will be addressed under a different federal authority and resources.

3.2 Evaluation Areas (EAs) of Contamination

Due to the complexity of the site, DEQ combined the various mining related features and contaminated media into Evaluation Areas (EAs) to streamline the development of remedial action alternatives. Detailed descriptions of the EAs and contaminant issues are found in the FS on pages 38-96 and in the Proposed Plan on pages 28-34 (Pioneer, 2015; DEQ, 2015). The EA's and affected media located on Forest Service lands are located on Figure 3 and are discussed below.

3.2.1 Evaluation Area 1 (EA 1) – Upland Waste Areas (soil contamination)

Evaluation Area 1 (EA 1) includes upland waste areas including the waste piles, underlying soils, and other mining impacted soils resulting from mining activities. EA 1 mine sites with wastes on federal lands includes the Edith Mine wastes, a portion of the Mary P wastes, the No. 3 Tunnel wastes in Sections 20, 21 (Figure 3). Detailed maps of sampling and contamination levels for these wastes are found in the FS in Figures 10, 12, and 15 (Pioneer, 2015).

Edith Mine Wastes/Exposure Unit 5

The Edith Mine is located just north of the Blackfoot River and west of Shave/Shaue Gulch on federal and private lands (Figure 3). The mine developed a molybdenum ore body as early as 1904 and in 1967 the mine was reopened by the Anaconda Company and some development occurred. This mine occurs just at the edge of the defined porphyry mineralization area of the UBMC. In 1995 ASARCO and ARCO removed mine wastes, about 5,000 cubic yards (cy), from several waste piles and waste areas at the Edith Mine and placed the waste in the Mike Horse Repository. Three areas where waste was previously removed were delineated and sampled by DEQ. Portions of the central and east areas are located on Forest Service lands. A portion of the central area is being removed as part of the Blackfoot River floodplain wastes

removal area that was included in the Forest Services' 2007 Action Memorandum. Thus, this feature will not be carried further in this Technical Memorandum.

Mary P Mine/Exposure Unit 7

The Mary P Mine is located south of the Blackfoot River on the edge of the Blackfoot River floodplain just northwest of the water treatment plant on federal and private lands (Figure 3). The Mary P was operated in 1911 and operations included a discovery cut and tunnel and a short drift. The mine has been closed for many years. Soil samples collected for this waste pile indicate that arsenic, copper and lead are present at concentrations above cleanup levels. The contamination issue with these wastes is the ongoing or potential for erosion of the wastes directly into the Blackfoot River and leaching of metals into surface waters. The estimated volume of waste is 708 cy.

No. 3 Tunnel/Exposure Unit 10

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 in the late 1960s. ASARCO and ARCO implemented waste rock removal at the No. 3 Tunnel area in 1996 (Figures 1 and 3). Approximately 4,955 yd^3 of mine waste were removed from the No. 3 Tunnel area. All material was fully amended and placed in the Paymaster Repository. Contaminant issues with the No. 3 Tunnel site include elevated metals in soils. No. 3 Tunnel area soils were sampled during the RI in 2007 and 2008 to assess the effectiveness of the previous actions. Arsenic, copper, iron, manganese, and zinc exceed cleanup levels. These soils are situated well above the Blackfoot River floodplain. The contamination issue with these wastes is the ongoing or potential for infiltration of runoff containing dissolved metals into soil and groundwater. The estimated volume of contaminated soils is 2,184 cy. There are no monitoring wells or surface water sampling sites associated with the No. 3 Tunnel area.

Table 3-1 is a summary of the soil contaminants found in the EA 1 waste piles.

3.2.2 Evaluation Area 2 (EA 2) – Groundwater

Evaluation Area 2 (EA 2) includes groundwater sources in the UBMC area. Contaminated groundwater occurs at the UBMC site related to historic mining activities and the wastes placed, as well as from the near surface ore body located in the area. There are no known contaminated groundwaters directly attributable to mining features on Forest Service lands (FS pages 45-46, DEQ, 2014). There is contaminated groundwater associated with the Upper Marsh. However, groundwater is a dynamic feature and there are elevated levels of metals from wastes or the naturally mineralized ore body on Forest Service lands that may be contributing contaminants to groundwater. Thus, further monitoring of actions proposed and implemented by DEQ may be necessary once ongoing and future waste source removals are completed. Groundwater is only discussed further as it relates to the Upper Marsh, Evaluation Area 4.

3.2.3 Evaluation Area 3 (EA 3) – Surface water, Streams and Stream Sediments

Evaluation Area 3 includes surface water in streams and its associated bottom sediments in the UBMC area. Contamination in streams and stream sediments is largely related to the mine waste and soils sources that have eroded into these waters and stream areas over the years, although not entirely. Stream and sediment features on USFS lands in the UBMC include the Blackfoot River,

Stevens Creek, Porcupine Creek, Paymaster Creek and Shave Creek. Within these drainages are discharges or seeps and springs.

Anaconda Creek

Anaconda Creek flows into Beartrap Creek just above the water treatment plant. The junction of the two streams is the start of the Blackfoot River (Figure 1). Anaconda Creek is largely devoid of mineralization and mining activity and water quality is good. There is one mining feature located near the junction of Anaconda Creek and Beartrap Creek on federal lands and this feature is included in the removal scope of the 2007 Action Memorandum. Thus it will not be carried further in this Technical Memorandum.

Blackfoot River

The Blackfoot River is the primary stream and stream sediment contamination feature of consideration on Forest Service lands and the river courses between federal and private lands until just below its confluence with Swamp Gulch in the upper Marsh area (Figure 3). Generally, the Blackfoot River surface water quality has regular exceedences of at least one human health or aquatic cleanup level, with cadmium, lead and zinc being the most frequent human health exceedances, in particular in the upper Marsh area. The most frequent aquatic life exceedences were cadmium and zinc. Available data suggests that the Blackfoot River is recovering downstream of the upper Marsh (Pioneer, 2015). Contaminated sediments reside within the Blackfoot River channel area having been carried downstream over the many years (Pioneer, 2015). The portion of the Blackfoot River on Forest Service lands with contaminated sediments includes the river channel area below the Edith mine (Figure 3). However, the portion of this channel area on federal lands is also inundated as part of the Upper Marsh area. Thus, further evaluation and discussions of the Blackfoot River and its sediments will be incorporated in the Upper Marsh EA 4 below.

Stevens Creek

Stevens Creek is a very small (350 acres) watershed with steep topography and little residual access from the mining era. It courses through geology that includes the near-surface porphyry ore body on which the Capital Mine was developed (Figure 3). Numerous small prospects and exploratory adits pock mark this drainage and an estimated 550 cubic yards of waste material from about 100 small features are located in the stream or drainage itself with additional wastes on the slopes above. These wastes are high in iron and have elevated levels of lead and zinc, in particular (Table 3-2). The wastes are being reworked and mixed during annual discharge events such that the sediments in the stream are now scattered the length of the drainage, 0.7 miles. There are many more cubic yards of upland mine waste. Seeping discharges occur within and near the stream area. The surface flow of Stevens Creek surfaces intermittently above the Capital Mine on private land. The Capital mine had a seepage that contributed to Stevens Creek until it was plugged in the 1990's. Prior to plugging this flow exceeded DEQ-7 standards for aluminum, cadmium, copper, iron, lead, manganese, and zinc. Stevens Creek has a low base flow (generally less than 2.0 cfs with an average of 0.5 cfs). Surface water quality in Stevens Creek exceeds aquatic life standards and data suggests a combination of the soil/waste contaminants as well as the seeps themselves being the sources (Pioneer, 2015).

Porcupine Creek

Porcupine Creek flows into the Blackfoot River just downstream of Meadow Creek. It includes a small watershed area of about 370 acres most of the drainage is on Forest Service lands. There is

an adit seep in this drainage, however it does not exceed human health or aquatic standards. Because there does not appear to be a water quality issue in Porcupine Creek, this feature will not be discussed further. The waste portion of this feature is discussed below in EA-5 Mining Related features.

Paymaster Creek

Paymaster Creek includes a watershed area of about 400 acres and flows into the Upper Marsh area of the Blackfoot River near the Paymaster mine site. There are several small mines located within the Paymaster Gulch drainage, which also rests squarely on the porphyry ore body of the site. Paymaster Creek has noticeable ferricrete deposits (ancient iron rich precipitate deposits) and mine workings. The average flow of Paymaster Creek is about 0.634 cfs and concentrations of cadmium, copper, iron, lead and zinc either equal or exceed aquatic life water quality standards (Table 3-2), (Pioneer, 2015).

Shave/Shaue Creek

Shave Creek is located on the north side of the Blackfoot River and has a drainage area of about 2,130 acres. Base flows of Shave Creek are about 0.51 cfs, however, flashy flows from summer storms are known to carry much higher flows. Some years Shave Creek dries up before its confluence with the Blackfoot River. Surface water sampled on Forest Service land had exceedences of aquatic life standards for copper. These exceedences are attributable to mine waste from mining feature SH-17 which is discussed under EA 5 Mining Related Features. There are many more cubic yards of mine waste in the upland areas.

3.2.4 Evaluation Area 4 (EA 4) Upper Marsh - (sediment, groundwater, surface water contamination, features)

Overview

The Upper Marsh evaluation area is the 62 acre wetland at the confluence of Pass Creek and the Blackfoot River (Figure 3). A substantial portion of this area is on Forest Service lands, approximately 95.7%. The Upper Marsh is part of a larger marsh system located downstream, however, only the Upper Marsh has a component of federal lands. The Upper Marsh is fed by a complex of surface flows of the Blackfoot River, Pass Creek, Paymaster Creek and Swamp Creek and groundwater flows. The Upper Marsh has been heavily impacted by historic mining and erosion events and contains a mixture of tailings, mine wastes and upstream sediments. The 1975 breech of the Mike Horse dam resulted in the deposition of a significant deposit of tailings into the wetland area. Vegetation in the marsh area generally appears healthy and the Upper Marsh includes two ecologically significant fens, which are wetland features that require a minimum of 1,000 years to develop (Figure 4). Beaver have continuously altered the configuration of the wetlands in recent years. Two roads cut into the Upper Marsh including the old Mike Horse road in the eastern portion of Section 20 and an old exploration drill road (Figure 4). The Blackfoot River channel is mappable within the Upper Marsh and has changed little in the last 50 years.

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. Beaver activity within the Upper Marsh continually alters the landscape and causes changes to the inundated areas and acreage; recent beaver activity has

caused submersion of previously exposed sediment deposits in the wetland complex. Water flow is dispersed across the landscape and the original stream channel has become a series of features, fully connected with the marsh areas and wetland features in the floodplain. Mike Horse Road acts as a spreader dike and further widens Pass Creek at its juncture with the Blackfoot River, inundating additional areas and causing flows to overtop the road in places. An old beaver dam feature is present within the main stem of the Blackfoot River, at the point where the river becomes entrenched (Figure 4). It is possible that loss or disruption of beaver activity in the Upper Marsh could destabilize the old beaver dam feature and could result in rerouting or lowering the main channel and draining flooded areas and, in turn, allow the oxidation of currently saturated or flooded sediments.

Marsh Sediments including Blackfoot River Sediments

The Blackfoot River courses through the Upper Marsh in a mostly defined channel configuration even though the channel is inundated in places due to beaver activity. Sediment samples have been collected within the channel area and two sample locations are representative of the metals carried in the river as it enters the Upper Marsh area (BRSW-12) and near the lower end of the Upper Marsh area BRSW-110. The stream sediments samples indicate that the metal contaminants are either slightly similar or decline somewhat from the upper to lower sampling areas. Site specific cleanup levels for sediments in the Blackfoot River in the Upper Marsh area are exceeded for arsenic, cadmium, copper, lead, manganese and zinc (Table 3-3). Based on the data presented in the RI, much of the mine waste is deposited within the Blackfoot River floodplain upstream of the confluence with Pass Creek, or in the upper part of the eastern marsh, creating areas with high levels of COCs. These areas could be as deep as 3 feet thick and are generally thickest in the area above the old drill road.

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 (Figure 5). This division, also used in the Baseline Ecological Risk Assessment (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. The drill road provided a containment feature for initial deposition of the tailings and fluvial sediment materials in the eastern portion of the marsh. Over time, the finer materials have been transported downstream into the western portion. The remaining areas of the Upper Marsh includes the fen vegetation features described above and other vegetation features.

The Upper Marsh has been a deposition area that captures fine sediments and mine wastes washing down from upstream. The thickness of these sediments varies and is thicker with coarser grains upstream of the old drill road which appears to have acted as a low dam during erosion events. Contaminated sediments are also transported within the Blackfoot River as it courses through the marsh area. Blackfoot River sediments are discussed herein within the context of the Upper Marsh as a whole. The sediments of the Upper Marsh contain metal contaminants including aluminum, arsenic, cadmium, copper, iron, lead and zinc above cleanup levels (Table 3-3). pH data suggest these contaminants may be bioavailable, particularly in the eastern portion where grain size tends to be larger. Reducing conditions occur within the marsh where sediments remain inundated. The areas inundated by water or exposed at the surface have fluctuated, particularly in the recent past with beaver activity, natural events or a combination of both.

Natural weathering of the quartz monzonite porphyry and diorite ore bodies in the mineralized areas within Pass Creek, Paymaster Gulch, and Swamp Gulch drainages contributes to the

elevated COC concentrations from these sediment sources. Particle sizes in the sediments typically range from gravels to clays. Poorly graded gravels underlay up to five feet of sediment in some areas. 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 species 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 deposits. Metals in the marsh are generally more mobile and bioavailable in the medium-grained sand size with lower particle surface area that is more common in the eastern portion when compared to the fine-grained sediments more common in the west (Tetra Tech, 2012).

The potential for marsh sediments to generate acid and mobilize metals may be inhibited by reducing chemical conditions and overlying saturated or flooded organic mats. Areas having contact with oxygen in the air have a higher potential to leach metals than those that are continually saturated or inundated. Organic matter also acts as a sink for metals, further reducing their mobility. If kept inundated, the wetland acts as a sink where the metals are chemically reduced and form complexes with other metals and organics thereby becoming relatively stable (Tetra Tech, 2013a).

Samples from three different sediment depths (0 to 2 inches, 2 to 6 inches, and 6 to 12 inches) were collected at 41 sampling locations in the Upper Marsh in 2007 and 2008 during the RI. In addition, more than 200 samples were collected from test pits along transects spaced approximately 750 to 1000 feet apart in the Upper Marsh during a 2012 floodplain study (Spectrum and Pioneer, 2013). Concentration versus sampling depth is shown for all COCs in the Upper Marsh in the FS. Elevated concentrations of COCs are confined by the Mike Horse Road and do not extend up Pass Creek as originally portrayed in the Feasibility Study. The analytical results for the sediment samples collected during the RI and floodplain study indicates that aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc are present in the Upper Marsh at concentrations above the cleanup levels. It is important to note that there is a marked reduction in the metal levels and their distribution from the eastern to the western marsh areas as delineated by the old drill road. While concentrations of metals in the sediments may show a similar range of values, there are only a few small areas within the western portion of the Upper Marsh that show the highest levels of metals. Conversely, elevated concentrations of all of the metal contaminants are mostly consistent across the entire portion of the eastern area. Arsenic concentrations exceed 160 mg/kg in the top 6 inches over a significant percentage of the eastern side of the marsh. Cadmium concentrations are consistently elevated ranging from 1.84-35 mg/kg in 0-12 inches in depth over the entire eastern side of the marsh. Copper concentrations exceed 700 mg/kg at 0-12 inches depth in much of the upstream portion of the eastern marsh. Iron and lead concentrations are similarly elevated over most of the eastern portion of the marsh from 0-12 inches depth with concentrations ranging from 14,500 to greater than 60,000 mg/Kg and 1,000-greater than 1,700 mg/kg respectively. These results are summarized in Table 6-3.

Remediation volume estimates of 90,345 cy and 110,676 cy were calculated for the areas of exceedance with the eastern and western portion of the Upper Marsh, respectively, assuming a removal depth of 2 feet below ground surface. The total remediation volume estimate for the Upper Marsh as a whole is 201,021 cy**.** This includes contaminated sediments within the Blackfoot River as it courses through the Upper Marsh area.

Upper Marsh Surface and groundwater, including the Blackfoot River

Surface water within the Upper Marsh has been collected at the upstream end, within the marsh, and at the outlet just below Swamp Gulch. Surface water samples have been collected since 2007 in the marsh area and more recently groundwater (Figure 6). Analytical data from these locations are summarized in the FS (Pioneer, 2015). Cadmium, manganese, and zinc concentrations decrease from upriver to downriver, while copper concentrations increase from upriver to downriver within the marsh. Lead concentrations increase toward the middle of the marsh compared with upstream and downstream, and arsenic was below detection levels in all the samples. Pass Creek background concentrations were generally lower than the surface water concentrations in this section of the Blackfoot River. Overall, surface water contaminant concentrations did not exceed DEQ-7 human health standards below the Upper Marsh. These data suggest that impacts to surface water in the Upper Marsh are minor, as concentrations of some metals decline through the marsh during periods where the metals would be expected to mobilize (Tetra Tech, 2013a). Surface water and contaminated sediments are contributing to uptake of metals by plants, invertebrates and small mammals living in the area, and particularly lethal impacts in the eastern portion of the marsh.

Groundwater data has been collected from piezometers or wells within alluvial aquifers in and near the Upper Marsh (Figure 6). Arsenic, iron and manganese have shown exceedences of either DEQ-7 human health standards (arsenic) or site specific cleanup levels (iron, manganese). A remediation flow estimate of 63.5 gallons per minute has been estimated for this alluvial aquifer.

Ecologically Significant Vegetation

Two large fens are located within the Upper Marsh at the inlets of Paymaster Creek and Swamp Gulch. Fen at the mouth of Paymaster Creek is on federal land. These features are 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, 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 since 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). Disturbance of these fen areas should be avoided if possible.

Old Mike Horse Road, Old Drill Roads

The Mike Horse road is located on the eastern side of the Upper Marsh area and crosses the marsh near the intersection of Pass Creek (Figure 4). This road is an older feature of the site and was likely the original access to the site. It is believed to have been constructed originally of mine waste with recent gravel surfacing applied to facilitate mine waste hauling that started in 2014. The Mike Horse road impounds and passes the waters of Pass Creek through several culverts underneath the road. In the past, Pass Creek has coursed over the road into the marsh due to excessive flows or plugging of the culverts. The Mike Horse road acts somewhat as a damper to the higher flow events coming from Pass Creek, however Pass Creek is often dry by the end of the summer. The Forest Service administratively closed this road when the new

Meadow Creek road was built in 2010 to ensure public safety and to facilitate haul traffic during reclamation activities. The agency has also identified that this road would be removed at the end of the reclamation era to restore Pass Creek, eliminate a fish passage barrier, and eliminate a maintenance item.

The old drill roads within the Upper Marsh are similarly unnatural features in the marsh area and may have been constructed of mine waste. The agency proposes removal of these features as part of removal and on-site disposal for the Upper Marsh. The final configuration of these features will be addressed during site specific design.

3.2.5 Evaluation Area 5 (EA 5) – Mining Related Features

Mining related features on USFS lands include physical safety hazards such as unsecured portals, collapsing infrastructure or workings, waste piles, and remnant drilling era roads and pads. As discussed in Section 2.0 above, the UBMC area includes numerous abandoned and inactive mine sites with a variety of remnant features and issues including open or collapsed adit portals, waste rock piles and disturbed areas, discharging seeps and springs coming from underground workings, and remnant buildings and infrastructure that is in a deteriorated condition.

Sampling events conducted by DEQ in 2007, 2008, and 2011 at the UBMC identified 269 mining-related features, including mine waste piles, adits, and exploratory drill pads. Based on visual observations of runoff channels and/or other erosion features extending from the mine features to downgradient streams or floodplains, it was determined that some of the identified mine features could potentially impact surface water during times of high runoff, precipitation, or snow melt. Mine waste or associated material, stream sediment, and surface water samples were collected and analyzed at 20 of the features identified as potential sources of contamination to nearby surface water. Dry site conditions were encountered at many of the features during the mine inventory evaluation work, and transport of acidic or metal rich leachate, runoff, or sediment loading from mine wastes into nearby streams was not observed. 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 material or less than 100 cy of excavated rock present.
- No discharge to or contact with surface water.

Of the remaining 72 features, 39 are located on federal lands and are summarized in Table 3-4 by drainage area (See Figures 7 and 8). The primary areas of concern for EA 5 features on federal lands are Paymaster Gulch, Shave/Shaue Gulch and Stevens Gulch where numerous features are located.

Analytical results from the features sampled in the RI were compared against site specific cleanup levels (SSCLs) to determine areas of exceedance.

3.3 Summary of Waste Volume Estimates on Forest Service Lands

Remediation volume estimates for areas within the EAs on federal lands that would require remedial action based on the site specific contaminant levels are presented in Table 3-5. Site specific cleanup levels by media type have been developed for the site based on the Human Health and Ecological Risk Assessments performed for the site. These are presented in Section 4.0 below.

4.0 Human Health and Ecological Risk Assessments and Identification of Contaminants of Concern

Contaminants of concern were evaluated in the Baseline Ecological Risk Assessment (BERA) (Tetra Tech, 2013) and the UBMC Human Health Risk Assessment (HHRA) (DEQ 2014). The BERA identified that aluminum, cadmium, copper, lead, manganese and zinc pose an unacceptable risk to plants, invertebrates, birds and small mammals in all areas of the site except the stream sediments, and to invertebrates, fish and birds in the stream sediments. Based on a calculated risk index, the BERA identified the greatest risk at the UBMC is to aquatic receptors. The BERA concluded that the actual risk at the UBMC may be lower than the calculated risk due to the limited ability of the habitat to support a healthy ecological community.

The Human Health Risk Assessment (HHRA) evaluated risk at the UBMC for human health using four recreational scenarios, and a residential scenario to evaluate site specific cleanup levels that are protective of human health and the environment. Health risks were estimated for all types of media at the site for exposure to potential contaminants of concern. Based on the results of the HHRA, arsenic is the primary contaminant of concern for wastes exposed at the surface and lead is the primary contaminant of concern for specific exposed wastes. For the remaining wastes on federal lands that are not already part of a removal decision, arsenic is a primary contaminant of concern for the Mary P mine wastes, and Tunnel No. 3 mine wastes. The Mary P wastes are exposed at the surface and are easily accessible by humans as they are located adjacent to primary access roads. The Tunnel No. 3 wastes are adjacent to an open road and some portions have been covered by soil and have a grass surface, while other portions have bare soil. Thus, some areas are more easily accessible to humans and some are not. Lead is a primary contaminant of concern for human health on federal lands for the Mary P mine wastes, and in the Upper Marsh.

4.1 Future Anticipated Land Use

Future anticipated land uses were identified as part of determining protective values. The current land use is primarily recreational with a small area of industrial use at the water treatment plant. DEQ identified reasonably anticipated future land uses of the private lands of the site but not specifically the reasonably anticipated future land uses of the USFS lands. DEQ summarizes the reasonably anticipated future land uses as ‘recreational/open space’ with the exception of the water treatment plant area. DEQ also recognizes that some of the private lands could include part-time or full-time residential use.

Federal land managing regulations do not provide for markedly different land uses than those identified above for the private lands of the UBMC. In addition, the federal lands are intermixed with the private lands of the site. Thus, adopting the DEQ future anticipated land uses for the purpose of determining Human Health risk on USFS lands is an appropriate strategy.

4.2 Identification of Contaminants of Concern (COCs) and Site

SPECIFIC CLEANUP LEVELS (SSCLs)

Based on the results of the site characterization of the various media of the site, and the BERA and HHRAs, the primary contaminants of concern (COCs) of the UBMC are aluminum, arsenic, cadmium, copper, iron, lead, manganese and zinc. These contaminants were synthesized by DEQ from a broader list identified in the RI (Tetra Tech, 2013a). All of the contaminants are metals which are made available for mobilization as products of sulfide mineral oxidation and water which creates acid and releases metals, potentially to surface and groundwater. Human and ecological effects from these contaminants are found on pages 45-48 of the t Proposed Plan (DEQ, 2015).

Contaminants of Concern (COCs)

Human Health Contaminants of Concern (COCs) are arsenic and lead in all media. Ecological Contaminants of Concern (COCs) for all ecological receptors are arsenic, cadmium, copper, lead, manganese and zinc. Aluminum was assumed to pose a risk to ecological receptors where soil pH was less than 5.5. Mercury was not evaluated because it was almost nonexistent in samples from the site. Iron was not evaluated because no screening benchmarks are available for soil, sediment or the food chain model. However, background concentrations of metals tended to be higher than the identified cleanup levels in most of the features of the site with the exception of the marsh and stream sediments features. For the marsh area cadmium is the only metal that has a risk-based remediation goal. For streambed sediments, there are risk-based remediation goals for arsenic, cadmium, copper, lead and zinc.

Site Specific Cleanup Levels (SSCLs)

Site specific cleanup levels (SSCLs) are concentrations in environmental media that correspond to a specific, acceptable target or hazard level when humans or ecological receptors comes into contact with a contaminated media or established site specific background concentrations. Site Specific Cleanup levels have been established for the various media of the site based on the HHRA and BERA. A summary of the human and or ecological health cleanup levels for soil and sediment is found on Table 4-1. For surface and groundwater the DEQ-7 human health water quality standards are the applicable cleanup levels unless site specific background levels exceed the DEQ-7 numeric water quality standards. In that case the background level becomes the SSCL. For COCs without a DEQ-7 human health standard available (aluminum, iron, manganese) the HHRA evaluated and established cleanup levels. A summary of the proposed groundwater and surface water cleanup levels are provided in Table 4-2.

5.0 Remedial Action Objectives

Preliminary Remedial Action Objectives have been established sitewide for the UBMC to aid in the identification and screening of remedial alternatives that will be protective of public health and safety and welfare of the environment. These objectives are the same as those identified by DEQ for the site with the addition of meeting Applicable, Relevant and Appropriate Requirements (ARARs) for the site. The cleanup activities on the site must attain a level of cleanup consistent with Applicable, Relevant and Appropriate Requirements (ARARs) for the site conditions which are a functional equivalent to DEQ's ERCLs (Environmental

Requirements, Criteria or Limitations). Appendix A includes the preliminary ARARs identified for the federal lands of the UBMC site.

The Preliminary Remedial Action Objectives for solid media for the site (soils, sediments, including mine waste and tailings) include:

- Prevent exposure of humans to COCs in solid media at concentrations greater than site specific cleanup levels
- Prevent exposure of ecological receptors to COCs in solid media at concentrations greater than site specific cleanup levels
- Reduce ecological risks to levels that will result in the recovery and maintenance of the health of local populations and communities of plants and animals
- Prevent migration of COCs from solid media to groundwater and surface water that would result in exceedences of site specific cleanup levels
- Meet site specific cleanup levels for COCs in soil and sediment
- Comply with Applicable, Relevant and Appropriate Requirements (ARARs)

The Preliminary Remedial Action Objectives for water media for the site (surface and groundwater) include:

- Meet groundwater and surface water site specific cleanup levels 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 site specific cleanup levels
- Comply with ARARs/ERCLs

6.0 Summary of Alternative Development

The Feasibility Study (Pioneer, 2015) developed and described remedial alternatives evaluated to clean up soil, sediments, groundwater and surface water at the UBMC (pages 82-105). This section summarizes the remedial alternatives that have been developed as they apply to the features of the site on USFS lands, identifies the criteria that are used to evaluate the remedial responses, and includes analysis of the alternative responses to the site features.

6.1 Remedial Activities That Apply to the Overall Site (Sitewide Elements)

All of the response alternatives, *except for No Action*, for the UBMC may have some type of activities that will need to be conducted regardless of the selected alternative, due to the size and previous actions that have been implemented on the site. These activities are referred to as Site Wide Elements. These elements are not separated by landownership. The site wide activities/elements include:

- Institutional Controls - Deed Restrictions, Easements, Covenants, Reservations
- Access Restrictions
- Long-term Monitoring and Maintenance

Institutional controls (ICs) may be placed on the site to mitigate the risk to public health, safety and welfare, and the environment. On the private lands of the site they may include but are not limited to: 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. On federal lands, institutional controls generally refer to management actions that can be taken to limit or restrict public access such as road or area closures. ICs do not remediate the contamination. For solid media, ICs prohibiting excavation in areas of capped or contained waste may be necessary. Although access restrictions limit exposure pathways, all identified contamination remains at the UBMC at concentrations exceeding the SSCLs and continues to impact soil, groundwater and surface water quality, and environmental receptors. Access restrictions can include road closures, installation of fencing and gates, and posting of signage.

A long-term monitoring and maintenance program evaluates the effectiveness of any remediation and ensures the protection of public health and the environment. At present, a long-term monitoring program for the UBMC includes semiannual sampling of an existing groundwater monitoring well network of 10 wells and vegetative cover inspections at the Mike Horse, Paymaster and Carbonate Repositories. For FS cost estimation purposes of this site-wide element, the existing monitoring program is expanded to include surface water monitoring at six stations along the Blackfoot River and at the Carbonate Mine and vegetative cover inspections at areas within the UBMC where waste is treated in place. Long-term monitoring and maintenance costs are calculated for a period of 30 years, taking into account the anticipated compliance of the remedy with applicable standards. Performance monitoring, if required, is included with the applicable alternative and not as a site-wide element.

6.2 Remedial Alternatives

The FS included an initial screening of potential alternatives and technologies for the site which resulted in elimination of alternatives that were not feasible for the UBMC site and retention of alternatives that are feasible (FS, pages 82-105). The resulting alternatives that have been retained as applicable for the site for the federal lands, and the media type they would address are listed below along with summary descriptions of the alternatives. More detailed information about these alternatives and the features they respond to are found in the FS.

Solid and Liquid Media Alternatives

Alternative 1 – No Action

Solid Media Alternatives– Soils, Sediment

Alternative 2 – Monitored Natural Recovery (sediments)
Alternative 3 – Physical Barriers (physical hazards)
Alternative 4 – Containment (soils and sediment)
Alternative 5 – Removal and On Site Disposal (soils and sediment)
Alternative 6 – Removal and Off Site Disposal (soils and sediment)
Alternative 7 – In-Situ Neutralization with Alkaline Amendment (soils)
Alternative 8 – Ex-Situ Neutralization with Alkaline Amendment (soils)

Liquid Media Alternatives – Surface and Ground Water

Alternative 9 – Monitored Natural Attenuation (MNA) (groundwater)
Alternative 10 – Containment (Retention Pond)

Descriptive summaries of these alternative cleanup methods are described below.

Alternative 1 - No Action

Under the No Action Alternative, no remedial activities would be conducted at the UBMC for the identified feature to reduce the risk from physical hazards or contaminated media. All contaminated media would remain in place. No Action serves as a baseline to compare other alternatives and help understand risk levels at the facility

Alternative 2 – Monitored Natural Recovery

Monitored natural recovery (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 and applies to the UBMC. EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA, 2005) indicates that MNR is similar in some ways to MNA used for groundwater and that the key difference between MNA for groundwater and MNR for sediment is in the type of processes most often being relied upon to reduce risk. "Isolation and mixing of contaminants through natural sedimentation is the process most frequently relied upon for contaminated sediment" (EPA, 2005). Under the MNR alternative, sediment is regularly monitored to track changes in COC concentrations with time after source removal or control actions. MNR relies on the mixing and isolation of contaminants through natural sedimentation processes without active treatment

Alternative 3- Engineering Controls – Physical Barriers

Physical barriers are often needed to prevent the public from entry into collapsing and unsafe mine workings. This work can be accomplished by installing bat gates, plugs, or bulkheads in adits or backfilling the openings reduces or prohibits entry by humans. These technologies are widely used, highly reliable, easy to maintain, and effectively seal or block unauthorized access to mine entrances. These structures provide no remediation to reduce toxicity, mobility, or volume of COCs and will only be identified herein where the physical control accompanies another alternative response action. The exterior portions of the access controls are often subject to vandalism and need to be inspected and repaired as needed.

Alternative 4 – Containment

Earthen vegetative covers include placing a soil and plant cover over the area to reduce the direct contact exposure pathway and establishing a self-sustaining plant cover to minimize erosion. The measure provides no remediation to reduce the toxicity, concentration, or volume of COCs and does not eliminate water infiltration and acid drainage, but may reduce the amount of infiltration and thus the volume of acid drainage. Containment may be more effective if waste is amended to reduce the toxicity and mobility of COCs before placing the cover. EPA's presumptive remedy guidance for metals-in-soils indicates containment may be appropriate for low-hazard wastes, such as those that do not exhibit leaching potential or are near the applicable SSCL (EPA, 2009).

In some areas where removal is not feasible and slopes are too steep (greater than 3:1 horizontal:vertical [3H:1V]) to establish a vegetative cover, applying an angular rock cover reduces direct contact, rain-drop impact energy with contaminated soils, and the associated erosion and transport of contaminated media. Rock covers can 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. It is most applicable to areas of lower levels of contamination, where other actions are not feasible, or where covering native high metals materials is necessary. The action can be applied in a wide variety of situations to enhance slope stability and reduce erosion. Additional erosion control measures such as slope drains, benching, cross-slope drains, erosion control blankets, check dams, and sediment traps may be required. Costs are driven by access, waste volume and area, and availability of a suitable source of cover material. Containment does not eliminate infiltration and may require a high level of maintenance in terms of erosion and weed control.

Alternative 5 – Removal and On-site Disposal

Removal actions typically call for wastes to be excavated to an established cleanup level, or excavated to a physical/visual indicator such as groundwater, underlying native lithologic unit, pre-determined over-excavation depth, or bedrock. Following removal the wastes would be taken to a approved repository site. Removal actions may be applied to any solid media at the facility including, but not limited to, waste rock, tailings, metals laden overburden, spoils, contaminated sediments, or contaminated underlying soils.

The measure is typically very effective for both large volume sources and smaller concentrated sources located close to or in direct contact with water. The excavated material is removed to a location away from surface water and other sensitive receptors and capped and/or isolated within a repository, making repository construction and capping co-alternatives. Removal is also

effective for small quantities, which may be removed and disposed at an off-site or on-site repository.

Removal is a proven remediation option that is typically highly effective and may be capable of meeting applicable removal objectives. The option is best suited for areas with adequate access; removal of small and/or isolated areas located away from good access roads is typically not cost effective. The impacts from road construction to reach sources, particularly in mineralized areas, may offset or exceed the benefits of removal. Standard equipment, survey activities, and construction oversight are required and numerous experienced contractors are available to complete the work

Temporary stream diversion and dewatering may be required if the source is located immediately adjacent to surface water or extends below the ground surface to groundwater. Over-excavation of material beneath the waste source is often required to ensure leached metals are adequately removed from underlying soils. Removal verification sampling can also verify removal effectiveness. Because over-excavation of native materials below the waste source is often necessary, clean backfill and cover material is typically required to reestablish natural grades and to provide suitable growth media for revegetation efforts

Removal costs vary greatly depending on availability of on-site disposal areas, additional off-site disposal costs, site accessibility, effort required to dewater or dry materials, haul distance to disposal areas, and availability and cost of suitable backfill and/or cover material. Additional sampling analyses, construction oversight, and monitoring of remediated areas and disposal sites also contribute to the total costs, but are typically small in comparison to the other factors.

Disposal of mine waste in an on-site repository is a conventional, widely used, and highly effective technology. The technology involves excavating (and typically drying) mine wastes and placing them within an engineered repository. The measure is highly effective and capable of meeting applicable PRAOs and reducing or effectively eliminating human and environmental exposures. Repositories typically incorporate an engineered cap with a vegetated earthen-cover soil layer, drainage layers, and a synthetic membrane cap liner to prevent water from infiltrating into and passing through the waste materials. In some cases, if waste materials are particularly reactive or highly metals laden, drainage layers, membrane bottom liners, clay liners, and leachate collection systems can also be employed to provide additional protection of groundwater resources at the repository site. It is also common for the repository excavation to serve as the cover soil borrow source for other site reclamation activities.

Implementability is driven by space, geology, groundwater, waste volume, and transport logistics. Repository construction typically only requires standard construction equipment, survey activities, and management practices and numerous experienced contractors are available regionally. There is a risk of spills during transport, but planning to address rapid response and cleanup activities is simple and typically available via the construction contractor. Long-term monitoring of the repository to verify vegetation establishment and to ensure protection of local groundwater is typical. Existing repositories are available within the UBMC at the Paymaster Mine and the Carbonate Mine; the Mike Horse Mine Repository is being removed as part of the 2014-2015 interim action. In addition, the USFS selected the on-site repository currently being constructed at Section 35 under its Action Memorandum, as amended. Use of the Paymaster and/or Carbonate Repository would require additional engineering.

Alternative 6 – Removal and Off-Site Disposal

Alternative 6 is similar to Alternative 5 except the solid wastes would be transported to a regulated, permitted facility. Removal costs are greatly increased with this alternative due to disposal distances. Disposal of contaminated solid media at an off-site repository is a commonly used conventional technology and involves excavating (and sometimes drying) mine wastes and placing them within an engineered repository. The off-site repository may be constructed to serve a single specific mine site, designed as a regional repository to service multiple sites, or may be a separate existing permitted facility not associated with the cleanup project. The measure can be highly effective in meeting PRAOs and decreasing risk of exposure at the remediation site. Typically, designing an off-site repository follows the same general procedures and criteria used to site and design an on-site repository. Off-site repositories may be used if a suitable repository site is not available on-site.

Disposal of solid media associated with mining waste at an off-site repository is typically limited to disposal of small volumes of highly contaminated solid media or treatment residues from treatment facilities. High transportation costs and landfill disposal fees make disposal of large volumes of mine waste too costly to be practical in most cases. If the waste to be disposed of fails the Toxicity Characteristic Leaching Procedure (TCLP) test, disposal in a permitted RCRA Type C facility may be required. Currently there are no such facilities in Montana and wastes would have to be disposed of out of state, making transportation and disposal at such a facility expensive.

Alternative 7 – In-Situ Neutralization with Alkaline Amendment

In-situ neutralization involves adding cement kiln dust, lime, or other alkaline material to mine waste and mixing the materials to neutralize acid-producing wastes. EPA's presumptive remedy guidance for metals-in-soils indicates that neutralization is a presumptive remedy for source materials, soils containing high levels of contaminants, and highly mobile contaminants (EPA, 2009). Acid mine drainage (AMD) is reduced by increasing the pH of the mixed materials and providing excess buffering capacity to minimize or eliminate acid production in the mine waste. Because most metals are typically only mobile or bio-available at low pH, increasing the pH decreases the mobility and bio-availability of the metals in the mine waste materials. Effectiveness is limited to the tillage depth and by the ability to get complete and uniform mixing of the amendments with the waste material. At the UBMC, in-situ neutralization is applicable to waste deposits less than 2 feet thick, or treatment of residual soil contamination following the removal of waste piles.

This treatment can be a very effective method to reduce the mobility of residual metals in underlying soils after removal of overlying contaminated materials. While treatment does not reduce the concentration of metals in the treated soils, it can effectively immobilize the metals to prevent migration to surface water and groundwater as well reduce the bioavailability of the metals for environmental receptors. It is difficult to safely operate tilling and mixing equipment on steep slopes (greater than 3 to 1 H:V).

Typically, excess amendment is added to wastes to address active acidity as well as the future acid-generating potential of the materials. Amendment materials need to be carefully selected to ensure an appropriate fine-size fraction to facilitate maximum soil particle contact and chemical reaction surface area. Amendment materials must also provide sufficient alkalinity to provide an

initial pH increase to precipitate metals already in solution within the soil. An equilibrating period is usually required after treatment to allow the pH to return to near neutral conditions to allow successful revegetation.

Treatment of materials in close proximity to groundwater or surface water is typically not recommended. Frequent rewetting can cause separation of the amendment from the soil particles and render the treatment ineffective. Erosion of treated materials may result in separation or segregation of the amendment material from the soil particles, thereby reducing the overall effectiveness of the treatment; therefore, this is not recommended for remediation of wastes in a floodplain or stream channel migration zone (CMZ).

Lime and other amendment sources may be limited and/or expensive due to current market conditions. Consideration of the cost and availability of lime materials is necessary during design to determine the availability of suitable sources and long-term contracts are sometimes required. Mine waste sources are typically heterogeneous and frequent testing is needed to determine the properties of the materials as they are treated and to adjust amendment rates as needed. Over-treatment of materials can inhibit vegetation establishment and/or cause the mobility of arsenic to increase. Additional construction oversight and testing would help to manage these issues during construction. The technology can be effective if used in conjunction with other alternatives.

Alternative 8 – Ex Situ Neutralization with Alkaline Amendment

This treatment action requires excavating and removing wastes to a mixing location, adding alkaline amendments (cement kiln dust, lime, or other alkaline material), and thoroughly mixing the amendment with the waste materials to neutralize acids and enhance the long-term geochemical stability of the treated waste mass. EPA's presumptive remedy guidance for metals-in-soils indicates that neutralization is a presumptive remedy for source materials, soils containing high levels of contaminants, and highly mobile contaminants (EPA, 2009). AMD is reduced by neutralizing the acid-generating potential of the wastes and through the associated decrease in metals mobility with increased pH. The neutralized waste material may be returned to the original excavation area, placed in a separate consolidation area, or placed in a repository.

This conventional technology is commonly used regionally and was applied at the Paymaster and Carbonate Mine repositories, as well as numerous other mine waste sites in Montana. If the technique is intended to stabilize soils in a consolidation area without an engineered cap or cover system, rigorous testing is needed during construction to adjust amendment ratios as needed to ensure adequate neutralization. Lime and other amendment sources may be limited and/or expensive due to current market conditions. Consideration of the cost and availability of lime materials is necessary during design to determine the availability of suitable sources and long-term contracts are sometimes required.

Alternative 9 – Monitored Natural Attenuation (MNA)

Monitored Natural Attenuation (MNA) for groundwater is typically used in conjunction with source removal. After source removal, groundwater quality would be monitored regularly to confirm that COC concentrations are improving over time and will reach SSCLs. The alternative relies on natural processes and source remediation efforts to reduce concentrations of COCs through time. The alternative alone would not meet PRAOs.

The measure would be easily implemented using the existing groundwater monitoring wells at the facility; however, it requires a comprehensive, long-term monitoring and data management and assessment plan. Monitoring for this alternative could be effectively combined with the site-wide long-term monitoring to reduce costs. The option can be used in conjunction with other alternatives and is applicable to some features that have already been reclaimed if implementing additional remedial actions is not deemed necessary. The MNA alternative can also be used in conjunction with site-wide ICs and to determine how and when ICs for portions of the facility may be revised.

Contaminant sources for surface water are being removed within the floodplain upstream of the Upper Marsh and the water treatment plant is treating contaminated water before it is discharged to surface water. As these sources are removed and clean water enters the system, surface water contaminant concentrations will decrease through dispersion and dilution. DEQ-7 standards may be achieved within 30 to 40 years, when combined with other alternatives or through natural attenuation, 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.

Alternative 10 - Containment (Retention Pond)

This measure uses a lined pond constructed near a drainage or seepage source to capture and retain Acid Mine Drainage (AMD). Treatment usually relies on evaporation and is therefore applicable only to low flows and not applicable to surface runoff flows with highly variable seasonal flows.

Evaporation of the water concentrates the metals in the water and leaves behind a residue of soluble metal salts. Periodic cleaning of the pond may be required to remove the residues. In some cases it may be necessary to remove and haul the water to a water treatment facility for treatment prior to disposal. The high concentrations and typically low pH of the water in the ponds may present high exposure risks to birds and other receptors; fencing, netting, or other engineering controls are needed to minimize receptors coming into direct contact with the AMD. Because the technology relies on evaporation, the effectiveness is greatly reduced at high elevations, cool climates, and on north-facing slopes.

For this option, design and construction are relatively easy and require only common construction techniques. The ponds require periodic inspections and can be prone to failure. If not covered with soils, the synthetic liner systems pose physical hazards to wildlife, deteriorate over time with exposure to sunlight, and may require periodic replacement. Ponds with exposed liners should be fenced and signed to prevent human and wildlife access. This option is best used in conjunction with other treatment options that use the containment systems for temporary storage or provide overflow capacity prior to water treatment.

6.3 Remedy Selection Criteria

The remedy selection criteria are the parameters identified below that are used to evaluate and compare the effectiveness of the various remedial alternatives. These criteria were developed and described for the site in more detail in the FS, pages 82-83. These criteria are consistent with EPA's Guidance on Conducting Non-Time Critical Removal Actions (EPA, 1993) and are summarized as follows:

Protectiveness: Overall protection of human health 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 substances, pollutants, or contaminants present at the facility by eliminating, reducing, or controlling exposure to protective levels. This criterion is a threshold that must be met by the selected alternative or combinations of alternatives.

Compliance with ARARs: This criterion evaluates whether each alternative will meet applicable or relevant state and federal requirements (ARARs). This criterion is a threshold that must be met by the selected alternative or combination of alternatives unless an applicable ARAR is waived. (ERCLS under CECRA are similar to ARARs, which are evaluated by the USFS under CERCLA and the NCP.)

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 this technology and approach could be applied at the facility.

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

- Capital costs, including both direct and indirect costs
- Annual O&M costs, including long-term effectiveness monitoring cost
- Periodic cost
- Implementation of ICs
- Net present worth of capital, O&M costs, periodic costs, and implementation of ICs

6.4 Remedial Alternatives Analysis for Contaminant Features on Federal Lands

The remedial technologies and representative process options discussed in Section 6.2 above have been assembled into remedial alternatives for the federal lands features in each Evaluation Area at the UBMC site in Tables 6-1 through 6-4. These tables are similar to the alternative tables provided in the Proposed Plan (Tables 10-1 to 10-5). Note that some remedial technologies do not apply to all of the media types. Groundwater is not included as a separate

table for federal lands as most of the identified source areas are located on private lands, and monitoring of the effectiveness of upgradient removal activities will be needed to evaluate if improvements to groundwater quality occur and to determine if additional actions are warranted.

It is important to note that the following alternatives evaluations are discussed as if they applied broadly across the UBMC. For some alternatives and the features they are responsive to, this is appropriate and for others it is not. However, it is useful for comparison of costs and effectiveness in the situation that a given alternative is applied broadly to the site.

Alternative 1 - No Action

Under the no action alternative, identified contamination remains at the UBMC and continues to impact soil, groundwater and surface water quality, and environmental receptors.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 within 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 present inundated conditions 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 ARARs/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 it is reasonable to assume compliance with ARARs/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 – The estimated total present worth cost for implementing this alternative at the UBMC is $0.

Seven alternatives were evaluated for solid media and physical hazards on federal lands at the UBMC:

- Alternative 2: Monitored Natural Recovery

- Alternative 3: Physical Barriers
- Alternative 4: Containment
- Alternative 5: Removal and On-site Disposal
- Alternative 6: Removal and Off-site Disposal
- Alternative 7: In-situ Neutralization with Alkaline Amendment
- Alternative 8: Ex-situ Neutralization with Alkaline Amendment

Alternative 2 – Monitored Natural Recovery

Under the MNR alternative, contaminated sediment are periodically monitored to track changes in COC concentrations with time after application of source removal or control actions. MNR relies on the mixing and isolation of contaminants through natural sedimentation processes without active treatment and is applicable to sediment. The features MNR can be applied to on federal lands are the Blackfoot River, Stevens Creek, Porcupine Creek, Shave Creek, and the upper marsh (EA's 3 and 4, Tables 6-2, 6-3). 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 acceptable standards. Performance monitoring 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 the 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 determined by the success of source removal or control actions. In some stream areas such as Stevens Creek and Porcupine Creek the application of MNR may represent a practical response alternative to more construction-oriented options that would result in new road construction and the potential for exposing the ore body that is in the shallow subsurface.

Compliance with ARARs/ERCLs - Under this alternative, contamination remains in place at concentrations exceeding SSCLs and may serve as a continuing source 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 ARARs/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.

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 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 – The estimated total present worth cost for implementing this alternative at all of the applicable features on the federal lands at the UBMC is approximately $1,609,800.

Alternative 3 – Physical Barriers

Under this alternative, adit openings or other physical hazards associated with mining-related features 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 hazards at PC-21, and SH-06. The partially open well casing at SG-01 would be plugged or backfilled. This alternative only addresses the safety hazards associated with open adits and well casings. The waste rock at SH-06 is addressed under other alternatives. On federal lands this alternative applies to EA 5 Mining Related Features and would only be applied in conjunction with a response action that addresses a human health or environmental issue.

Protectiveness –This alternative is protective of the public safety, associated with open adits and well casings because the openings would be closed to prevent human entry. This alternative does not address risk to human health and the environment posed by exposure to COCs and would need to be combined with other alternatives to address the exceedances of SSCLs at SH-06.

Compliance with ARARs/ERCLs – This alternative only addresses the safety hazards associated with open adits and well casings. There are no ERCLs applicable to this alternative. As noted above, the waste rock at SH-06 would be addressed under other alternatives.

Mitigation of Risk – By eliminating purposeful or accidental access to the adit opening and other physical hazards, risks to public safety, would be mitigated under this alternative. This alternative does not address risk to human health and the environment posed by exposure to COCs and would need to be combined with other alternatives to address the exceedances of SSCLs at SH-06.

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 and other physical 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 and hazard closure is a standard mining construction practice. Physical barriers could be easily implemented at the four mining-related features under this alternative

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

Cost Effectiveness – The estimated total present worth cost for implementing this alternative at the applicable features on the UBMC on federal lands is $133,200.

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Alternative 4 – Containment – solid media

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 waste areas on federal lands in EA 1, to the waste rock/soils/sediments located in the EA 3 areas, and the waste rock piles associated with the mining related features in EA 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 protection to groundwater SSCLs and could serve as a continued source of contamination to groundwater.

Compliance with ARARs/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 ARARs/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 ARARs/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 relevant reclamation ARARs/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 protection to groundwater SSCLs may continue to leach to groundwater, and therefore this alternative does not adequately mitigate risk to human health and the environment. Alternatively,

opening roads and other infrastructure to get some of these features may exacerbate contamination issues.

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 in close proximity 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 – The estimated total present worth cost for implementing this alternative on all of the applicable features on federal land at the UBMC is approximately $4,925,000.

Alternative 5 – Removal and On-site Disposal

Under this alternative all solid media (soil and sediment) exceeding the SSCLs would be removed, transported, and disposed of at an engineered on-site repository. Removal is applicable to areas within EA 1 (Table 6-1), EA 3 (Table 6-2), EA 4 (Table 6-3), and most of the mining-related features in EA 5 (Table 6-4).

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. Alternatively, opening roads and other infrastructure to get some of the more remote features may exacerbate contamination issues.

Compliance with ARARs/ERCLs –Since the contamination exceeding the SSCLs is effectively 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 ARARs/ERCLs immediately. In locations of impacted groundwater and/or surface water, compliance with surface water and groundwater ARARs/ERCLs may be achieved within 30 to 40 years, when combined other alternatives or through natural attenuation, 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 is sited in an area that meets location-specific ARARs/ERCLs and is designed and constructed to comply

with solid waste ARARs/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 ARARs/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 in close proximity 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 estimated total present worth cost for implementing this alternative on all of the applicable federal features at the UBMC is approximately $13,726,000.

Alternative 6 – Removal and Off-site Disposal

Under this alternative all solid media (soil and sediment) exceeding the SSCLs would be removed, transported, and disposed of at an engineered off-site repository. Removal is applicable to areas within EA 1, EA 3, EA 4 , and most of the mining-related features in EA 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 ARARs/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 ARARs/ERCLs immediately. In locations of impacted

groundwater and/or surface water, compliance with surface water and groundwater ARARs/ ERCLs may be achieved within 30 to 40 years, when combined other alternatives or through natural attenuation, 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 meets location-specific ARARs/ERCLs and would be designed and constructed to comply with solid waste ARARs/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 ARARs/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 in close proximity 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 estimated total present worth cost for implementing this alternative on the applicable features on federal land at the UBMC is approximately $18, 203,000.

Alternative 7– In Situ Neutralization with Alkaline Amendment

Under this alternative, all solid media (soil), such as mine waste piles, 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. Concentration of metals in the soil is unchanged. In-situ neutralization is applicable to areas within EA1 (Table 6-1) and most of the mining-related features in EA-5 (Table 6-4).

Protectiveness – This alternative is a treatment that is 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 protection to groundwater SSCLs.

Compliance with ARARs/ERCLs - Under this alternative, contamination remains in place at concentrations exceeding protection to groundwater SSCLs. In areas of impacted groundwater or surface water, compliance with surface water and groundwater ARARs/ERCLs may be achieved within 30 to 40 years, when combined other alternatives or through natural attenuation, 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 ARARs/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 protection 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 in close proximity 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 off-site source of lime is required and will involve hauling of these materials on public roads. This alternative is practicable and implementable at the UBMC to waste deposits less than 2 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 - The estimated total present worth cost for implementing this alternative on the applicable features on federal land at the UBMC is approximately $2,303,000.

Alternative 8 - Ex-situ Neutralization with Alkaline Amendment

Under this alternative, all solid media (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, the Mary P waste dump and the Tunnel No. 3 wastes area on federal lands

Protectiveness – This alternative is a treatment that is 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 protection to groundwater SSCLs.

Compliance with ARARs/ERCLs - Under this alternative, contamination remains in place at concentrations exceeding protection to groundwater SSCLs. In areas of impacted groundwater or surface water, compliance with surface water and groundwater ARARs/ERCLs may be achieved within 30 to 40 years, when combined other alternatives or through natural attenuation. 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 ARARs/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 ARARs/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 protection 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 in close proximity to surface water. Best management practices 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, mixing, 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 these materials on public roads. This alternative is practicable and implementable at the UBMC to large areas of previous removal that exceed 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 - The estimated total present worth cost for implementing this alternative for the applicable features on federal land at the UBMC is $109,000.

Alternative 9 - Monitored Natural Attenuation (MNA) – applicable to groundwater in Upper Marsh on federal lands

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 on federal lands within the Upper Marsh – EA-4 (Table 6-3). 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 determined by the success of source removal or control actions.

Compliance with ARARs/ERCLs - Based on experience at other similar sites such as Silver Bow Creek in Butte, Montana, compliance with groundwater ARARs/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 ARARs/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 process, 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 off-site. 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. 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 – The estimated total present worth cost for implementing this alternative on the applicable features on federal land at the UBMC is $296,000.

Alternative 10 – Containment (Retention Pond for surface water, seeps, discharges)

Under the containment (retention pond) alternative, surface water would be captured and stored in a retention pond or gallery of some type. Retention relies on evaporation and/or infiltration without active treatment. Containment is applicable on federal lands in the upland waste areas of EA 1 and mining-related features within EA-5 that have seeps or discharges, which are captured on (Table 6-2 under EA-3. This technology is not applicable for larger flow quantities such as creeks or rivers in this space-limited upland environment.

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 ARARs/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 ARARs/ERCLs because of continuing inputs of contamination. Based on engineering judgment and review of guidance documentation (EPA, 2015), surface water downstream of the retention pond may comply with ARARs/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.

Effectiveness and Reliability – Containment of water in a retention pond will reduce the extent of impacts resulting from 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 potential need for excavation, filling, lining, grading, and revegetation steps 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 - The estimated total present worth cost to implement this alternative at the UBMC is approximately $900,000.

7.0 Proposed Remedial Response Options for Federal Lands

As identified previously, DEQ has issued the UBMC Proposed Plan (2015) for the preferred remedy for the private lands of the UBMC site. This section describes the proposed response actions for the USFS lands of the UBMC site that were not previously included in the Forest Services' 2007 Action Memorandum. The Forest Service's proposed responses herein are, for the most part, the same actions included in DEQ's proposed plan on pages 73-82. The reason for this is based on the complex landownership array that has resulted in artificial landowner boundaries being placed on site features with portions located on both ownerships. In addition, the agencies agreed to a holistic and watershed-based cleanup strategy for this site when they ratified the Watershed Restoration Agreement in 2008. Application of this strategy has successfully guided the ongoing removal activities of the Mike Horse dam and impounded tailings as well as the evaluation and selection of the Section 35 repository site, a site-wide repository for the wastes of this facility

The proposed remedial response options herein are conceptual, based on a site-wide approach. Once response options are selected, more site specific design level activities will be conducted, and construction techniques developed. It is possible that new information or changes in site conditions gleaned through design, or through application of Site Wide Elements, could result in adjustments of the selected remedy. The proposed remedial response options herein also incorporate restoration components and costs at the site wide level. Specific restoration activities will also be determined at the design level and it is possible that new information or changes at the site could result in adjustments. The Forest Service will be consulted and authorize any changes that result in ground disturbance on federal lands

The total cost for the proposed response action on the federal lands of the site is $7,123,838.

Site-Wide Elements

Site wide elements, as identified above, include institutional controls and access restrictions and long term operations and monitoring for the site that may be needed over many years, regardless of the selected response actions. The federal lands response actions below identify the costs for implementation of the proposed response actions and site wide elements where they apply

EA 1 – Upland Waste Areas

The features of EA 1 located on federal lands that were identified above as having COCs above site cleanup levels are the Mary P waste dump and the Tunnel No 3 wastes. Note that a portion of the Mary P waste dump is believed to be on private lands, however, the waste pile is small, thus the entire volume is included herein. The proposed response action for the soils of the Mary P waste dump and Tunnel No. 3 sites is Alternative 5 – Removal and On-site Disposal described in Section 6.4 above.

Alternative 5 would result in the complete removal of all soils with metal values exceeding cleanup levels, including any potentially contaminated subsurface soils, and reclamation of the removal area to restore site productivity. The rationale for this proposed response is that soils of these mine areas exceed site specific cleanup levels, are physically close to good roads for an ease of access, and they are easily accessible to the recreating public. The need for post response Site wide controls is minimal as these actions will not require post removal protections.

The total estimated volume of contaminated soils to be removed for these two features is 2,892 cubic yards. The total cost for the proposed response actions on the identified features of EA-1 is $96,000.

EA 3 - Surface Water and Stream Sediment

Blackfoot River – Removal of sediment sources from federal lands within the Blackfoot River channel is limited to the Upper Marsh area, see EA 4, below.

Stevens Gulch – Stevens Gulch includes sediments in the stream channel and surface flows. Stevens Gulch is a steep sided, deeply incised drainage with little access. On federal lands, there are three mine features with some type of discharge that have either suspected or confirmed water quality exceedences. None of the flows from these features reaches the mouth of Stevens Creek and sampling suggests the overall water quality from Stevens Creek entering the Blackfoot River during intermittent flow events is improving, primarily as a result of the removal of the Capital Mine wastes in 1997. For these reasons the proposed response alternative on federal lands for the Stevens Gulch discharges, including SG 55 and SG 98 is Site Wide Elements. The specific technology would be determined during detailed design.

The sediments that are in Stevens Creek show a similar trend also suggesting that metal contaminants in the sediments are reducing over time due to removal of a primary sediment source at the Capital mine. While removal activities are possible within this drainage, the risk of creating new contaminant sources through construction activities is high. For these reasons, the proposed response action alternative for EA 3 Stevens Gulch sediments is Alternative 2 –

Monitored Natural Recovery. Monitoring could trigger the need for more aggressive response at a later time should the need or opportunity arise.

Paymaster Creek – Paymaster Creek has a similar mineralized signature to Stevens Creek and the stream area has mapped natural ferricrete deposits. While removal activities are possible within this drainage, the risk of creating new contaminant sources through construction activities is high. In addition, the natural fen feature located at the base of Paymaster Creek in the Blackfoot River floodplain is a feature that is dependent on the flows of Paymaster Creek. For these reasons, the proposed response action alternative for the stream is Alternative 1 – Site Wide Elements. This alternative is conditioned on the understanding that the natural chemistry of Paymaster Creek may never reach water quality standards, and the need to maintain the downstream fen feature. Paymaster Creek sediments proposed response action is Alternative 2 Monitored Natural Recovery similar to Stevens Creek. Monitoring could trigger the need for more aggressive response at a later time should the need or opportunity arise

Shave/Shaue Creek - Shave Creek exceedences are attributable to sediment sources that have eroded into the drainage from upland mining features and adit discharges. Because the amount of stream sediments is very small and a substantial reach of stream would be excavated to achieve the removal, the proposed response action alternative for the sediments is Alternative 2 – Monitored Natural Recovery. Also note that recovery of this section of Shave Creek could result from removal of upstream wastes as described in EA 5 below. Similar to Stevens Gulch, the mine discharges in Shave Gulch exhibit low flows to a stream that doesn't usually flow into the Blackfoot River during parts of the year, and source removals have not yet been conducted to determine if contaminant levels in the adit would be reduced over time. For these reasons, the proposed response alternative for EA 3 Shave Creek adit SH-43 on federal lands is Site Wide Elements.

Porcupine Creek - The proposed remedy for Porcupine Creek sediments is Alternative 2- Monitored Natural Recovery. Removal options are not considered due to the low volume of contaminated material and the need for extensive construction to conduct a small scale removal with little potential site improvement. The proposed remedy for the Porcupine Creek adit PBBS is Site Wide Elements due to the small volume of discharge, and the need for relatively extensive construction activities for a relatively small flow.

Note that small volume surface water discharges on federal lands associated with the historic mine workings on federal land, including BR-01, PBBS, PC-11 and PC-22, are currently known to be low volume flows associated with some level of collapsed mine workings. All of these discharges are problematic for collecting and treating, and mayexhibit only localized impacts, if any. For example, Pass Creek does not show any water quality impacts from the small flows associated with PC-11, PC-22 (RI, 2013a). There is potential for a substantive remedy to result in more harm than good. For these reasons, the proposed response action for these features is Site Wide Elements. If additional monitoring results in changed site conditions change, a different response option may need to be considered.

The total cost for the response options for the surface water features of EA 3 with the exception of the sediments that are included in EA 5 below is $1,545,080.

EA 4 – Upper Marsh

The Upper Marsh as described previously is located on federal and private lands and is a difficult feature to dissemble into representative landownerships. For this reason, the preferred remedy for the eastern and western marsh areas is the same as identified in DEQs proposed plan on pages 79-80. In summary, the preferred remedy for the sediments of the eastern portion of the upper marsh is Alternative 5 – Removal and On Site Disposal of tailings throughout the eastern marsh area floodplain. There would be no removal in the area of the fens and in an appropriate buffer area surrounding the fens. Removal and On Site Disposal includes removal of the sediments within the Blackfoot River channel and floodplain area as it courses through the eastern marsh, with onsite disposal in the Section 35 repository site. This also includes the removal of the old Mike Horse and the drill roads near the end of the construction era in this area, and Site Wide Elements needed to protect sensitive vegetation areas and monitoring and maintenance. The Section 35 repository site was previously selected in 2012 (USDA Forest Service, 2012). The amount of waste to be removed is approximately 90,345 cubic yards.

The preferred remedy for the western portion of the upper marsh is Alternative 2 Monitored Natural Recovery and Site Wide Elements needed to protect sensitive vegetation areas, monitoring and maintenance. The rationale for the preferred remedy is that the western portion of the marsh is expected to see recovery based on upstream removals by eliminating significant future source of contamination. This option is also protective of the natural vegetation features in the western portion of the Upper Marsh.

An adaptive response approach to groundwater and surface water in the the upper Marsh area is proposed. The proposed treatment option for groundwater in the Upper Marsh is monitored natural attenuation which will provide for reviewing of changes to groundwater following source removal activities upgradient. Similarly, there is no specific proposed treatment option for the surface waters of the Upper Marsh as achieving cleanup levels for surface water will rely to a great extent on the success of the proposed removal/remedial activities upstream.

The total cost for the response options, including site wide elements for the features of EA 4 is $4,574,000.

EA 5 - Mining Related Features

Impacted soils and mine wastes from the mining related features in EA 5 will be addressed by Site Wide Elements, Alternative 3 Physical Safety Hazards (only in combination with another response action), and Alternative 5 – Removal and On Site Disposal. Because of the individual number and types of mining related features within the UBMC on federal lands, the proposed alternative response actions, rationale and costs are summarized in Table 7-1. The response options for these features may change once site specific design activities are initiated. In addition, the condition of a feature could change over time resulting in the need to change responses to that feature.

As an overall objective, the USFS seeks to minimize new infrastructure in this very impacted mining area as new roads, cutting of trees, and new soil disturbance have the potential to result in negative, unanticipated consequences. The further a feature is located from a currently open road, the more likely the potential for negative consequences. Thus, with the available information, the Forest Service concurs with DEQ's strategy for alternative response actions that

consider the ease or difficulty of access to a feature. For more detailed discussion, refer to pages 80-82 in the Proposed Plan.

The total cost for the proposed response options for the EA 5 Mining Related Features on federal lands is $909,089.

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FIGURES

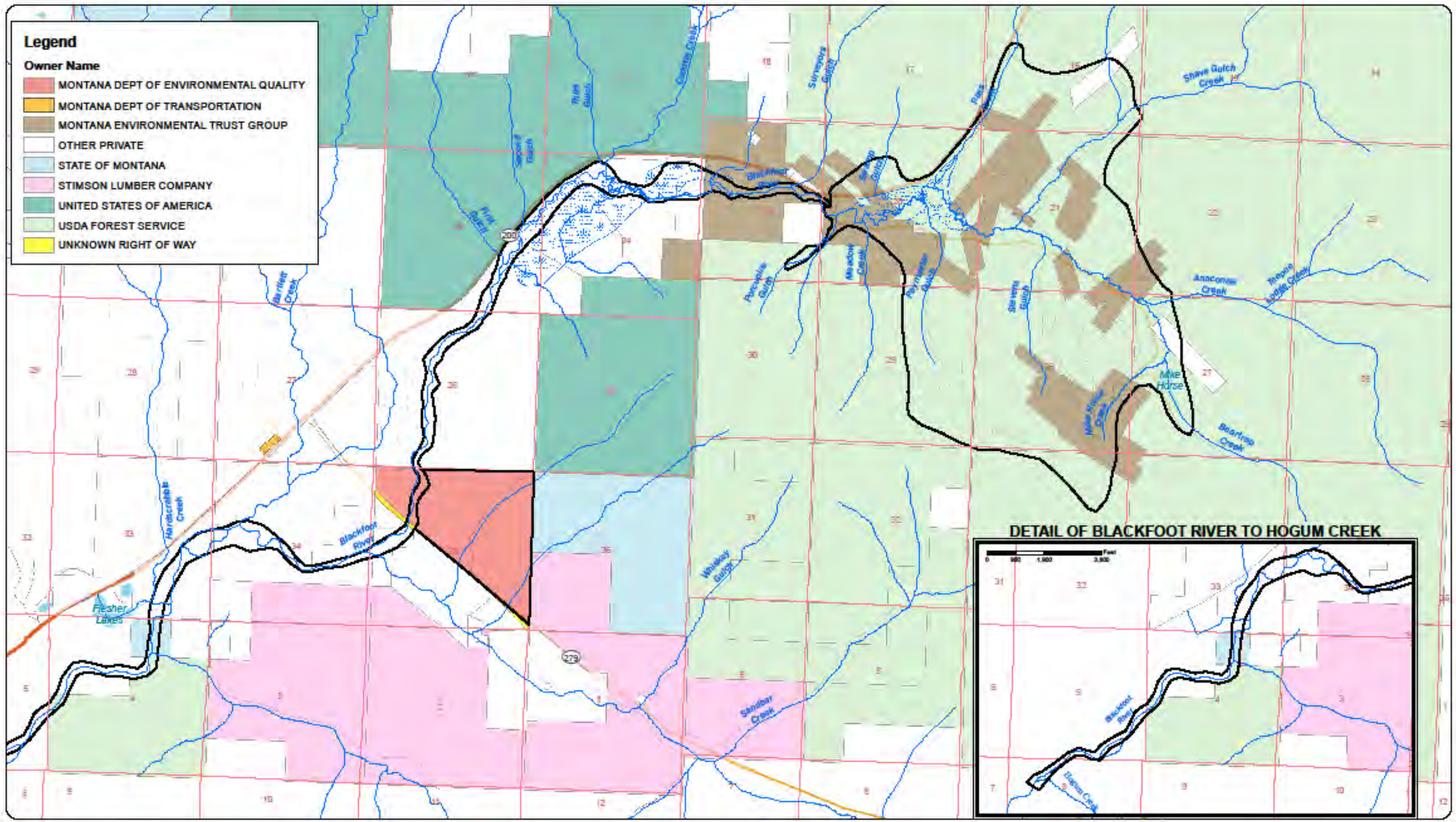
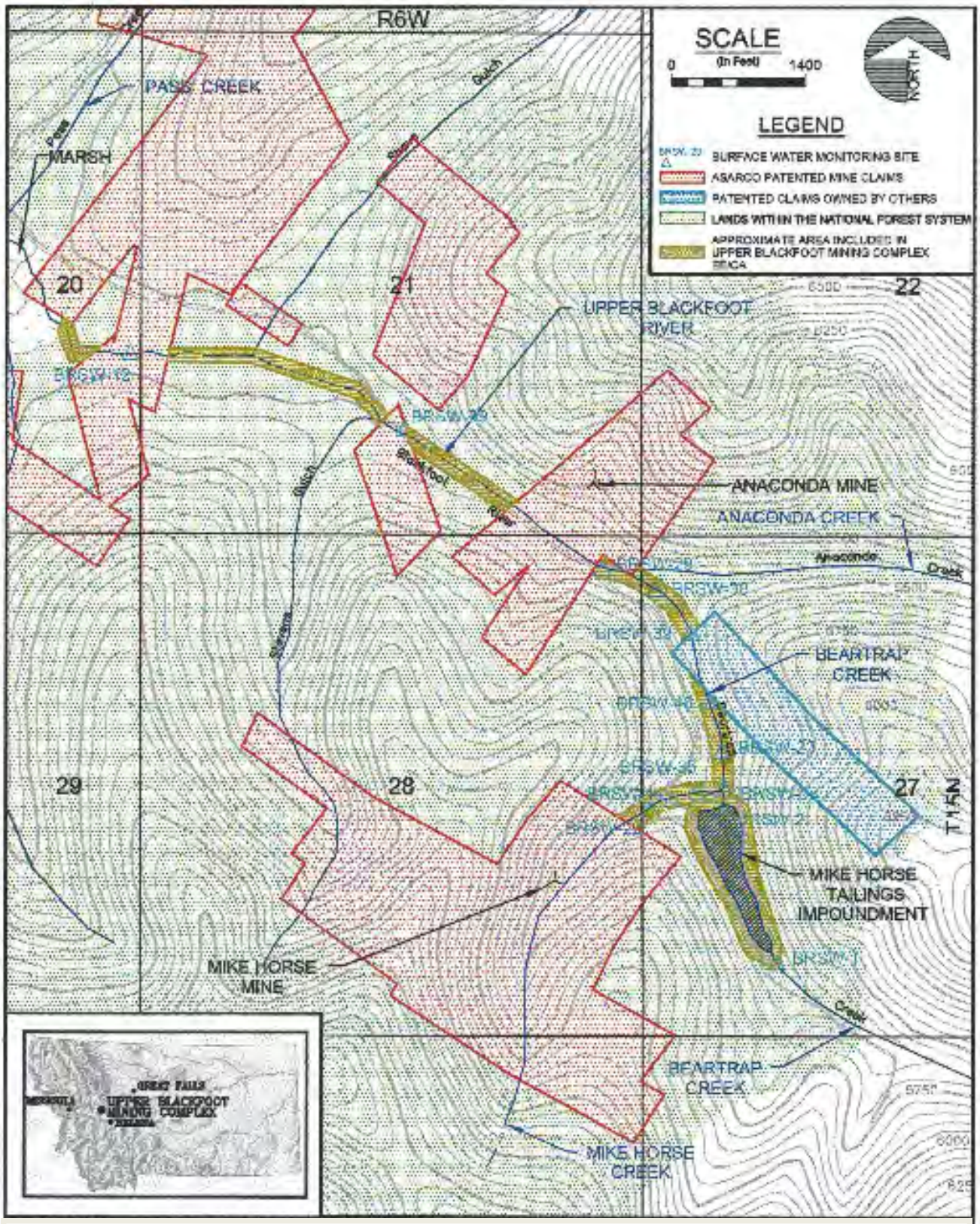


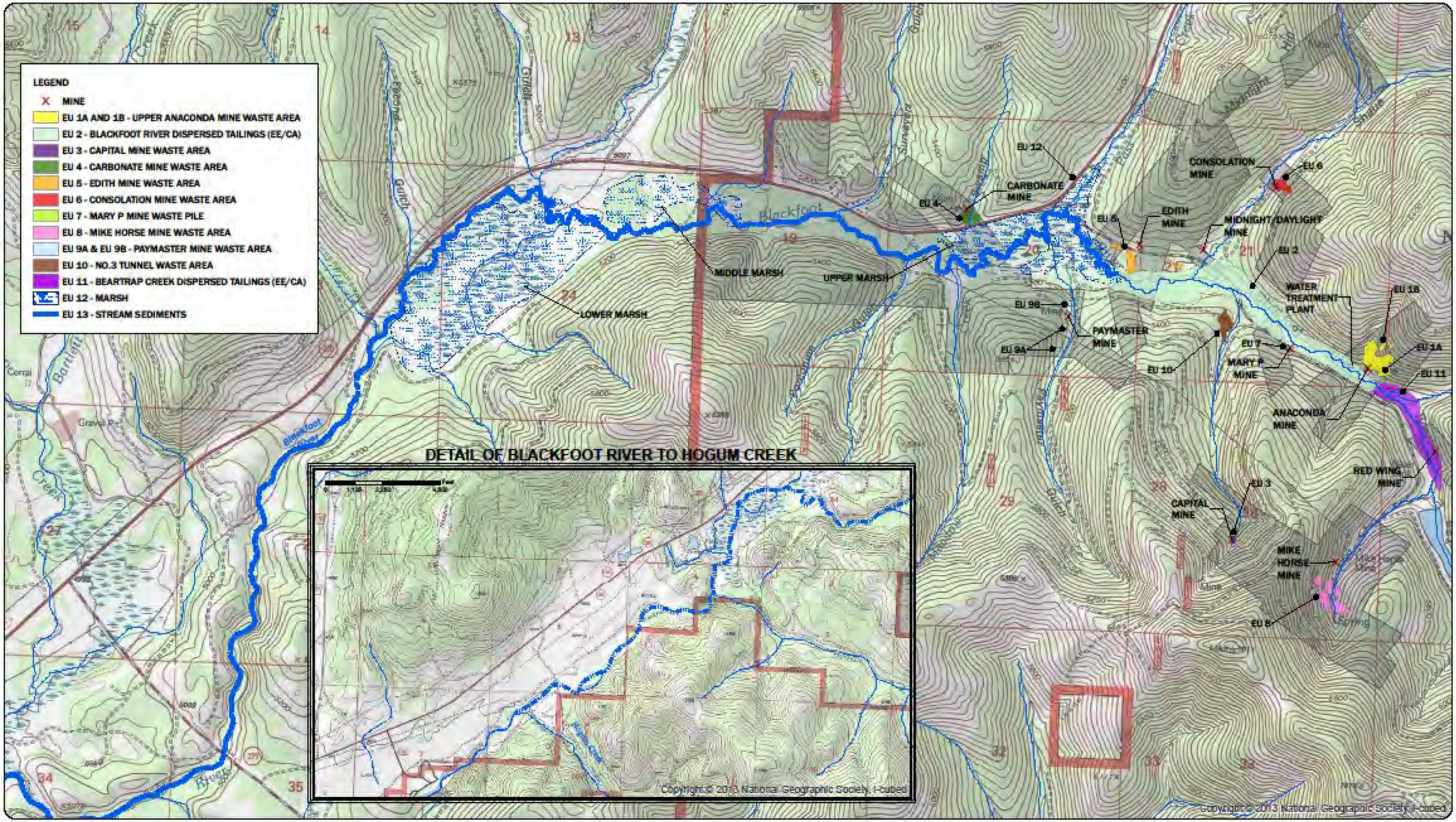
FIGURE 1—UBMC Technical Memorandum
Location Map and Forest Service Lands
From DEQ Proposed Plan August 2015

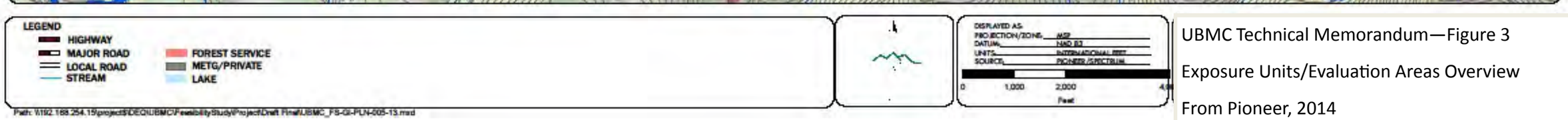


UBMC TECHNICAL MEMORANDUM— Area of 2007 Action Memorandum

From: Hydrometrics, 2007

Figure 2

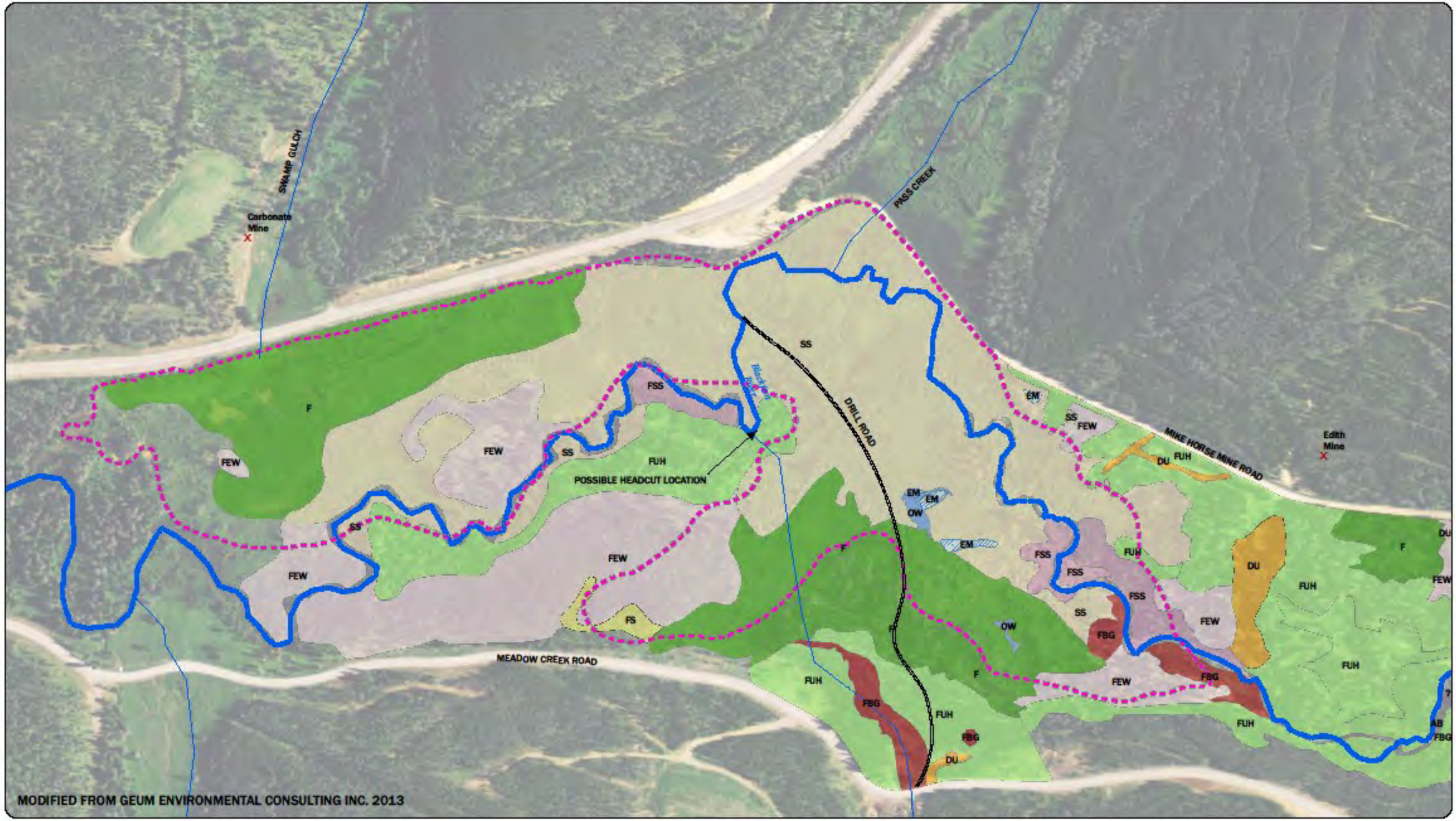




UBMC Technical Memorandum—Figure 3

Exposure Units/Evaluation Areas Overview

From Pioneer, 2014



LEGEND

DU DISTURBED UPLAND	FSS FILLED SCRUB SHRUB	FS FORESTED SHRUB WETLAND	SS SHRUB WETLAND	MARSH BOUNDARY (EU 12)	
EM EMERGENT MARSH	FBG FORESTED BARE GROUND	FUH FORESTED UPLAND HERBACEOUS	DRILL ROAD	X MINE	
F FEN	FEW FORESTED EMERGENT WETLAND	OW OPEN WATER	STREAM	STREAM - EU 13	

N

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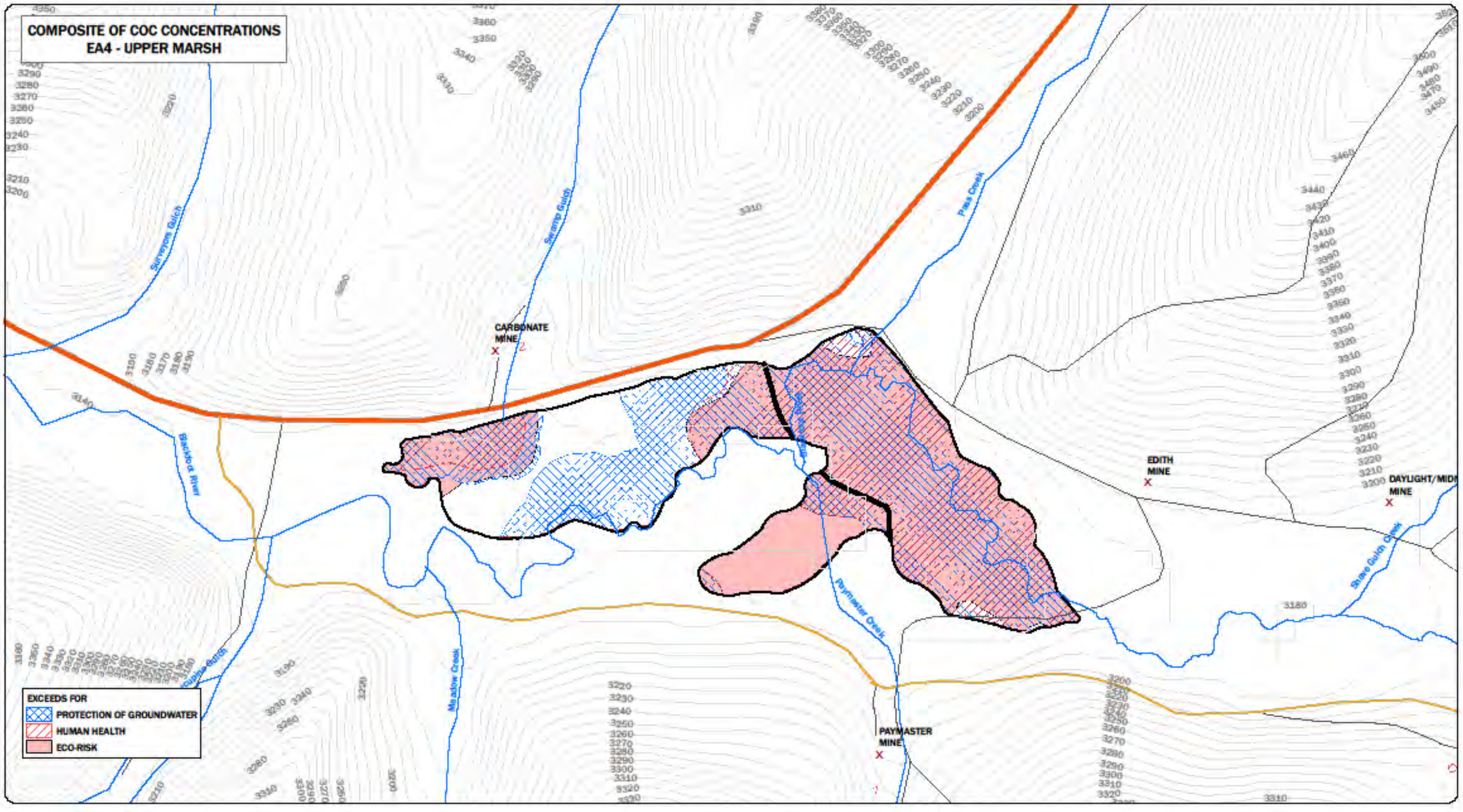
UBMC Technical Memorandum Figure 4

Upper Marsh Area Vegetation and features

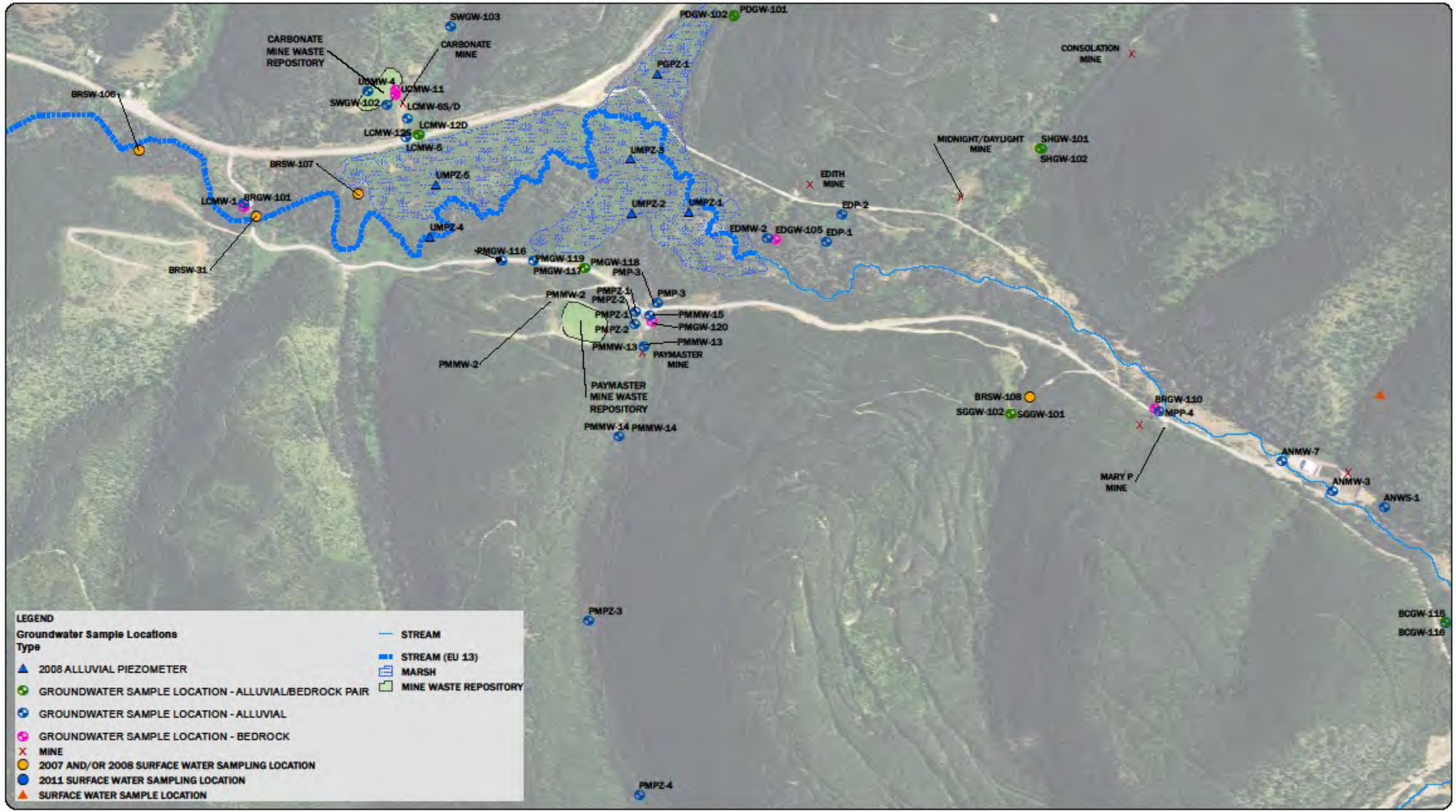
From Pioneer, 2014



UBMC Technical Memorandum Figure 5

Upper Marsh Area—East and West divisions

From Pioneer, 2014



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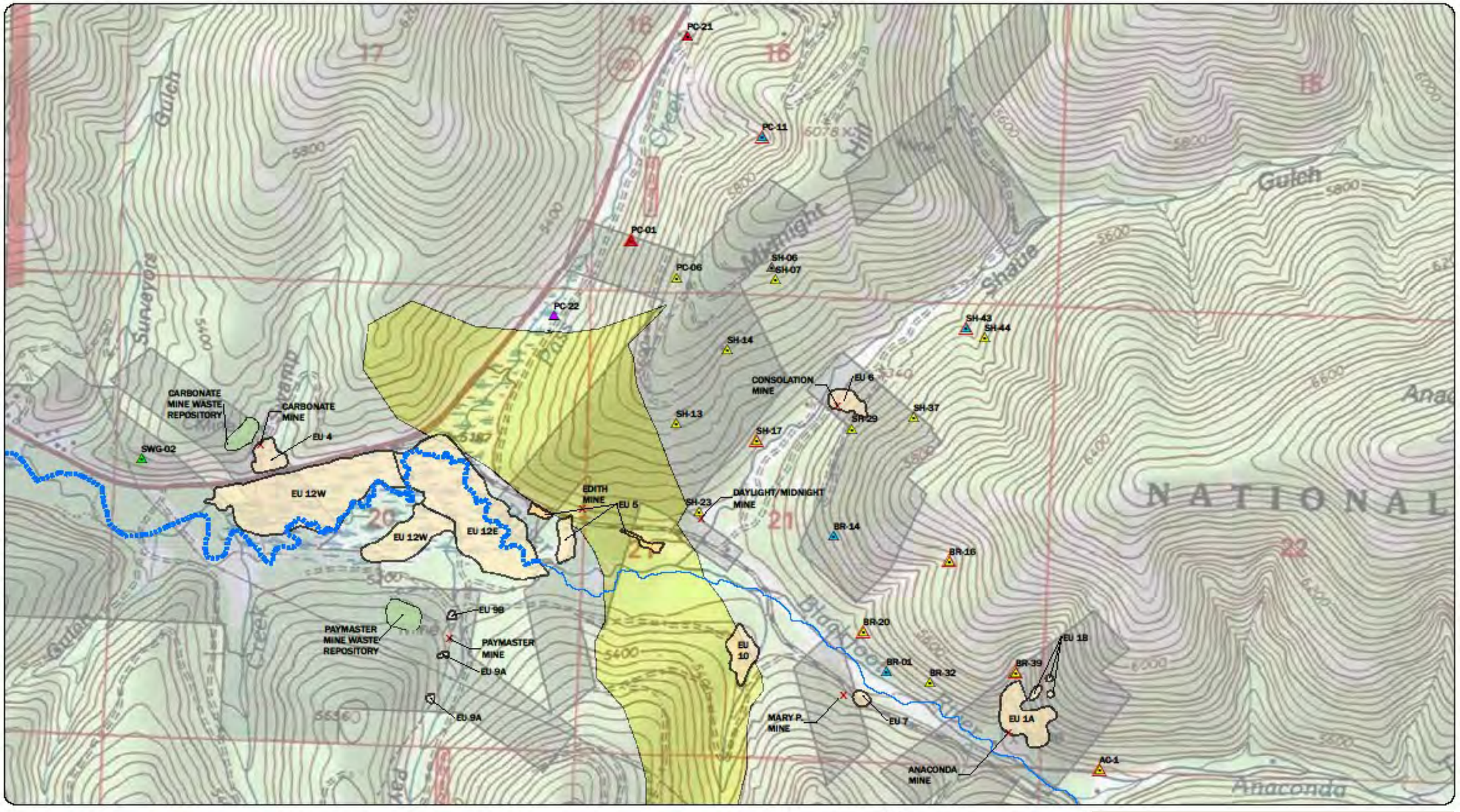
UBMC Technical Memorandum 2015 Figure 6

Surface and Groundwater Monitoring Locations

(note: UBMC area includes numerous other monitoring locations that are not shown on this map—See Feasibility Study, 2014)

From, Pioneer, 2014



UBMC Technical Memorandum 2015 Figure 7

EA 5 Mining Related Features—North Half

From Pioneer, 2014

LEGEND

- EXPOSURE LIMITS
- MINE WASTE REPOSITORY
- METG/PRIVATE
- Approximate Boundary of Copper & Molybdenum Ore Body
- SAMPLE COLLECTED
- COLLAPSED ADIT WITH DISCHARGE
- COLLAPSED ADIT WITH WASTE ROCK
- COLLAPSED ADIT WITH WASTE ROCK AND DISCHARGE
- DISTURBED AREA
- DISTURBED AREA WITH DISCHARGE
- PHYSICAL HAZARD
- PHYSICAL HAZARD WITH WASTE ROCK
- SURFACE WATER/SEDIMENT
- MINE
- STREAM
- STREAM (EU 13)

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UBMC Technical Memorandum 2015 Figure 8

EA 5 Mining Related Features South Half

From Pioneer, 2014

TABLES

Table 3.1 EA 1 – Upland Waste contamination, Remediation Volume Estimates for Features on Forest Service Lands

UBMC Location	Mine Waste Impacted Soil Volume In cubic yards	Metal Concentrations in Waste/Site Specific Cleanup Levels In Mg/Kg	Comments
Mary P Mine waste/EU7	708	As 23.12-235.74/**40.4*** Pb 141 – 4169/**1,110*** Fe 39,348 – 112,241	pH average 4.2 Acid generating potential uncertain
Tunnel No. 3 mine waste/EU10	2,184	As 18.69-71.46/**40.4*** Fe 17,214 – 83,696	pH ranged from 4.7-5.8 Acid generating potential uncertain
Total	2,892 cy		

*** Site Specific Cleanup Level**

Table 3-2. EA 3 - Streams and Stream Sediment on Federal Lands

UBMC Location	Flow	Contaminants in Water	Contaminants in Stream Sediment in mg/kg	Comments
Stevens Gulch	.001 – 2.0 cfs Avg. 0.5 cfs	Cd, Cu, Pb, Zn Exceed aquatic life standards	Al 3740 – 6460 As 145 – 324 Cd 1.29 – 11 Cu 336 – 588 Fe 58,000 – 159,000 Pb 674 – 2,300 Mn 259 – 481 Zn 415 – 2,320 Est stream sediment volume is 550 cy scattered over almost 1 mile of stream channel	Remobilization and mixing of eroded wastes over time
Paymaster Creek	0.634 cfs	Cd, Cu, Fe, Zn Exceed aquatic life standards	Waste piles see EA 5 Mining Related Features	Naturally occurring acid rock drainage
Shave Gulch	0.51 cfs	Cu exceeds chronic and acute aquatic life standards	Stream sediments exceed cleanup levels for arsenic, lead, manganese, Est stream sediment volume is 30 cy in a 200 foot area from upland area.	

Table 3-3. EA 4 - Upper Marsh Sediments

UBMC Location	Marsh sediment volume In cubic yards	Metal Concentrations in Marsh Sediments/Site Specific Cleanup Levels In Mg/Kg (in bold) (from FS Figures 29-32)	Comments
Eastern Portion of Upper Marsh	90,345	Al – 0 – 16,000/**8030** As – 32.3->160/**32.3** Cd – 1.84-35/**3.53** Cu-197->700/**197** Fe – 0->60,000/NR Pb-174->1700/**174** Mn – 696->6,000/**696** Zn – 300->2,300/**300**	Coarser grained, thicker sediments
Western Portion of Upper Marsh	110,676	Al – 0-16,000/**8030** As – 0-32.3/**32.3** Cd – 0-35/**3.53** Cu-0->700/**197** Fe – 0-1,000/NR Pb-0->1,700/**174** Mn – 0-6,000/**696** Zn – 0->2,300/**300**	Finer grained, thinner sediments
Blackfoot River Sediments as it flows into Upper Marsh area at sampling site BRSW12		As – 19-26.2/**17.0** Cd – 9.97-13.3/**3.53** Cu-253-334/**197** Pb-474-530/**91.0** Mn – 2,540-3,140/**578** Zn – 1,890-2,350/**315**	
Blackfoot River sediments at lower end of Upper Marsh as sampling site BRSW-110		As – 12.9-14.8/**17.0** Cd – 4.53-5.48/**3.53** Cu-127-158/**197** Pb-351-395/**91.0** Mn – 979-1,200/**578** Zn – 856-994/**315**	Metals concentrations reduced from upstream to downstream in sediments
Total	201,021 cy		

Table 3-4. EA-5 Summary of Mining Related Features on Forest Service Lands, including seeps, discharges

UBMC Drainage Area BR=Blackfoot River AC=Anaconda Creek PC=Pass Creek SG=Stevens Gulch PM=Paymaster Cr PBBS=Porcupine Cr Sh=Shave/Shaue Cr	**Feature ID**	**Site Type**	**Mine Waste/Impacted Soil with Metals exceeding site specific cleanup levels(FS - Sec 6.5 & Appendix C)**	**Surface Water Exceedences; DEQ -7 standards (sampled or inferred) (FS -Sec 6.3.4)**
Anaconda Creek – 1 feature	AC-01	Collapsed Adit with waste rock	Est 500 cy *will be removed under existing Action Memorandum	
Blackfoot River – 4 features	BR-16, 20, 32 BR-01	Collapsed Adits with waste rock Collapsed adit with waste rock and discharge	2985 cy	
Pass Creek – 3 features	PC – 21 PC – 11, 22	Physical Hazard Collapsed adit with discharge	0	 PC-22-seep only, no sample collected
Paymaster Gulch – 5 features	PM-12, PM-26, PM-35, PM-37 PM-28	Collapsed adit with waste rock Disturbed area	5089 cy	
Porcupine Gulch – 1 feature	PBBS	Collapsed adit with discharge	0 cy	Seep - Human Health and Aquatic Life Standards exceeded
Shave Gulch – 6 features	SH-06 SH-07, SH-17, SH-23, SH-44 SH-43	Physical hazard with waste rock Collapsed adit with waste rock Collapsed adit with waste rock and discharge	12,810 cy total	 Spring 2-5 gpm discharge, aquatic standards exceeded

UBMC Drainage Area BR=Blackfoot River AC=Anaconda Creek PC=Pass Creek SG=Stevens Gulch PM=Paymaster Cr PBBS=Porcupine Cr Sh=Shave/Shaue Cr	**Feature ID**	**Site Type**	**Mine Waste/Impacted Soil with Metals exceeding site specific cleanup levels(FS - Sec 6.5 & Appendix C)**	**Surface Water Exceedences; DEQ -7 standards (sampled or inferred) (FS -Sec 6.3.4)**
Stevens Gulch – 19 features	SG-01	Physical hazard	50, 378 cy total	
	SG-44, 99	Collapsed adit with waste rock		
	SG-98	Collapsed adit with discharge		Seep only, no sample collected
	SG-55	Disturbed area with discharge		Small pipe with flow, Human health standard for As exceeded
	SG-24, 31, 33, 35, 53, 56, 58, 67, 78, 82, 86, 89, 95, 96	Disturbed area		
Total			71,262 cy	

Table 3-5 Volume Estimates by EA for Contaminated Solid Media at the UPBMC on Federal Lands

UBMC Location	Mine Waste/Impacted Soils in cubic yards (cy)	Sediments/ Tailings In cubic yards (cy)
EA-1 Upland Waste Areas	Mary P – 708 Tunnel No. 3 – 2184	
EA-3 – Streams and Stream Sediment		Blackfoot River – see Upper Marsh Stevens Gulch – 550
EA- 4 Upper Marsh (includes Blackfoot River on USFS lands)		Eastern – 90,345 Western – 110,676
EA-5 Mining Related Features All	71,262	
Total	**74,154**	**201,571**

Table 4-1. Removal Site Specific Cleanup Levels (SSCLs) for Soil and Sediment for Protection of Human and/or Ecological Health
in Mg/Kg

Exposure Unit	Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Zinc (Zn)
Mary P wastes	NR	40.4	NR	275	NR	1,110	4,890	551
Tunnel No. 3 wastes	NR	40.4	4.8	275	NR	1,110	4,890	551
Upper Marsh Sediments	8,030	32.3	3.53	197	NR	174	696	300
Stream Sediments	9,400	17.0	3.53	197	NR	91.0	578	315

NR = No risk

Table 4-2. Removal Site Specific Cleanup Levels SSCLs) for Surface and Groundwater for Protection of Human and/or Ecological Health in Mg/liter

Standard	Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Zinc (Zn)
Human Health Standard - Surface Water	-	0.01	0.005	1.3	-	0.015	-	2.0
Chronic Aquatic Life	0.087	0.15	HD[3]	HD	1.0	HD	-	HD
Acute Aquatic Life	0.750[2]	0.34	HD	HD	-	HD	-	HD
SSCL Surface Water from HHRA	-	-	-	-	-	-	0.43	-
Human Health Standard - Groundwater	-	0.01[1]	0.005[1]	1.3[1]	-	0.015[1]	-	2.0[1]
SSCLs Groundwater from HHRA	20[1]	-	-	-	14[1]	-	0.94[1]	-

NR = No risk. [1]Values are based on dissolved concentrations. [2] Values are based on total recoverable concentrations. [3] HD =hardness dependent sample calculated for each sample. HD=hardness dependent.

Table 6-1 Alternatives for EA-1 Upland Waste Areas on USFS lands

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	
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.
No. 3 Tunnel Mine (EU 10) 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. Vegetative cover at the site is good. Area of exceedance is relatively small.

Table 6-2 Alternatives for EA 3 - Surface Water and Sediment for streams on Federal lands – Includes seeps/discharges associated with Mining Related Features on federal lands shown in Table 6-4 below

EVALUATION AREA EA 3 Surface Water and Sediment	REMEDIAL ALTERNATIVE															
		PHYSICAL HAZARDS/SOLID MEDIA								SURFACE WATER						
			ENGINEERING CONTROLS/ LAND DISPOSAL				TREATMENT			ENGINEERING CONTROLS				TREATMENT		
							In-situ	Ex-situ						Active		Passive
	No Action	Monitored Natural Recovery	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) - SEE EA 4																
Comments																
Stevens Creek	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No

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		
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	In-situ	Ex-situ		Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Active		Passive
							Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment					Chemical Reagent	Physical/ Mechanical	Chemical Reagent
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 from Stevens Creek are addressed in EA 5.															
Other Streams																
Porcupine Creek	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Comments	Surface water samples in Porcupine Creek (PBBS-200, PBBS-202) showed exceedances of human health standards; sediment samples also showed exceedances. Therefore only solid media alternatives are applicable. Remediation volume estimates and costs are included with mining-related feature PBBS.															
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.															
Shave 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. A 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.															
Mining-related Feature Discharge, Seep or Spring – See also EA-5																
Mine Feature BR-01 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Intermittent spring (150 square feet) at the toe of slope. No flow or water quality data.															
Mine Feature PBBS Discharge, seep, or spring	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No
Comments	Seep from collapsed adit. Surface water exceeds HH: Cd, Pb, Mn, Zn; Chronic: Cd, Cu, Fe, Pb, Zn; Acute: Cd, Cu, Pb, Zn. No flow data. Sediment exceeds for As, Cd, Pb, Mn, Zn.															
Mine Feature PC-11 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Seep from collapsed adit. Surface water exceeds Chronic: Cd, Zn; Acute: Zn.															

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		
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	In-situ	Ex-situ		Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Active		Passive
							Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment					Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Mine Feature PC-22 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	PC-22 was identified as PC-21 in the RI but is a separate feature and includes a collapsed adit with a marshy area at the entrance, indicating adit discharge. No waste rock piles observed. No flowing water was observed and no water quality data were collected.															
Mine Feature SH-43 Discharge, seep, or spring	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No
Comments	Collapsed and leaking adit (2 to 5 gpm estimate) with additional flow contributed by seeps between adit and mined rock pile. Surface water (SHSW-103) exceeds HH: Mn; Chronic: As, Cd, Cu, Fe, Pb, Zn; Acute: Cd, Cu, Pb, Zn. Sediment exceeds for As, Cd, Pb, Mn, Zn. Access poor, new road construction or reconstruction problematic.															
Mine Feature SG-55 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Pipe (4 inch) protruding from toe of cut-slope leaking small amounts of water. Surface water exceeds HH: As, Mn; Chronic: Fe; Acute: No exceedances. No flow rate measured. Access poor, new road construction or reconstruction problematic.															
Mine Feature SG-98 Discharge, seep, or spring	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Comments	Adit apparently had flow at some point as evidenced by strong iron oxide staining but was dry at the time of the field investigation in 2008. No flow or water quality data. Access poor. New road construction or reconstruction problematic.															

[1]From the Upper Marsh to Hogum Creek.

Acute: DEQ-7 Acute Aquatic Standard and Chronic: DEQ-7 Chronic Aquatic Standard.

Table 6-3 Alternatives for EA 4 - Upper Marsh Area

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		
			Physical Barriers	Containment	Removal and On-site Disposal	Removal and Off-site Disposal	In-situ	Ex-situ			Containment (Retention)	Detention	Hydrologic and Hydraulic Control	Inundation	Active		Passive
							Neutralization w/Alkaline Amendment	Blending and Co-Disposal	Neutralization w/Alkaline Amendment						Chemical Reagent	Physical/ Mechanical	Chemical Reagent
Upper Marsh (EU 12) Blackfoot River Eastern Area Sediments, Surface and Groundwater	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	No
Comments:	Containment of marsh sediments for any of the engineering controls options 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. Several variables make surface water treatment of the Blackfoot River 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. We 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. Upper Marsh contamination sources to groundwater not well understood and likely masked by other upstream waste sources and natural mineralization. Appropriate response options include monitored natural attenuation to evaluate changes to groundwater quality as upstream removals and other actions occur.																
Upper Marsh (EU 12) Blackfoot River Western Area Sediments	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	No
Comments:	Containment of marsh sediments for any of the engineering controls options 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. Several variables make water treatment of the Blackfoot River 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. We 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.																

Table 6-4 Alternatives for EA 5 - Mining-related Features on Forest Service Lands

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	
Anaconda Creek Drainage									
AC-01	Yes	No	No	Yes	No	No	No	No	Waste removal included as part of previous Action Memorandum decision area.
Blackfoot River Drainage									
BR-01, BR-16	Yes	No	Yes	Yes	Yes	Yes	No	No	BR-01 is acollapsed adits with seeps. Access to BR-01, adjacent to the Blackfoot River, is relatively easy, but access to the other sites will be difficult on the steep, timbered slope. Seepage water and unnamed creek water quality are addressed in EA 3.BR-16 is a collapsed working with waste rock pile.
Pass Creek Drainage									
PC-11, PC-21, PC-22	Yes	Yes	Yes	Yes	Yes	Yes	No	No	PC-21 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-11 is a collapsed adit with a seep. Water from PC-11 is addressed in EA 3. PC-21 is an open adit requiring a physical barrier. Water from PC-22 is address in EA 3.
Porcupine Gulch Drainage									
PBBS	Yes	No	No	No	No	No	No	No	Site includes collapsed adit with a discharge, waste rock pile in close proximity to Porcupine Creek. No exceedances in the sampled waste. Access is moderately difficult on unmaintained road. Water from the adit is addressed in EA 3.
Paymaster Gulch Drainage									
PM-12, PM-35 PM-37	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.
PM-26, PM-28	Yes	No	Yes	Yes	Yes	Yes	No	No	PM-26 is located high up in the drainage and PM-28 is located at the very top of the drainage – access will be difficult for both.
Shave Gulch Drainage									
SH-17, SH-23 SH-43, SH-44	Yes	No	Yes	Yes	Yes	Yes	No	No	Features SH-17 and SH-23 are located on the west side of Shave Gulch Road, near Shave Creek. SH-29, 37, 43, and 44 are located on the east side of Shave Gulch, uphill from the creek. SH-43 is a collapsed and leaking adit. Water from SH-43 is addressed in EA 3.
SH-07	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. SH-06 is an open adit with waste rock requiring a physical barrier.
Stevens Gulch Drainage									

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	
SG-24, SG-44, SG-53 SG-56, SG-58, SG-67, SG-98	Yes	No	Yes	Yes	Yes	Yes	No	No	These sites are located fairly high up in the drainage, with SG-44 and SG-98 being associated with the Viking mine site, situated near the top of the drainage. Access will require constructing an extensive network of roads along the west side of Stevens Gulch.
SG-55, SG-82 SG-95, SG-96, SG-99	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.
SG-01, SG-31, SG-33, SG-35 SG-78, SG-86, SG-89	Yes	Yes	Yes	Yes	Yes	Yes	No	No	SG-01 is a partially open 8-inch well requiring a physical barrier. Relatively easy access to all sites. SG-31, 33, and 35 are in close proximity to Stevens Creek.

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

Table 7-1. EA 5 Mining Related Features Preferred Remedy

Feature Name	Site Type/Description	Preferred Remedy	Cost	Comments
BR-20, 32	Collapsed Adits with waste rock 2,985 cy	Alternative 5 Removal and On Site Disposal	$132,546	Easy to Moderate Access, both piles proximal to floodplain
BR-16	Collapsed adit with waste rock	Site-Wide Elements	$8,009	Difficult access, remote location, steep terrain, poor access
BR-01	Collapsed adit with waste rock and discharge	Alternative 5 Removal and On Site Disposal	$66,273	Easy to Moderate Access, pile is proximal to floodplain
PC-11	Collapsed adit with waste rock and discharge	Site Wide Elements	Costs captured in EA 3	Difficult access, remote location, steep terrain, poor access
PC-22	Collapsed adit with discharge	Alternative 5 Removal and On Site Disposal	$66,616	Easy to Moderate Access, near opened road
PC – 21, SH-06, SG-01	Physical Hazard	Physical Barriers	$133,249	Would only be applied in combination with an environmental remedy
PC – 11, 22	See EA 3 above			
PM-12, PM-35, PM-37	Collapsed adit with waste rock	Alternative 5 Removal and On Site Disposal	$109,303	Easy to Moderate Access, near opened road

Feature Name	Site Type/Description	Preferred Remedy	Cost	Comments
PM-26, PM-28	Disturbed area	Site-Wide Elements	$11,174	Difficult access, remote location, steep terrain, poor access
PBBS	See EA 3 above			
SH-07	Collapsed adit with waste rock	Site-Wide Elements	$5,127	Difficult access, remote location, steep terrain, no existing roads
SH-17, SH-23	Collapsed adit with waste rock	Alternative 5 Removal and On Site Disposal	$200,692	Easy Access on old drill road
SH-43	Collapsed adit with waste rock and discharge, acquatic standards exceeded	Alternative 5 Removal and On Site Disposal	$100,346	Easy access on open road in Shaue Gulch
SH-44	Collapsed adit with waste rock	Site-Wide Elements	$3,694	Difficult access, prospect pits and trenches
SG-44	Collapsed adit with waste rock	Site-Wide Elements	$4,465	Difficult access, remote location, steep terrain, near ore body
SG-99	Collapsed adit with waste rock	Site-Wide Elements	$3,652	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening

Feature Name	Site Type/Description	Preferred Remedy	Cost	Comments
SG-98	Collapsed adit with discharge, staining noted, no flow observed	Site-Wide Elements	$4,465	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening
SG-55	Disturbed area with discharge and pipe	Site-Wide Elements	$4,465	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening
SG-89	Disturbed area	Site-Wide Elements	$3,616	Small area of disturbance
SG-24, 53, 56, 58, 67	Disturbed area	Site-Wide Elements	$22,325	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening
SG-31, 33, 35, 86	Disturbed area	Site-Wide Elements	$14,464	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening
SG-78, 82, 95, 96	Disturbed area	Site-Wide Elements	$14,608	Difficult access, remote location, steep terrain, near ore body. Old drill road would require reopening
		TOTAL	$909,089	

APPENDIX A – Preliminary Applicable or Relevant and Appropriate Requirements (ARARS)

Cleanup actions conducted under CERCLA need to achieve a level or standard of control that at least attains any standard, requirement, criteria or limitation under any federal environmental law or any more stringent promulgated standard, requirement, criteria or limitation under a State environmental law which is legally applicable to the hazardous substance concerned or is relevant and appropriate under the circumstances of the release of such substance, pollutant or contaminant. The standards, requirements, criteria or limitations identified pursuant to this section are commonly referred to as ARARs.

Preliminary Federal and State Applicable or Relevant and Appropriate Requirements (ARARs), Upper Blackfoot Mining Complex Site, Technical Memorandum Remedial Area, Oct 2015, Helena National Forest, Lewis and Clark County

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
National Historic Preservation Act (NHPA) National Register of Historic Places Determinations of eligibility for inclusion in the National Register of Historic Places Protection of historic properties Requirements for environmental information documents and third-party agreements for U.S. Environmental Protection (EPA) actions subject to National	16 United States Code (U.S.C.). 470 36 Code of Federal Regulations (CFR) 60 36 CFR 63, 65 36 CFR 800 40 CFR 6.301(b) 16 U.S.C. 461, et seq. 40 CFR 6.310(a)	Applicable	Requires federal agencies to take into account the effect of this response action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally, 50 years old or older).	Heritage inventory conducted in removal area by a qualified heritage resource professional. Site recommended ineligible for listing on National Register of Historic Places. Construction contract provisions provide direction for potential unknown resources uncovered during construction activities. The Helena National Forest works with the Montana State Historic Preservation Office under a Programmatic Agreement that identifies procedures for meeting the terms of NHPA.		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
Environmental Policy Act (NEPA) Historic Sites Act of 1935							
Archaeological and Historic Preservation Act Requirements for environmental information documents and third-party agreements for EPA actions subject to NEPA Protection of archaeological resources	16 U.S.C. 469 40 CFR 6.301(c) 43 CFR 7	Applicable	Establishes requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	See Above . Area has been surveyed by heritage resources professional..		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
Fish and Wildlife Coordination Act Responsible official requirements Rules implementing the Fish and Wildlife Conservation Act of 1980	16 U.S.C. 661 et seq., 40 CFR 6.302(g) 50 CFR 83	Applicable	Requires coordination with federal and state agencies for federally funded projects to ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provides for adequate protection of fish and wildlife resources.	The areas that would undergo removal action are located within or near the Blackfoot River. The Forest Service is in ongoing consultation with the US Fish and Wildlife Service Montana Fish Wildlife and Parks and Forest Service fisheries biologists as part of reaching this proposed site remedy.		✓	
Floodplain Management Regulations	40 CFR 6.302(b) Executive Order No. 11988	Relevant and Appropriate	Requires that actions be taken to avoid, to the extent possible, adverse effects associated with direct or indirect development of a floodplain, or to minimize adverse impacts if no practicable alternative exists.	These standards are relevant and appropriate to all actions within these floodplain areas and appropriate engineering controls are incorporated into construction design.		✓	
Protection of Wetlands Regulations	33 U.S.C. 1344 40 CFR 6, Appendix A, Exec Order 11990	Applicable Relevant and Appropriate	Requires federal agencies and the potentially responsible party (PRPs) to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. Prohibits discharge of dredged or fill material into waters of the United States	Jurisdictional wetlands would be addressed in site specific design and through ongoing consultation with US Fish and Wildlife Service. u		✓	✓
Endangered Species	16 U.S.C. 1531 -	Applicable	Provides that federal activities not	There are 12 animal species		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
Act (ESA) Responsible official requirements Endangered and threatened wildlife and plants Interagency cooperation-ESA of 1973, as amended	1543 40 CFR 6.302(h) 50 CFR 17 50 CFR 402		jeopardize the continued existence of any threatened or endangered species. ESA Section 7 requires consultation with the United States Fish and Wildlife Service (USFWS) to identify the possible presence of protected species and mitigate potential impacts on such species.	that are classified as either threatened or endangered in Montana and three plant species identified as threatened. Bull trout and Canda lynx occur within this project area and critical habitat for the grizzly bear is directly adjacent to this area.			
Migratory Bird Treaty Act List of Migratory Birds	16 U.S.C. 703, et seq. 50 CFR 10.13	Relevant and Appropriate	Makes it unlawful to "hunt, take, capture, kill," or take other various actions adversely affected a broad range of migratory birds, without the prior approval of the Department of the Interior.	The selected removal action will be carried out in a manner to avoid adversely affecting migratory bird species, including individual birds or their nests.		✓	
Bald Eagle Protection Act	16 U.S.C. 668, et seq.	Applicable	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 of the site does not unnecessarily adversely affect the bald and golden eagles.	Project area does not have this species.		✓	
Native American Graves Protection and Repatriation Act	25 U.S.C. 3001, et seq.	Applicable	The Act prioritizes ownership or control over Native American cultural items, including human	Based on field review by qualified Forest Service professional, no known		✓	✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
			remains, funerary objects and sacred objects, excavated or discovered on federal or tribal lands. Federal agencies and museums that have possession or control over Native American human remains and associated funerary objects are required under the Act to compile an inventory of such items and, to the extent possible, identify their geographical and cultural affiliation. Once the cultural affiliation of such objects is established, the federal agency or museum must expeditiously return such items, upon request by a lineal descendent of the individual Native American or tribe identified.	cultural items, including human remains, funerary objects and sacred objects are located on the site and no excavation of such features is anticipated. Contract provisions provide procedures in the event that a previously unknown feature is discovered.			
American Indian Religious Freedom Act	42 U.S.C. 1996 et seq.	Applicable	This Act establishes a federal responsibility to protect and preserve the inherent right of American Indians to believe, express and exercise the traditional religions of American Indians. This right includes, but is not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.	Consultation with native American Tribes as Natural Resource Damage Trustees is ongoing with this project		✓	
Clean Water Act	33 U.S.C. 1251 et seq.	Relevant and Appropriate	Regulates discharge of dredged or fill materials into waters of the United	Would be addressed during detailed design phase of		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
	33 CFR 330		States.	project. As provided under Section 303 of the Clean Water Act, 33 U.S.C. 1313, the State of Montana has promulgated water quality standards. See the discussion concerning State surface water quality requirements.			
National Ambient Air Quality Standards	40 CFR 50.6 (PM-10) 40 CFR 50.12 (lead)	Applicable	These provisions establish standards for PM-10 and lead emissions to air. (Corresponding state standards are found at Administrative Rules of Montana (ARM) 17.8.222 [lead] and ARM 17.8.223 [PM-10].) The PM-10 standard is 150 micrograms per cubic meter ($\mu g/m^3$), 24-hour average concentration, and the lead standard is 1.5 $\mu g/m^3$, maximum arithmetic mean averaged over a calendar quarter.	The selected remedial actions will be carried out in a manner that will comply with all the National Ambient Air Quality Standards. Providing dust control using a water truck is anticipated as part of the construction activities.	✓		
Protection and Enhancement of the Cultural Environment	16 U.S.C. 470 Executive Order No. 11593	Applicable	Directs federal agencies to institute procedures to ensure programs contribute to the preservation and enhancement of non-federally owned historic resources.	Project area occurs on federal land. Project has been identified as ineligible for the National Register of historic places.		✓	
The Archaeological Resources Protection Act of 1979	16 U.S.C. 470aa-47011	Relevant and Appropriate	Requires a permit for any excavation or removal of archeological resources from public lands or Indian lands.	Substantive portions of this act may be relevant and appropriate if archeological		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
				resources are encountered during onsite removal activities.			
Federal and State Resource Conservation and Recovery Act (RCRA) Subtitle D and Solid Waste Management Requirements	40 CFR 257	Not Applicable	Establishes criteria under Subtitle D of the Resource Conservation and Recovery Act for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment.	Project wastes are not considered to be RCRA Subtitle D wastes. However, stability evaluation and siting analysis performed by qualified Professional Engineer as part of project repository design.			✓
Federal RCRA Subtitle C Requirements	42 U.S.C. Section 9621, et seq. 40 CFR 261-268	Not Applicable	RCRA Subtitle C and implementing regulations are designated as applicable for any hazardous wastes that are actively "generated" or that were "placed" or "disposed" after 1980.	RCRA Subtitle C requirements will generally not be relevant and appropriate for those wastes for which EPA has specifically determined that Subtitle C regulation is not warranted (i.e., wastes covered by the Bevill exclusion). Thus contaminated soil is assumed to not be classified as hazardous waste.			✓
Resource Conservation and Recovery Act	40 CFR Part 264.18	Relevant	Provide seismic and floodplain restrictions on the location of a waste management unit.	Stability evaluation and siting analysis performed by qualified Professional Engineer as part of project		✓	✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
Federal ARARs and TBCs							
				repository design.			
Occupational Safety and Health Act	29 CFR 1910	To Be Considered	Provides standards and guidance for worker protection during conduct of construction activities.	Occupational Safety and Health Administration (OSHA) regulations are construction standards and not environmental standards. The substantive portion of these regulations would be considered for onsite response activities.	✓		✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
Groundwater Protection	ARM 17.30.1005 ARM 17.30.1006 ARM 17.30.1011	Applicable	Explains the applicability and basis for the groundwater standards in ARM 17.30.1006, which establish the maximum allowable changes in groundwater quality and may limit discharges to groundwater. Provides that groundwater is classified I through IV based on its present and future most beneficial uses and also sets the standards for the different classes of groundwater listed in department Circular WQB-7.[1] This section 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 Montana Code Annotated (MCA) 75-5-303 and ARM 17.30.7.	The proposed remedial actions do not directly address contaminated groundwater. However, the removal activities could indirectly result in improvements to groundwater through removal of contaminant sources.		✓	✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
Montana Water Quality Act (Continued)	ARM 17.30.623 ARM 17.30.637	Applicable	Waters classified B-1 are, after conventional treatment for removal of naturally present impurities, suitable for drinking, culinary and food processing purposes. These waters are also suitable for bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and use for agricultural and industrial purposes. Provides that surface waters must be free of substances attributable to industrial practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) 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; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; (e) create			✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
	ARM 17.30.705		conditions which produce undesirable aquatic life. Existing and anticipated uses of surface water and water quality necessary to support those uses must be maintained and protected.				
Montana Ambient Air Quality Regulations	ARM 17.8.206 ARM 17.8.220 ARM 17.8.222 ARM 17.8.223 ARM 17.8.304(2) ARM 17.8.308	Applicable	This provision establishes sampling, data collection, and analytical requirements to ensure compliance with ambient air quality standards. Settled particulate matter shall not exceed a 30 day average of 10 grams per square meter. Lead emissions to ambient air shall not exceed a 90 day average of 1.5 micrograms per cubic liter of air. PM-10 concentrations in ambient air shall not exceed a 24 hour average of 150 $\mu g/m^3$ of air and an annual average of 50 $\mu g/m^3$ of air. Emissions into the outdoor atmosphere shall not exhibit an opacity of 20 percent or greater averaged over 6 consecutive minutes. There shall be no production, handling, transportation, or storage of any material, use of any street,	Project activities are of limited scope and duration. Engineering controls and dust abatement are incorporated into project design. Open burning may be conducted on slash materials not utilized during construction activities following completion of removal action. Appropriate State burning measures will be included.	✓		✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State of Montana ARARs and TBCs							
	ARM 17.8.604(2)		road, or parking lot, or operation of a construction site or demolition project unless reasonable precautions are taken to control emissions of airborne particles. Lists material that may not be disposed of by open burning except as approved by the department.				
Montana Antiquities Act	MCA 22-3-421, et seq	Relevant and Appropriate	Addresses the responsibilities of State agencies regarding historic and prehistoric sites including buildings, structures, paleontological sites, archaeological sites on state owned lands	If historic or prehistoric sites are discovered during excavation activities on any state-owned lands then the provisions of this regulation may apply. These regulations may be relevant and appropriate for lands with other types of ownership.		✓	
Montana Human Skeletal Remains and Burial Site Protection Act	MCA 22-3-801	Applicable	Provides that all graves within the State of Montana are adequately protected.	If human skeletal remains or burial site are encountered during removal activities at the site, then requirements will be applicable.		✓	✓
Montana Floodplain and Floodway Management Act and Regulations	MCA 76-5-401, et seq. ARM 36.15.601, et seq.	Applicable	Specifies types of uses and structures that are allowed or prohibited in the designated 100-year floodway and floodplain.	These standards are applicable to all actions within these floodplain areas. A qualified professional engineer registered in the State of Montana would be needed for preparation of the drawings and specifications for this project at the design		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State of Montana ARARs and TBCs							
				phase of the project.			
	ARM 36.15.602	Applicable	Describes conditions for uses within designated floodway and specifically prohibits storage of flammable, toxic, or explosive materials.	See response to ARM 36.15.6 above.		✓	
	ARM 36.15.603	Relevant and Appropriate	Describes conditions for proposed diversions or changes in place of diversion that may affect flood flows.	See response to ARM 36.15.6 above.		✓	
	ARM 35.15.604	Relevant and Appropriate	Prohibits new artificial obstructions or nonconforming uses that will increase the upstream elevation of the base flood 0.5 of a foot or significantly increase flood velocities.	See response to ARM 36.15.6 above.		✓	
	ARM 36.15.605 § 76-5-403, MCA	Relevant and Appropriate	Identifies artificial obstructions and nonconforming uses that are prohibited within the designated floodway and includes "a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway...." Solid waste disposal and storage of highly toxic, flammable, or explosive materials are also prohibited.	See response to ARM 36.15.6 above.		✓	
	ARM 36.15.606	Relevant and Appropriate	Identifies flood control works including dams, levies, flood walls, rip-rap, and channelization projects that are allowed within designated	See response to ARM 36.15.6 above.		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State of Montana ARARs and TBCs							
			floodways with certain conditions.				
	ARM 36.15.701	Relevant and Appropriate	Describes allowed uses in the flood fringe.	See response to ARM 36.15.6 above.		✓	
	ARM 36.15.703	Applicable	Lists prohibited uses within the flood fringe and includes solid and hazardous waste disposal and storage of toxic, flammable, or explosive materials.	See response to ARM 36.15.6 above.		✓	
	ARM 36.15.801		Allowed uses where the floodway is not designated or where no flood elevations are available. Establishes minimum standards which would be applicable if a response action alters or affects a streambed, including any channel change, new diversion, riprap or other stream bank protection project, jetty, new dam or reservoir or other commercial, industrial or residential development. Projects must be designed and constructed using methods that minimize adverse impacts to the stream (both upstream and downstream) and future disturbances to the stream.	Actions contemplated on federal lands would address the adverse effects of the deposited tailings to the creek and floodplain environment. The potential temporary impacts of remedial actions are mitigated to the extent practicable by incorporation of appropriate engineering controls. See response to ARM 36.15.6 above.		✓	✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State of Montana ARARs and TBCs							
Endangered Species	§§ 87-5-106, 107, and 111, MCA ARM 12.5.201	Relevant and Appropriate	Endangered species should be protected in order to maintain and, to the extent possible, enhance their numbers. Certain activities are prohibited.	TES species being addressed through ongoing consultation with USFWS.		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
Montana Natural Streambed and Land Preservation Act and Regulations (continued)	MCA 87-5-502 and 504	Relevant and Appropriate	Provides that a state agency or subdivision shall not construct, modify, operate, maintain or fail to maintain any construction project or hydraulic project 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 in a manner that will adversely affect any fish or game habitat.			✓	
Substantive MPDES Permit Requirements	ARM 17.30.1342-1344	Applicable	These set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System (NPDES) permits.				✓
Water Quality Statutes and Regulations	MCA 75-5-605	Applicable	This section of the Montana Water Quality Act prohibits the causing of pollution of any state waters. Pollution is defined as contamination or other alteration of physical, chemical, or biological properties of state waters which exceeds that permitted by the water quality standards. Also, it is unlawful to place or caused to be placed any wastes where they will cause pollution of any state waters.			✓	✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
Water Quality Statutes and Regulations (continued)	MCA 75-5-303 ARM 17.30.705	Applicable	This provision states that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected. This 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 non degradation rules at ARM 17.30.708.	See response to ARM 36.15.6 above.	✓		
Stormwater Runoff Control Requirements	ARM 17.24.633	Applicable	All surface drainage from a disturbed area must be treated by the best technology currently available	These requirements would be applicable to disturbed areas. Storm water and sedimentation control measures are incorporated as part of the engineering design of this project.			✓
State of Montana Solid Waste Requirements	MCA 75-10-212 ARM 17.50.503	Not 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. Solid wastes are grouped based on physical and chemical characteristics which determine the degree of care required in handling and disposal and the potential of the wastes for	.			✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State of Montana ARARs and TBCs							
	ARM 17.50.523		causing environmental degradation or public health hazards. Specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.				
Montana Solid Waste Management Act	§§ 75-10-201, MCA, et seq. ARM 17.50.1004	Applicable	A solid waste facility located within the 100-year floodplain may not restrict the flow of the 100-year floodplain, reduce temporary water storage capacity, or result in washout that poses a hazard to human health or the environment.	See response to ARM 36.15.6 above.		✓	
	ARM 17.50.1005	Applicable	A solid waste facility cannot be located in a wetland unless there is no demonstrable practicable alternative.	The repository area has not been designated a wetland. See response to ARM 36.15.6 above.		✓	
	ARM 17.50.1006	Applicable	A solid waste facility cannot be located within 200 feet of a fault that had displacement in Holocene time with an alternative setback.	See response to ARM 36.15.6 above.		✓	
	ARM 17.50.1007	Applicable	A solid waste facility may not be located in a seismic impact zone without special requirements.	See response to ARM 36.15.6 above.		✓	
	ARM 17.50.1008	Applicable	A solid waste facility may not be located in an unstable area (based on soil and geologic conditions) without special requirements.	See response to ARM 36.15.6 above.		✓	

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
	ARM 17.50.1009	Applicable	Provides general requirements applying to the location of a solid waste facility, including availability of a sufficient amount of land for design, operation, and capacity of the disposal facility and adequate separation of wastes from groundwater and surface water.	See response to ARM 36.15.6 above.		✓	
	§ 75-10-212, MCA	Relevant and Appropriate	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, and recreation is allowed, is prohibited.	See response to ARM 36.15.6 above.		✓	
Noxious Weeds	MCA 7-22-2101 (8)(a) ARM 4.5.201, et seq.	Applicable	Defines "noxious weeds" as any exotic plant species established or that may be introduced in the state which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities and that is designated: (I) as a statewide noxious weed by rule of the department; or (ii) as a district noxious weed by a board, following public notice of intent and a public hearing.	Applicable requirements for all response actions and would include establishment of seed during restoration, incorporation of equipment cleaning measures during construction and use of certified noxious weed seed free materials during construction.			✓
Occupational Health Act	MCA 50-70-101, et seq ARM 17.74.101	To Be Considered	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.	OSHA regulations are construction standards and not environmental standards. The substantive portion of these regulations would be	✓		✓

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
	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.	considered for onsite remedial activities. This regulation pertains only to limited categories of workers and for most workers the similar federal standard in 29 CFR 1910.95 applies. 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 addresses only to limited categories of workers and for most workers the similar federal standard in 29 CFR 1910.1000 applies			

Statues, Regulations, Standards, or Requirements	Citations or References	ARAR Determination	Description	Comment	Chemical -Specific	Location -Specific	Action-Specific
State of Montana ARARs and TBCs							
Montana Safety Act	MCA 50-71-201 through 203	To Be Considered	States 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.	Construction contract includes requirement for appropriately trained employees.			✓
Employee and Community Hazardous Chemical Information Act	MCA 50-78-201, 202, and 204	To Be Considered	States that each employer must post notice of employee rights, maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used.	Employees must be informed of the chemicals at the work place and trained in the proper handling of the chemicals during remedial activities. HAZCOM standards required for construction site workers.			✓

[1]Montana Department of Environmental Quality, Water Quality Division, Circular DEQ-7, Montana Numeric Water Quality Standards (August 2010).
[2]Montana's MPDES regulations are more stringent than the Federal NPDES regulations

Acronyms

ARAR	Applicable or Relevant and Appropriate Requirements
ARM	Administrative Rules of Montana
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
$\mu g/m^3$	micrograms per cubic meter
FIRM	flood insurance rate map
MCA	Montana Code Annotated
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
OSHA	Occupational Safety and Health Administration
OU	operable unit
PRP	potentially responsible party
RCRA	Federal and State Resource Conservation and Recovery Act
TBCs	to be considered information
U.S.C	United States Code
USFWS	United States Fish and Wildlife Services