Summary of the

DRAFT ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) FOR THE MIKE HORSE DAM AND IMPOUNDED TAILINGS, AND LOWER MIKE HORSE CREEK, BEARTRAP CREEK AND BLACKFOOT RIVER FLOODPLAIN REMOVAL AREAS UPPER BLACKFOOT MINING COMPLEX

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Summary of the Draft Engineering Evaluation/Cost Analysis for the Mike Horse Dam and Impounded Tailings, and Lower Mike Horse Creek, Beartrap Creek and Blackfoot River Floodplain Removal Areas, Upper Blackfoot Mining Complex

1.0 INTRODUCTION

This report is a summary of the Draft Engineering Evaluation/Cost Analysis (EE/CA) for the Mike Horse Dam and Impounded Tailings, and Lower Mike Horse Creek, Beartrap Creek and Blackfoot River Floodplain Removal Areas located at the Upper Blackfoot Mining Complex site near Lincoln, Montana (Drawing 1). The EE/CA was prepared by Hydrometrics, Incorporated for the Forest Service and Asarco in response to an Administrative Order on Consent (AOC) entered into in November, 2002 between Asarco, Incorporated (Asarco) and the U.S. Department of Agriculture (Forest Service). The EE/CA has been prepared in accordance with the Non-Time Critical Removal Action process described in the Comprehensive Environmental Response, Compensation and Liability Act, and the National Oil and Hazardous Substances Pollution Contingency Plan.

The EE/CA evaluates alternative options for addressing mining-related impacts to the areas and drainages identified above which are located primarily on National Forest System lands. The objective of the EE/CA is to develop and present reclamation options that may be implemented to reduce or eliminate potential human health and environmental risks posed by mining-related impacts and to present a comparative analysis of these options based on their relative effectiveness, implementability and cost.

2.0 SITE DESCRIPTION AND HISTORY

The project area lies primarily on lands administered by the Helena National Forest within the greater Upper Blackfoot Mining Complex site (UBMC) in Lewis and Clark County, Montana (Drawing 1, Figure 2-1). The four sub-areas of mining related impacts addressed in the EE/CA include:

- The Mike Horse Tailings Impoundment which includes the Mike Horse dam and the tailings impounded behind the dam
- Lower Mike Horse Creek drainage bottom wastes from the National Forest Boundary downstream to the confluence with Beartrap Creek
- Beartrap Creek drainage bottom wastes from the Mike Horse dam downstream to the confluence with Anaconda Creek
- The Upper Blackfoot River floodplain wastes from the confluence of Anaconda Creek and Beartrap Creek downstream to a large marsh system near the confluence with Pass Creek.

Mining activity at the UBMC began in the late 1800's with the discovery of silver, lead and zinc bearing ores. Numerous mines, including the Mike Horse and others were developed over the years with the most significant production occurring from the Mike

Horse mine in the late 1930's through 1955. The Mike Horse Mining and Milling Company was the owner and chief operator of the Mike Horse mine from 1938 until 1945 when its stock and assets were purchased by Asarco. Mining activities ceased by the mid 1950's and an era of more recent exploration was conducted by the Anaconda Company in the early 1960's through the 1970's through a lease arrangement with Asarco. In 1979, following cessation of the Anaconda Company's exploration activities in the Heddleston District, the Anaconda Company was merged into Arco. Asarco purchased all of Arco's holdings in the mining district in 1981. From 1981 to present, Asarco has performed limited exploration work on the property, as well as extensive mine reclamation activities with Arco's participation.

In 1975, a major storm event combined with snowmelt led to the failure of a diversion ditch which had routed Beartrap Creek around the Mike Horse mine tailings pile, as well as other erosional problems with the tailings pile. As a result, Beartrap Creek flowed into the tailings which resulted in the release of approximately 100,000 tons of tailings into Beartrap Creek and the Upper Blackfoot River. Repairs were made to the tailings impoundment by The Anaconda Company which resulted in the construction of a modified dam at the downstream face of the tailings pile. Several additional repairs to the dam were made by The Anaconda Company in 1980.

In 1993 Asarco initiated reclamation activities under a voluntary agreement with the State of Montana which continued until 1998. In 1999 Asarco petitioned the Montana Board of Environmental Review (BER)for adoption of temporary water quality standards for certain portions of the site and these were adopted by the BER in June 2000. As part of the temporary standards, Asarco developed a conceptual plan for mitigating water quality limiting factors and has annually conducted monitoring, maintenance and waste removal under the terms of annual work plans.

In November 2002, Asarco voluntarily entered into the AOC with the Forest Service for preparation of this EE/CA, as described above. Prior to preparation of the EE/CA, the Forest Service requested that Asarco prepare concept alternatives for public review for the four primary mine waste elements on Forest Service lands. Two Alternatives Technical Memorandums were prepared: 1. Alternatives Technical Memorandum for Mine Waste Removal at the Upper Blackfoot Mining Complex Site, January 2005, and Draft Alternatives Technical Memorandum for the Mike Horse Dam and Tailings Impoundment, February 2006. Based on public and agency review of these documents, reclamation alternative options were refined. These are the alternative options that are presented and evaluated in the Draft EE/CA.

Several engineering technical evaluations were also prepared regarding the Mike Horse dam and tailings impoundment. Based on the information presented in these evaluations, the Forest Service recommended that the Mike Horse dam be removed from service. Thus, reclamation options are included in the draft EECA, and are summarized herein, which describe and evaluate various options that result in taking the dam from service. In 2005 Asarco prepared an Emergency Action Plan for the tailings impoundment with the

intent of avoiding loss of human life and minimize environmental damage to the Upper Blackfoot River drainage in the event of a failure of the Mike Horse dam.

3.0 SITE INVESTIGATIONS

Numerous investigations and monitoring activities have occurred at the site since the early 1990's. Information collected includes surface and groundwater sampling, seepage water quality from the toe of the tailings impoundment, surface and subsurface soils, mine waste, tailings samples from the impoundment as well as downstream, and leach tests on Beartrap Creek tailings. Results of data collection indicate the following:

Mike Horse Dam and Impounded Tailings

- Tailings metals concentrations are higher in the tailings material impounded behind the tailings dam than in the material comprising the dam
- Surface water in Beartrap Creek upstream of the impoundment and in the impoundment is generally good
- Surface water in Beartrap Creek below the impoundment is periodically slightly impaired for several metals. Seeps and water quality vary seasonally.
- Tailings materials within the impoundment have high concentrations of several metals including arsenic, cadmium, and copper and very high concentrations of lead, manganese and zinc
- Groundwater below the Mike Horse dam meets water quality standards

Lower Mike Horse Creek

- There is approximately 10,000 – 15,000 cubic yards of mine waste adjacent to the Lower Mike Horse Creek stream channel. These wastes contain moderate to high levels of metals and the wastes are potentially acid generating.
- The mine wastes are acting as sources of metals loading to the creek, and to bottom sediments, particularly during spring runoff
- Shallow bedrock groundwater near one well is impaired by cadmium and zinc and may be the primary source of metals to lower Mike Horse creek seasonally.

Beartrap Creek

- Tailings and mine waste are found in isolated, concentrated pockets along the floodplain, intermixed with stream and floodplain sediments, and in a concentrated area located at the Flossie and Louise mine. Metals concentrations in these wastes are moderate to high
- The concentrated tailings have potential to leach metals more so than the other types of tailings and waste occurrences
- Small increases in metals loadings in surface water occur within Beartrap Creek
- Shallow groundwater in Beartrap Creek has metals concentrations that are elevated above the water quality of area clean wells

Upper Blackfoot River

- Mine wastes occur as a relatively concentrated pile of tailings near the confluence of Shave Gulch and the Blackfoot River, and in smaller discrete deposits of fine grained tailings and dispersed occurrences of coarser grained tailings
- The wastes have moderate metals contents and are capable of generating elevated metals concentrations in runoff water coming in contact with them
- There is good groundwater quality in the area of the water treatment cells near Anaconda Creek but the groundwater quality near Shave Gulch is poor. Water quality varies seasonally.

4.0 STREAMLINED RISK EVALUATION

As part of the EE/CA, a streamlined human health risk evaluation and a streamlined ecological risk evaluation were performed. On the basis of these evaluations, preliminary removal action objectives and preliminary removal goals were developed. This information is used to define potential exposure pathways, identify appropriate cleanup goals, and ultimately select a removal action.

The primary sources of elevated contaminants (metals) identified to date is the mine waste rock and tailings. The primary metals of concern include aluminum, arsenic, cadmium, copper, lead, manganese and zinc. Since the UBMC is not located in proximity to residential areas, the public recreational scenario was utilized for evaluating the potential hazard to human health. The identified pathways include adsorption through the skin, ingestion or inhalation from wind blown dust. The results of the evaluation indicate that unacceptable risk exists as a result of potential human recreational exposure to arsenic, manganese and or lead in one or more of the exposure areas.

The potential routes of exposure to the terrestrial and aquatic environment include ingestion by birds/mammals with food by direct or incidental contact while eating. For fish, aquatic plants and benthic invertebrates a similar ingestion scenario is evaluated. The results indicate a potential adverse health impact to species that live within or may otherwise frequent the locally impacted areas.

5.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND GOALS

The streamlined human health and ecological risk evaluations concluded that mine waste/soils and surface water at the UBMC pose potential risks to both human health and the environment. The overall objective of removal actions described in the EE/CA is to reduce the current and/or threatened release of potentially hazardous substances to the environment. Specific removal action objectives include:

- Reduce the potential for contaminant migration from mine waste (waste rock/tailings), soils and sediments that would result in unacceptable risk to human health and the environment

- Reduce the potential for unacceptable risk to human health through ingestion of mine waste, soils and sediment and/or inhalation of dust
- Improve water quality in Lower Mike Horse Creek, Beartrap Creek, and the Upper Blackfoot River to the extent possible accounting for the presence of up gradient sources
- Improve watershed functionality in the Blackfoot Headwaters area to promote a more stable, natural hydrologic system.

These objectives should be achieved through attainment of cleanup goals summarized below. In addition to these primary removal action objectives, a number of secondary objectives have been identified by the USFS. Secondary removal action objectives include:

- Minimize effects to significant historic features at the site
- Enhance future recreational opportunities for the site
- Improve overall site aesthetics.

The primary goal of removal actions described in the draft EE/CA is protection of human health and the environment through minimization of direct contact with metals, and minimization of migration and mobility of metals to the environment. In order to determine whether or not a reclamation option is responsive to this overall goal, cleanup standards and requirements developed through Federal and State laws, called ARARs (Applicable, Relevant and Appropriate Requirements) regarding surface and groundwater would apply. Surface water goals specify protection levels for human health and aquatic life. Groundwater goals include the State and Federal human health standards. Risk based cleanup levels for soils and mine wastes have also been developed for the site. In addition to ARARs, many Federal and State environmental and public health programs also have criteria, advisories and guidance that are not legally binding but may provide useful information or recommended procedures.

6.0 REMOVAL ACTION OPTIONS (Alternatives Descriptions)

Reclamation options, also referred to as ‘removal actions’, for the four mining impacted areas on Forest Service lands at the UBMC have been developed. Each area includes options which range from a No Action option to a complete removal option. These options were initially presented in the Alternatives Technical Memorandums, described above. Based on the results of public and agency comments to those Memorandums, Beartrap Creek Option 3 and Blackfoot River Option 3 were not considered for detailed evaluation in this EE/CA. The remaining alternative options are essentially the same as those presented in the Alternatives Technical Memorandums with minor refinements.

Many of the removal actions would necessitate development of a mine waste repository to place removed wastes, which is a similar concept to a landfill. Several repository options have been identified and evaluated preliminarily, including the existing Paymaster Repository area, an area west of the tailings impoundment, and an offsite area.

Mike Horse Tailings Impoundment Options

The Mike Horse Tailings Impoundment is located within the Beartrap Creek drainage (Drawing 1 and Figure 2-1). The impoundment includes the upstream tailings material which is largely inundated by water, and the reconstructed dam located on the downstream end of the impoundment area.

Option 1: No Action The No Action option would leave the tailings impoundment in its current state with no removal or modifications. The No Action option would not achieve the removal action objectives and goals. Metals-bearing seepage would continue to occur at the toe of the dam, and the structure's ability to handle flows resulting from the ½ probable maximum flood (½ PMF), based on USFS design criteria for dams. The primary purpose of Option 1 is to provide a baseline condition for comparison to other removal options. Under Option 1, monitoring would continue under the current monitoring program, including regular inspections of the dam and impoundment, monitoring of seepage quantity and quality at the dam toe, and groundwater quality monitoring downgradient of the dam. The Emergency Action Plan would also remain in effect.

Option 2: In-Place Dam Stabilization/Seepage Reduction (Drawing 2 attached) Option 2 is intended to address concerns regarding the stability of the Mike Horse dam while leaving the dam and impoundment in place. Specific objectives include:

In order to meet removal action objectives, several modifications would be made to the existing structure, including construction of an emergency overflow spillway and lining the interior dam face. The spillway would be constructed on the west side of the dam, and would be approximately 100 feet wide at the top, 30 feet wide at the bottom, and 15 feet deep.

The spillway would be designed to handle the runoff resulting from the ½ PMF, or approximately 850 cubic feet per second (cfs). The spillway would be riprapped to prevent downcutting into the dam fill if flow through the spillway were to occur. A riprapped drainage channel would also be constructed down the dam face to safely convey spillway overflow to lower Mike Horse Creek. The spillway invert elevation would be about 5486 feet (ft) above mean sea level (amsl), or about six feet higher than the existing spillway pipe invert and one foot higher than the spillway pipe crest. Thus, flow would not occur through the proposed overflow spillway unless sustained inflow to the pond exceed the 179 cfs capacity of the existing spillway pipe, a condition that has not occurred since the dam was reconstructed in 1975. Approximately 13,000 cubic yards (cy) of tailings/dam fill material would be excavated during construction of the spillway and placed in on-site repository for disposal.

In order to eliminate or reduce seepage of pond water through the dam, the interior face of the dam would be covered with a low permeability liner. A plastic liner such as 60 ml HDPE or similar material would be used, with a protective cushion layer (fabric) and six to 12 inches of earthen material placed over the liner. The liner would extend from the dam crest, down the interior face to elevation 5476. The bottom edge of the liner would

terminate in a five-foot deep anchor trench, extending the liner coverage down to 5471 ft amsl.

Option 2 includes installation of a dam toe drain in order to prevent saturated conditions at the dam toe. The drain system would include a series of trenches excavated to several feet below ground surface, containing perforated pipes and drain rock. The drains would capture and divert shallow groundwater to Lower Mike Horse Creek and/or Beartrap Creek.

Monitoring and maintenance requirements for Option 2 would be similar to those listed for Option 1 with a few exceptions. Monitoring would continue under the current monitoring program, including regular inspections of the dam and impoundment, monitoring of seepage quantity and quality at the dam toe, and groundwater quality monitoring downgradient of the dam. The Emergency Action Plan would also remain in effect. In addition, the emergency overflow spillway would need to be inspected on a regular basis, and vegetation monitoring would be required on the dam face and other areas to be seeded.

Option 3: Partial Removal with Engineered Channel (Drawing 3 attached) Option 3 includes partial removal of the dam and impoundment tailings, and construction of an engineered Beartrap Creek channel through the impoundment area. The excavated tailings would be placed in an on-site repository to be located along the west side of the impoundment. This option would result in removal of the dam from service.

In order to remove the dam from service, the dam would be breached on the east side and the dam fill excavated down to native ground. A channel corridor would be excavated down to native ground along the east side of the impoundment, providing a conveyance pathway for Beartrap Creek flows through the impoundment area. The west side of the excavation would be sloped back to a 3 horizontal to 1 vertical slope (3:1), whereas the east side of the excavation would be taken down to native ground. Locating the breach and channel corridor along the extreme east side of the impoundment would minimize the volume of material requiring removal, since the dam fill and impounded tailings are shallowest on the east side.

Following excavation, an engineered channel would be constructed to convey the Beartrap Creek flow through the impoundment area. The channel would be designed to safely convey the 500-yr flow event, which was calculated to be approximately 570 cfs. The conveyance would be a trapezoidal channel with a bottom width of 8 feet and 3:1 side slopes. The water depth resulting from the 100 yr and 500 yr flow events would be 2.0 and 3.5 feet, respectively, with corresponding flow velocities of 6.4 and 8.7 ft/sec. The channel would be lined with riprap, and would include a drop structure at the downstream end to safely transition from the constructed channel to downstream Beartrap Creek. Under Option 3, the constructed channel through the impoundment area would intended to provide a safe conveyance for Beartrap Creek flows, and is not intended to function as a live stream or accommodate fish passage.

The excavated material would be placed in an on-site repository to be developed along the west side of the impoundment. The excavated material would be placed on top of the tailings to be left in place and would be capped with either a one foot thick soil layer, or an engineered composite cap. The cap would encompass the repository area (the area where excavated tailings are placed), as well as the tailings to be left in place. One advantage of Option 3 is that the west impoundment repository would have a total capacity of approximately 180,000 cy, compared to an estimated removal volume of 60,000 cy for Option 3. This means that up to 120,000 cy of material removed from Lower Mike Horse Creek, Beartrap Creek, and/or the Upper Blackfoot River could be placed in the Option 3 West Impoundment Repository if desired. Also of note is the fact that, of the 60,000 cy of material to be excavated under Option 3, up to 40,000 cy would be natural earthen fill material which was used to reconstruct the dam in 1975, as opposed to tailings.

Monitoring and maintenance requirements would be similar to Option 2 and would include regular inspections of the impoundment area including the engineered channel and repository cap, groundwater monitoring down gradient of the dam, and vegetation monitoring. Monitoring of potential seepage along the west side of the channel from the in-place tailings would also be required to evaluate the possible short-term release of pore water from the tailings, or possible groundwater flow through the lower portion of the tailings. If the one-foot soil cover cap option is used, a seepage collection and monitoring system may be required along the toe of the tailings left in place (along the west side of the channel). If the engineered composite cap is selected, the need for a seepage collection system is not anticipated. The Emergency Action Plan would no longer be in effect.

Option 4: Partial Removal of Dam and Impounded Tailings with Construction of Functioning Beartrap Creek Channel and Floodplain (Drawing 4 attached) Similar to Option 3, Option 4 includes removal of the dam from service by breaching, and constructing a new Beartrap Creek channel through the impoundment area. Unlike Option 3 however, the Option 4 stream channel would be suitable for fish passage thereby providing a hydrologic and biologic link between Beartrap Creek upstream and downstream of the impoundment.

Under Option 4, the central portion of the dam and impounded tailings would be removed down to native ground, so that the Beartrap Creek channel could be constructed through the lowest portion of the original drainage bottom along the alignment of the original channel. The depth of excavation through the dam would be approximately 70 feet, with the excavation bottom averaging about 40 feet wide to accommodate a functioning channel and floodplain. The west excavation wall, which will be comprised of tailings to be left in place, will be laid back at a 3:1 slope. The tailings would be removed down to native ground on the east side and bottom of the excavation.

Following excavation, a functioning stream channel and floodplain system would be developed through the impoundment area. The stream channel and floodplain would be designed for proper hydrologic functioning under the 100-yr maximum flow of 274 cfs.

The stream channel would be approximately 10 feet wide and the floodplain would average 35 feet in width. To prevent westward migration of the channel and undercutting of the tailings left in place, the bottom of the west excavation wall would be buttressed with riprap design to withstand the 500 yr flow event (570 cfs).

A total of 220,000 cy of material would be excavated under Option 4, of which 180,000 cy would be tailings and 40,000 cy would be earthen fill placed during the 1975 dam repairs. Both the west impoundment and Paymaster Repository sites would be used for disposal, with about 35,000 cy placed in the west impoundment site and the remaining 185,000 cy hauled to the Paymaster (or other potential on-site repository). An estimated 120,000 cy of tailings along the west side of the impoundment would be left in place, with the West Impoundment Repository built on top of the in-place tailings. Both repositories would be capped with either a one-foot soil cover or an engineered composite cap, as would the tailings left in place. As with the other impoundment options, the portion of the downstream dam face to remain in place would be covered with one foot of soil and seeded to address potential human health concerns.

Monitoring and maintenance requirements would be similar to those for Option 3 and would include regular inspections of the impoundment area including the constructed channel/floodplain and repository cap, groundwater monitoring down gradient of the dam, and vegetation monitoring. Monitoring of potential seepage along the west side of the channel from the in place tailings would also be required to evaluate the possible short-term release of pore water from the tailings or possible groundwater flow through the lower portion of the tailings. The Emergency Action Plan would no longer be in effect.

Option 5: Complete Removal of Dam and Impounded Tailings (Drawing 5 attached)
Under Option 5, all tailings and dam fill material would be removed and placed in an off-site repository, and the impoundment area restored to as close to pre mining conditions as practicable. Objectives would be similar to those for Option 4, although Option 5 would restore the impoundment area to a more natural condition and may provide a greater level of protection to the environment.

Under Option 5, all tailings and mine waste would be removed along with an estimated two feet of underlying soil. The estimated removal volume would be about 370,000 cy, with 40,000 cy being underlying soils, 40,000 cy clean dam fill, and 290,000 cy tailings. A functioning stream channel and floodplain would be creating to approximate the natural drainage system, and the riparian area restored through native grass and shrub plantings. One foot of clean soil would be spread over the entire removal area to provide suitable growth medium for site revegetation. Based on a surface area of 580,000 square feet for the Option 5 removal, approximately 22,000 cy of soil would be required to provide a one foot thick cover. An adequate borrow source has not yet been identified for this quantity of soil, and identification of an off off-site source may be required. The post-excavation ground surface may be amended with lime products to neutralize acidity, or with organic material and/or nutrients if necessary, to reduce the quantity of cover soil required.

Based on a repository siting investigation conducted by the USFS, no potential on-site repository locations have been identified capable of handling 370,000 cy of excavated soils and tailings. Therefore, Option 5 would require identification and procurement of an off-site repository location for disposal of excavated materials. Although a suitable off-site location has not yet been identified, it is assumed for comparison purposes that a suitable location can be found within ten miles of the impoundment. Based on a total volume of 370,000 cy, and an assumed average repository fill thickness of 15 feet, the off-site repository would cover about 15 acres. Therefore, an estimated 20 to 30 acre area would be needed to accommodate the repository, and support construction operations and provide a suitable buffer zone around the repository. The repository would be capped with either a one-foot soil cover or engineered composite cap.

Monitoring requirements under Option 5 would be less than those for the other impoundment options since all mine waste and fill would be removed. Monitoring would likely consist of surface water and groundwater quality monitoring, vegetation monitoring; and inspections of the removal area to identify possible erosion or other indicators of site stability concerns.

Lower Mike Horse Creek Options

For purposes of the EE/CA, Lower Mike Horse Creek includes the lower 900 feet of stream and drainage bottom located on NFS lands (Drawing 1 and Figure 2-1). A number of mine waste piles located along the Lower Mike Horse Creek drainage bottom have been shown to impact surface water quality in Mike Horse Creek and downstream drainages. The upstream portion of Mike Horse Creek drainage has previously undergone reclamation by Asarco, with additional reclamation scheduled to occur in 2006. Removal options considered for Mike Horse Creek include No Action (Option 1), partial mine waste removal (Option 2), and complete mine waste removal (Option 3). The Lower Mike Horse Creek removal options are described below.

Option 1: No Action The No Action option would leave Lower Mike Horse drainage in its current state with no removals or modifications. The No Action option would not achieve the removal action objectives, nor would it comply with Laws and requirements. Metals leaching and erosion of mine waste would continue to impact surface water quality and pose potential risks to recreationists and to the ecosystem. Option 1 is included in the EE/CA to provide a baseline condition for comparison to other removal options. Under Option 1, a certain level of maintenance and monitoring would be required for Lower Mike Horse Creek. Maintenance and monitoring may include surface water and groundwater quality monitoring, monitoring for erosion and implementing necessary erosional controls, weed control, and other potential requirements.

Option 2: Partial Mine Waste Removal (Drawing 9 attached) Option 2 would include removal of mine waste from the drainage bottom and partial removal from the drainage walls (to increase slope stability), and in-place reclamation of surrounding mine waste. The removal area and mine waste left in place would be covered with soil and seeded. The objective of this option would be to eliminate direct contact of mine waste with

surface water, minimize erosion of soil/mine waste from unstable slopes, and address potential human health and ecological risks associated with site soils.

Prior to conducting removal actions, the Mike Horse Creek flow would be diverted around the removal area to allow work to take place in the creek channel and drainage bottom. A temporary dam would be constructed in Mike Horse Creek upstream of the removal area for diversion of flow around the work area. The water would be routed through a settling basin for sediment removal prior to discharge to the creek. Since Option 2 should be implementable in a relatively short time period, the diversion structure may be sized to handle a relatively small flow such as the 2 year maximum flow event. A temporary settling basin would also be constructed at the mouth of Mike Horse Creek to help remove sediment which may be transported downstream with any seepage or precipitation runoff that may occur within the removal area.

Mine waste materials would be removed from the drainage bottom down to approximately one-foot below the top of native sediment/soils or clean fill, or to bedrock. Discrete mine waste piles along the drainage sides would also be removed and side slopes reshaped to a more stable configuration. A total of about 5,000 cy of mine waste and contaminated soil would be excavated under Option 2. The excavated mine waste would be placed in an onsite repository (the Paymaster Area, west impoundment area, or other potential on-site repository). The west impoundment repository could only be used if Option 3 was selected for the dam and tailings Impoundment.

Mine waste/contaminated soils left in place above the high water mark would be regraded to simulate a more natural topography. The upper one-foot of material may be amended with acid-neutralizing material such as lime, and then covered with one foot of clean soil to serve as a cap and as growth medium. The removal area would then be seeded to promote revegetation, and erosion control measures installed to temporarily stabilize site soils until vegetative cover is established. Over-excavated areas would be backfilled with clean soil as needed to maintain a consistent longitudinal profile to the creek channel and stable embankment slopes.

The creek channel will be reconstructed to pass the 100-year flow event, and safely convey the flow resulting from a 500-year event. Based on the naturally steep gradient of lower Mike Horse Creek (approximately to 10%), and to prevent future undercutting and sloughing of mine waste remaining in the drainage walls, the reconstructed Mike Horse Creek would be a rip rapped channel designed to prevent lateral migration and down cutting. The primary channel design criteria would be based on creation of a stable channel and safe conveyance of design flows, as opposed to aquatic and riparian habitat conditions. The channel would be about 30 feet wide, with approximately 3:1 side slopes. Approximately 1,300 linear feet of stream channel would be constructed from the up gradient National Forest boundary to the confluence with Beartrap Creek.

Option 3: Complete Removal of Mine Waste and Placement in an On-Site Repository (Drawing 10 attached)

Under Option 3, all mine waste and contaminated soils in the Lower Mike Horse removal area would be excavated and placed in an on-site repository. The primary difference between Options 2 and 3 is that mine waste within the drainage walls and immediately surrounding area would not be left in place under Option 3.

Water management under Option 3 would be similar to that described above for Mike Horse Creek Option 2. All mine waste within the stream channel, drainage walls and immediately surrounding area would be excavated and placed in an on-site repository. This includes all of the discrete mine waste piles located in Lower Mike Horse Creek drainage, and approximately one to two feet of soil along the entire drainage bottom and walls. The removal boundaries would encompass portions of the existing Mike Horse Dam access road, with portions of the access road relocated slightly to the south from its current location. Excavation depths would extend to the native ground surface, or to clean earthen fill beneath the dam access road, with one to two feet of underlying native material removed as well. The estimated removal volume for Option 3 would be 15,000 cy.

Following mine waste removal, clean soil would be imported to the site and placed to a thickness of one foot over the entire removal area. The cover soil would serve as a growth medium with the entire removal area seeded, and would also aid in final site grading to provide a more natural appearance and more stable site configuration. An estimated 3,500 cy of cover soil would be required to obtain an average one-foot of cover over the entire Lower Mike Horse removal area. Additional clean backfill may also be required for any localized areas requiring overexcavation.

Channel reconstruction for Option 3 would be identical to that described for Option 2. The channel design objectives would focus on stabilization of the active channel as opposed to aquatic habitat or fish migration. However, if Option 5 is selected for the Tailings Impoundment (complete removal and site restoration), a more natural channel design and reconstruction may be adopted for Lower Mike Horse Creek.

Beartrap Creek Options

The Beartrap Creek drainage bottom lies between the Mike Horse Tailings Impoundment and Anaconda Creek (Drawing 1 and Figure 2-1). It consists of a relatively wide, flat floodplain with limited vegetative cover. The drainage bottom varies in width from about 60 feet to over 200 feet through most of this reach, but widens to approximately 300 feet upstream of the confluence with Anaconda Creek. Steep, heavily forested hillsides border both sides of the drainage bottom, clearly demarcating the drainage bottom area included in the EE/CA.

Five preliminary removal options were initially evaluated for Beartrap Creek drainage in the mine waste removal alternatives technical memorandum (Hydrometrics, 2005a). Option 3 was eliminated from further consideration through the alternatives tech memo review process, due to redundancy with other options, and anticipated difficulties associated with the floodplain soil amendment component. The remaining four options

are described below, with the original option numbers retained for consistency with the alternatives tech memo.

Option 1: No Action The No Action option would leave Beartrap Creek drainage in its current state with no removals or modifications. The No Action option would not achieve the removal action objectives and goals. Metals leaching and erosion of mine waste would continue to impact surface water quality and pose potential risks to recreationists and to the ecosystem. Option 1 is included in the EE/CA to provide a baseline condition for comparison to other removal options. Under Option 1, a certain level of maintenance and monitoring would be required for Beartrap Creek. Maintenance and monitoring may include surface water and groundwater quality monitoring, monitoring for erosion and implementing necessary erosional controls, weed control, and other potential requirements.

Option 2: Remove Concentrated Tailings and Place in On-Site Repository (Drawing 6 attached) Under this option, only the isolated deposits of concentrated tailings would be removed from the drainage bottom. The Beartrap Creek concentrated tailings include six individual deposits totaling about 5,300 cy in volume. The tailings deposits are relatively thin, generally one to two feet in thickness, and the 5,000 cy volume includes one foot of underlying soil. In addition to the concentrated tailings, two mine waste piles located on the Flossie and Louise patented mining claims would be removed from the drainage bottom. Removal of the mine waste piles would require the cooperation of the property owner and an oversight agency with authority to work on private land. The Flossie and Louise dumps total about 1,200 cy in volume, bringing the total removal volume to about 6,500 cy for Option 2.

Following excavation, the removal areas would be covered with clean soil (if necessary) to restore the areas to a suitable grade and to serve as growth medium. The post-excavation soil surfaces may also be amended to neutralize potential residual acidity in the soils or to improve agronomic properties such as organic matter content. The removal areas would then be seeded to promote revegetation of the removal sites. Option 2 would not include removal of the intermixed tailings present within the Beartrap Creek drainage bottom alluvium, nor would the existing stream channel be modified. Option 2 is intended to address the most problematic materials present in the Beartrap Creek removal area, which is based on leaching tests and runoff sampling as described in Section 3. Follow-up monitoring would then be performed to determine if additional removal actions are warranted based on the response in surface water quality and the status of upgradient sources of metals loading.

The excavated mine waste would be placed in an on-site repository, most likely either the Paymaster Area Repository or the west impoundment repository. The west impoundment repository could only be used if Option 3 is selected for the Mike Horse Tailings Impoundment.

Option 4: Remove all Concentrated Tailings; Remove Intermixed Tailings Within an Active Stream Channel Migration Corridor; Placement of Removed Materials in

an On-Site Repository (Drawing 7 attached) Option 4 would include removal of the concentrated tailings deposits and Flossie and Louise mine waste dumps as described under Option 2, plus removal of all intermixed tailings and alluvium within an active Beartrap Creek channel migration corridor. Option 4 is intended to address the more reactive mine waste materials as proposed in Option 2, plus eliminate contact between the creek and the less reactive intermixed tailings/alluvium. This would decrease the potential for metals leaching from the intermixed tailings/alluvium to Beartrap Creek, and entrainment of tailings into the creek through channel migration and associated bank erosion.

All concentrated tailings deposits and mine waste dumps would be excavated from the drainage bottom as described under Option 2. In addition, a band of the intermixed tailings/alluvium would be removed down the length of the drainage to accommodate a floodplain and meander belt for Beartrap Creek free of tailings. Based on the hydrologic modeling, the 100-year floodplain in lower Beartrap Creek would range from 25 feet to 45 feet wide, depending on the drainage gradient and channel depth, and would average 30 feet. The existing tailings/alluvium would be excavated from the floodplain area to a depth of approximately four feet, which past field investigations have shown to be the average depth to clean native sediments. The total volume of intermixed tailings/alluvium to be removed is estimated to be 26,000 cy. Including the concentrated tailings, the combined removal volume for Option 4 is approximately 32,500 cy.

Following mine waste removal, a new stream channel and floodplain would be created from the Mike Horse Tailings Dam to the confluence with Anaconda Creek. The channel system would be designed to properly function (from a hydrologic standpoint) under the maximum 100-year flow of 278 cfs. The channel would average about eight feet wide with a depth of 2.5 to 3.5 feet. Soft armoring, such as vegetation, boulders, root wads, and other suitable material would be placed along the floodplain margins to prevent undercutting of, and stream migration into, the surrounding intermixed tailings. Riprap would likely be required in some areas to further stabilize the stream migration corridor. Additional riprap would be placed above the 100-year floodplain to protect the removal area from flows up to the 500-year flow of 575 cfs. Clean backfill/soil would be imported to the site to restore the removal area to a suitable grade and to promote revegetation of the riparian and floodplain areas.

Peak flows and corresponding stream channel floodplain widths determined through the hydrologic modeling performed for the EE/CA are based on the Mike Horse tailings dam either being taken out of service (Impoundment Options 3 or 4), or removed (Option 5). If the dam were to remain in place (Impoundment Option 2), the peak flows in downstream Beartrap Creek would be less than those presented here, although the difference is not expected to be significant for the 100-year and 500-year flows. Additional hydrologic modeling will be required once a site-wide removal action alternative is selected.

The excavated soil/mine waste would be placed in one of the potential on-site repository locations. If Option 3 is selected for the Tailings Impoundment, then the Beartrap Creek

mine waste could be placed in the west impoundment repository. Otherwise it would go in the Paymaster Area repository or other potential on-site repository. Based on the high coarse rock content in the intermixed tailing/alluvium, it may be possible to reduce the volume of material to be placed in a repository by screening the coarse rock out prior to hauling offsite. Screening out the coarse rocks, which range up to eight inches or more in diameter and consist primarily of Belt rock or other "non-mine waste-related" materials, could reduce the volume of intermixed tailings material requiring disposal (26,000 cy) by approximately 50%. The over-screened material could likely be used for backfill, riprap, or other construction materials in the floodplain/stream channel reconstruction.

Option 5: Complete Mine Waste Removal and Placement in an On-Site Repository (Drawing 8 attached) Under Option 5, all mine waste within the Beartrap Creek drainage bottom, including the concentrated tailings, Flossie and Louise waste rock piles, and intermixed tailings/alluvium, would be removed from the Beartrap Creek drainage bottom. The objective of Option 5 would be to remove all mine waste materials and restore the segment of Beartrap Creek between the tailings dam and Anaconda Creek to as close to pre-mining conditions as practicable.

Mine waste excavation would extend down to the clean (tailings free) underlying sediments, or three to four feet below existing ground surface based on field investigation results. Based on the drainage bottom dimensions and an estimated average dispersed tailings thickness of four feet, the total volume of dispersed tailings is on the order of 60,000 cubic yards, including removal of one foot of underlying soil. All of the removed mine waste would be placed in an on-site engineered repository as discussed for Option 2. As described for Option 4, it may be possible to reduce the volume of material requiring disposal in a repository by up to 50% if the non-mine waste-related coarse rock is separated from the finer grained tailings and impacted soils by screening the excavated soils prior to hauling to the repository. The over-screened material (clean rock) could be used in restoration of the drainage bottom.

Clean backfill/soil would be imported to the site to restore the removal area to a suitable grade (if needed) and to promote revegetation of the riparian and floodplain areas. Since much of the material that would be removed is foreign to the drainage bottom (i.e., the mine waste), restoring the drainage bottom to its current elevation would not be necessary, nor would it likely be desirable. Prior to the aggradation of mine waste in the drainage bottom, the elevation of the creek channel and flood plain most likely was lower than it is today. Therefore, the amount of clean fill required likely would be less than the quantity of mine waste removed. The quantity of fill required would be dependent on the depth of mine waste excavation, and the desired final stream elevation and grade. Determining the desired channel elevation and grade through Beartrap Creek drainage would depend in part on the removal options selected for the up gradient tailings impoundment and Lower Mike Horse Creek, and would be determined following selection of a site-wide removal action alternative.

Following mine waste removal, the drainage bottom would be restored to a functioning stream system. Final site restoration would include construction of a new stream channel

and associated floodplain and riparian area. Stream channel and floodplain design would follow that described under Option 4, except that riprap protection for the 500-year flow event would not be required since all mine waste would be removed and the channel would be allowed to meander across the entire drainage bottom. Final restoration details would depend on the scope of up gradient removal actions performed under this EE/CA as well as future water quality conditions entering the site from upstream sources. If future water quality conditions necessitate, restoration of Beartrap Creek could be designed to optimize downstream water quality by developing a series of wetlands along the drainage bottom. These wetlands could remove trace amounts of contaminants in Beartrap Creek (if present after removal actions are completed) thereby improving downstream water quality to the point that the Blackfoot River below the confluence of Beartrap Creek and Anaconda Creek could support fish. This would serve to connect the isolated cutthroat trout population in Anaconda Creek with the downstream Blackfoot River fishery.

Blackfoot River Options

The Upper Blackfoot River portion of the UBMC extends from the confluence of Beartrap Creek and Anaconda Creek, to the head of the natural marsh system in the east half of Section 20, Township 15N, Range 6W (Drawing 1 and Figure 2-1). Land ownership within the drainage bottom is primarily U.S. Forest Service interspersed with Asarco-owned patented mining claims. Similar to Beartrap Creek, this segment of Blackfoot River has been impacted by historic mining activities, including deposition of mine waste within the floodplain and degradation of the stream channel structure and associated aquatic habitat. Previous reclamation activities in the Upper Blackfoot River drainage include reclamation of the Anaconda mine (removal of approximately 25,000 cubic yards of mine waste and placement in a repository, and capture and treatment of discharge water from the Anaconda adit and shaft), and removal of approximately 10,000 cubic yards of mine waste from the Edith Mine area and placement in a repository (Hydrometrics, 1999). A constructed wetlands-based water treatment system is located at the site of the reclaimed Anaconda Mine and currently treats discharge waters from the Anaconda adit/shaft and the Mike Horse Mine adit.

Two general types of mine waste are present within the Upper Blackfoot River floodplain including fine-grained pyritic tailings, and coarser grained tailings (coarse sand to fine gravel size). The fine tailings most likely originated from operation of the floatation mill constructed at the Mike Horse Mine around 1941. These tailings were likely deposited along the floodplain as a result of the 1975 tailings dam breach. Production of the coarse tailings predates the fine tailings with the coarse tailings produced from operation of the older jig mill(s).

Four preliminary removal options were initially evaluated for the Upper Blackfoot River drainage in the mine waste removal alternatives technical memorandum. Option 3 was eliminated from further consideration through the alternatives technical memo review process due to redundancy with other options, and anticipated difficulties associated with the floodplain soil amendment component. The remaining three options are described

below, with the original option numbers retained for consistency with the alternatives tech memo. Although extensive field characterization activities have been completed in the Upper Blackfoot drainage, additional field characterization will be necessary for final evaluation of the removal options outlined below. Additional data needs include a detailed topographic survey of the area, and detailed sampling of Blackfoot River alluvium between the confluence of Anaconda and Beartrap Creeks downstream to surface water monitoring site BRSW-9.

Option 1: No Action The No Action option would leave the Upper Blackfoot River drainage in its current state with no removals or modifications. The No Action option would not achieve the removal action objectives, nor would it comply with Laws and requirements. Metals leaching and erosion of mine waste would continue to impact surface water quality and pose potential risks to recreationists and to the ecosystem. Option 1 is included in the EE/CA to provide a baseline condition for comparison to other removal options. Under Option 1, a certain level of maintenance and monitoring would be required for the Upper Blackfoot River. Maintenance and monitoring may include surface water and groundwater quality monitoring, monitoring for erosion and implementing necessary erosional controls, weed control, and other potential monitoring and maintenance requirements.

Option 2: Remove Shave Creek Concentrated Tailings and Larger Dispersed Tailings Deposits and Place in On-Site Repository (Drawing 11 attached) Under this scenario, all of the Shave Creek concentrated tailings and other significant tailings deposits located on NFS lands would be removed and placed in an on-site repository. Other significant tailings deposits include fine grained tailings deposits UBDT-100 and UBDT-101 located downstream of the Shave Creek tailings, the area of fine tailings bisected by the Blackfoot River approximately 600 feet downstream of the Anaconda wetland treatment cells, the area of tailings adjacent to the treatment cells, coarse-grained tailings deposit, and the two lobes of coarse tailings immediately downstream of the Anaconda wetland treatment cells. The objective of this alternative would be to remove the largest and most accessible of the identified tailings deposits located on public lands. Portions of these tailings deposits, most notably the area of tailings located adjacent to the Anaconda wetland water treatment cells lay in part on private property. Complete removal of these tailings may require coordination between the EE/CA program, and reclamation activities being conducted primarily by Asarco on private lands at the UBMC.

The concentrated tailings and larger dispersed tailings deposits would be excavated along with underlying soils to a depth of approximately one foot below the tailings/native sediment interface. The post-excavation soil surface would then be tested to determine if additional soil removal and/or soil amendment is warranted. Once soil removal is completed, clean earthen fill would be placed in the excavation areas as needed maintain an appropriate grade across the site. The excavation areas would then be covered with one foot of clean soil and revegetated with a suitable suite of grasses and shrubs. Under Option 2, modifications to the Blackfoot River channel would be limited to those necessary to address channel disturbance caused by the removal action.

Based on existing information, including detailed mapping and sampling of the Shave Creek concentrated tailings, the Shave Creek deposit contains an estimated 16,000 cubic yards of tailings, with the tailings generally two feet or less in thickness, except for a narrow band corresponding to a former stream channel where the tailings reach five feet in thickness. Tailings areas UBDT-100 and 101 contain a total of about 2,500 cubic yards, and the coarse-grained tailings areas contain about 3,500 cubic yards. Total removal volumes for these areas, including one foot of underlying soil, are estimated to range between 30,000 and 35,000 cubic yards. No other mine waste removal would occur under this option.

The excavated mine waste would be placed in one of the potential on-site repositories. The Upper Blackfoot mine waste could be placed in the west impoundment repository if Tailing Impoundment Option 3 is selected, and depending on options selected for Lower Mike Horse and Beartrap Creek. Alternatively, the Upper Blackfoot River mine waste would be placed in the Paymaster Area Repository or other suitable on-site repository. The repository design would include either a one-foot thick soil cover, or an engineered composite cap consisting of a plastic liner, drainage net, and two feet of cover soil.

Option 4: Complete Mine Waste Removal and Placement in an On-Site Repository (Drawing 12 attached) Under Option 4, all mine waste within the Upper Blackfoot River floodplain, including the concentrated and dispersed tailings slated for removal under Option 2, would be removed and placed in an on-site repository. Additional elements on Option 4 as compared to Option 2 include removal of a series of small, isolated fine tailings deposits located downstream (west) of deposit UBDT-100, removal of additional mine waste that may be intermixed with alluvium throughout the floodplain (to be investigated in 2006 through test pit excavation and soil sampling), relocation of river to what is believed to be its original location (through the Shave Creek concentrated tailings area), and restoration of the floodplain and riparian zone throughout the Upper Blackfoot River removal area. The merits of, and appropriate location for the Blackfoot River realignment would be based on a detailed topographic survey to be conducted in 2006. A portion of the County road (Mike Horse Road) may also be relocated under Option 5 to reduce the overall road length and minimize the length of road falling within the riparian zone.

Mine waste removal under Option 4 would follow that described for Option 2. Excavation would extend to about one-foot below the native soil/mine waste interface, with the total volume of material to be excavated estimated at 45,000 cy. This estimated volume might change pending detailed floodplain soil sampling to be performed in 2006. Over-excavated areas would be backfilled with clean earthen fill to maintain a suitable grade through the removal area. Since the majority of mine waste present within the Upper Blackfoot River drainage bottom was deposited on top of the original ground surface, removal of the mine waste should restore the original topography and grade of the affected areas. Therefore, backfill material would only be necessary to replace over-excavated areas. The actual quantity of fill required would be dependent on the depth of mine waste excavation, and the desired final stream and floodplain elevation and grade. Removal areas would also be covered with six to 12 inches of clean soil and seeded to

promote revegetation. Excavated mine waste/soils would be placed in an on-site repository, either at the West Impoundment or Paymaster Area site, or other suitable on-site repository location.

Following mine waste removal, the drainage bottom would be restored to a functioning stream/floodplain system. If appropriate, the Blackfoot River channel would be relocated to what is believed to be the original channel location through the Shave Creek concentrated tailings area. The channel and floodplain design would be based on the modeled 100-year maximum flow of 900 cfs. The stream channel and floodplain dimensions, as well as the exact location for the new stream channel, would be determined following the detailed topographic survey to be completed in 2006. Final restoration would also include restoration of the riparian area to provide suitable aquatic habitat and stream channel stabilization.

As with Beartrap Creek, hydrologic modeling performed to determine the 100-year (and 500- year) flows for the Upper Blackfoot River ignore effects on site hydrology of the Mike Horse Dam. If the dam were to remain in place (Impoundment Option 2), the peak flows in downstream Beartrap Creek would be less than those presented here, although the difference is not expected to be significant for the 100-year and 500-year flows. Additional hydrologic modeling will be required once a site-wide removal action alternative is selected to account for the final upstream hydrologic conditions resulting from removal actions at the Mike Horse Tailings Impoundment, Lower Mike Horse Creek and Beartrap Creek.

7.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION OPTIONS

The performance of each removal action option for the individual portions of the UBMC was evaluated based on effectiveness, implementability, and cost. Effectiveness includes: overall protection of human health and the environment; compliance with Laws and requirements; long-term effectiveness and permanence; reduction of toxicity, mobility or volume of hazardous materials; and short-term effectiveness. Implementability includes: technical feasibility; administrative feasibility; and availability of services and materials. Cost includes construction costs, capital cost, and monitoring and maintenance costs based on net present worth. The qualitative ranking of the various options is described below. Detailed costs are presented in Appendix H of the draft EE/CA.

Mike Horse Tailings Impoundment

Five options were evaluated for the Mike Horse Tailings Impoundment including: Option 1; No Action; Option 2: In place stabilization and seepage reduction; Option 3: Partial removal with engineering channel, Option 4: Partial removal with functioning Beartrap Creek and Floodplain, and Option 5: Complete Removal. All five options are screened against the three criteria listed above.

Option 1: Based on existing site conditions and the streamlined risk evaluation, Option 1 (No-Action) would not achieve the removal action goals and objectives, would not

comply with the Laws and requirements, and would not be protective of human health and the environment. Option 1 would not reduce the toxicity, mobility, or volume of Contaminants at the site. For these reasons, Option 1 ranks low for effectiveness. Because Option 1 requires no actions to be performed, other than ongoing monitoring and maintenance, it ranks high for technical feasibility, and for availability of services and materials. Option 1 ranks low for administrative feasibility since it does not address environmental issues associated with the site.

Cost - There would be no capital or construction costs associated with Option 1. The net present worth of monitoring and maintenance costs for a 30-year period is $372,272.

Option 2: The multiple components included in Option 2 would provide moderate overall protection to human health and the environment. Lining the interior dam face would reduce or eliminate seepage through the tailings dam and resulting metals-bearing seepage at the dam toe. Covering the dam face with clean soil or a composite cap, and covering or removing tailings exposed along the tailings pond shoreline would reduce potential human health concerns associated with the dam soils and tailings. The emergency overflow spillway would prevent uncontrolled overflow and down cutting of the dam should impoundment inflow rates exceed the existing spillway pile and additional freeboard capacity. For these same reasons, Option 2 would rank moderate for long-term effectiveness. Short-term effectiveness would be moderate to high due to the minimal pond dewatering, and minimal mine waste hauling and disposal required. Option 2 ranks low to moderate for reduction of toxicity, mobility or volume of wastes because, although the dam liner would reduce seepage through the dam, the majority of tailings would remain in the Beartrap Creek drainage bottom. Option 2 ranks moderate for compliance with applicable and laws and requirements. The technical feasibility of Option 2 is moderate to high since all components can be constructed with standard earth moving equipment and standard construction practices and needed materials are available. Administrative feasibility is moderate to high because Option 2 would comply with most environmental issues.

Cost - Option 2 costs include $1,283,159 for capital and construction expenses, and net present worth monitoring and maintenance costs with a soil cap and $1,419,013 with a composite material cap.

Option 3: Overall protection of human health and the environment would be moderate since all mine waste would be capped either in a repository or in place, although metals-bearing seepage from tailings left in place has the potential to occur. Also, the reconstructed channel would not permit fish passage through the impoundment area. Short-term effectiveness would be moderate due to the need for dewatering of the pond, excavation and disposal of a significant volume of material, and possible short-term seepage from the tailings left in place in response to loading from construction of the West Impoundment repository on top of the in place tailings. Long-term effectiveness would be moderate to high, depending on the occurrence and volume of potential seepage from the tailings left in place. The long-term effectiveness would be moderate if a one-foot soil cover was placed over the tailings in lieu of the engineered cap. Reduction in

toxicity, mobility and volume of source materials would be moderate because the volume of material would not change while the mobility would be reduced by taking the dam out of service and capping all tailings. Option 3 ranks moderate for compliance with applicable and laws and requirements since it may not fully comply with some such as surface water regulations. The technical feasibility of Option 3 is moderate to high. Although excavation of tailings and dam fill can be accomplished with standard construction equipment and practices, the need for pond dewatering and potential challenges of tailings excavation under these conditions may complicate the removal action. Administrative feasibility is high since Option 3 should address all human health and environmental issues with post removal monitoring proposed to assure this is the case.

Cost - Option 3 costs include $2,795,917 for capital and construction expenses, and net present worth monitoring and maintenance costs and a soil cap and $3,572,350 with a composite material cap.

Option 4: Overall protection of human health and the environment would be moderate to high since a significant portion of the tailings would be removed, all tailings would be capped either in a repository or in place, and eliminating the pond should eliminate metals bearing seepage at the dam toe. Short-term effectiveness would be moderate due to the need for dewatering of the pond, excavation and disposal of a significant volume of material at a location other than the impoundment, and possible short-term seepage from the tailings left in place in response to loading from construction of the West Impoundment repository on top of the in place tailings. Potential seepage from in place tailings would be less under Option 4 as compared to Option 3 however due to the smaller volume of tailings to be left in place. Long-term effectiveness would be moderate to high, depending on the occurrence and volume of potential seepage from the tailings left in place. The long-term effectiveness would be moderate if a one-foot soil cover was placed over the tailings in lieu of the engineered cap. Reduction in toxicity, mobility and volume of source materials would be moderate to high in response to the dam being taken out of service and all relocated and in place materials being capped, with the precise level of protection dependant on the use of a 12-inch soil cover or an engineered cap over the repository and in-place tailings. Option 4 ranks moderate for compliance with applicable and laws and requirements since it may not fully comply with some such as surface water regulations. Option 4: The implementability of Option 4 is similar to that described for Option 3.

Costs - Option 4 costs include $8,090,717 for capital and construction expenses, and net present worth monitoring and maintenance costs with a soil cap and $9,631,017 with a composite engineered cap.

Option 5: Option 5, complete removal of the tailings dam and impounded tails, ranks high for overall protection of human health and the environment, long-term effectiveness and compliance with applicable and laws and requirements because all tailings and impacted soils would be removed from the drainage bottom, and the area restored to as close to pre-mining conditions as practicable, Option 5 would meet all long-term removal

action objectives. Short-term effectiveness is low to moderate due to the significant disturbance that would be caused by total excavation of the impoundment material, and the need to haul excavated materials off-site on a public highway, and disturbance of a presently undisturbed site for construction of an off-site repository. Reduction in toxicity, mobility and volume of source materials is moderate to high depending on the use of a 12-inch soil cover or an engineered cap at the off-site repository. The technical feasibility of Option 5 is moderate due to the large volume of tailings and soils requiring removal, the need for pond dewatering, challenges associated with removing and hauling tailings under potentially wet conditions, and the need to identify and secure a suitable land for an off-site repository. Availability of required services and materials is moderate since an adequate borrow soil source would have to be identified for the 22,000 cy of soil required for closure of the impoundment removal area and 24,000 cy for repository closure, and a suitable repository site would need to be secured. Administrative feasibility is moderate to high since all human health and environmental issues would be addressed, but additional permits and agency (and public) coordination would be required for the large amount of off-site work associated with Option 5.

Costs - Option 5 costs include $20,841,966 for capital and construction expenses, and net present worth monitoring and maintenance costs with a soil cap and $22,603,826 assuming use of an engineered cap.

Lower Mike Horse Creek

Three options were evaluated for Lower Mike Horse Creek drainage including: Option 1; No Action; Option 2: Partial Mine Waste Removal; Option 3: Complete Mine Waste Removal. All three options are screened against the three criteria listed above.

Option 1: Based on existing site conditions and the streamlined risk evaluation, Option 1 (No-Action) would not achieve the removal action goals and objectives, would not comply with the laws and requirements, and would not be protective of human health and the environment. Option 1 would not reduce the toxicity, mobility, or volume of Contaminants at the site. For these reasons, Option 1 ranks low for effectiveness. Because Option 1 requires no actions to be performed, other than ongoing maintenance and monitoring, Option 1 ranks high for technical feasibility, and for availability of services and materials. Option 1 ranks low for administrative feasibility since it does not address environmental issues associated with the site.

Costs - There would be no capital or construction costs associated with Option 1. The net present worth of monitoring and maintenance costs for a 30-year period is $372,272.

Option 2: Overall protection of human health and the environment is low to moderate since not all mine waste would be removed from Lower Mike Horse drainage. Mine waste removal from the drainage bottom and covering remaining mine waste with soil would reduce potential exposure for site visitors, and would reduce metals leaching to surface waters. However, Option 2 is not expected to fully remedy potential; human health and environmental issues related to the site. Short-term effectiveness is low to

moderate due to removal actions being completed in the stream channel. Long-term effectiveness would be moderate because Option 2 would leave mine waste, albeit covered with clean soil, in Lower Mike Horse Drainage. Reduction in toxicity, mobility and volume of source materials would be low to moderate. Although the toxicity and volume would not change, mobility would be reduced by relocated waste out of the drainage bottom and covering with soil. Option 2 ranks low to moderate for compliance with laws and requirements since it is not expected to address water quality-related (and possibly other) requirements. The technical feasibility of Option 2 is high since all components can be constructed with standard earth moving equipment and standard construction practices. Adequate soil for capping the removal area should be available on site. Administrative feasibility is low to moderate because Option 2 would likely comply with some but not all environmental issues associated with the site.

Costs - Option 2 costs include $601,725 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Option 3: Overall protection of human health and the environment, long-term effectiveness, reduction in toxicity, mobility and volume of source materials, and compliance with laws and requirements are all expected to be high for Option 3 since all mine waste would be removed from Lower Mike Horse drainage and clean backfill and cover soil imported for site restoration. However, this assumes that all potential sources of Contaminants associated with the adjacent Mike Horse Tailings Impoundment, and sources in Upper Mike Horse drainage, are also addressed. Short-term effectiveness is low to moderate for the same reasons expressed for Option 2. As with Option 2, the technical feasibility of Option 3 and availability of required services and materials is high. Adequate backfill and cover soil material should be available on site. Administrative feasibility would also be high since all mine waste would be removed from the site.

Costs - Option 3 costs include $951,811 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Beartrap Creek

Four options were evaluated for the Beartrap Creek drainage including: Option 1: No Action; Option 2: Removal of Concentrated Tailings Deposits; Option 4: Removal of Concentrated Tailings and Creek Migration Corridor; and, Option 5: Complete Mine Waste Removal. All four options are screened against the three criteria listed above.

Option 1: Based on existing site conditions and the streamlined risk evaluation, Option 1 (No-Action) would not achieve the removal action goals and objectives, would not comply with laws and requirements, and would not be protective of human health and the environment. Option 1 would not reduce the toxicity, mobility, or volume of Contaminants at the site. For these reasons, Option 1 ranks low for effectiveness. Because Option 1 requires no actions to be performed, other than maintenance and monitoring, Option 1 ranks high for technical feasibility, and for availability of services and

materials. Option 1 ranks low for administrative feasibility since it does not address environmental issues associated with the site.

Costs - There would be no capital or construction costs associated with Option 1. The net present worth of monitoring and maintenance costs for a 30-year period is $372,272

Option 2: Overall protection of human health and the environment is moderate for Option 2 since the most reactive mine waste (concentrated tailings deposits, Section 3) would be removed, but the tailings intermixed with alluvium would be left in place and no stream restoration work would be performed. Short-term effectiveness is moderate to high. Although some stream disturbance would occur under Option 2, the level of disturbance and resulting turbidity and sediment generation would be lower than for other options. Long term effectiveness would be moderate because Option 2 would leave mine waste in the Beartrap Creek floodplain, and would not include any stream channel stabilization or restoration. Reduction in toxicity, mobility and volume of source materials would be moderate. Although the toxicity and volume would not change, mobility would be reduced through removal of the concentrated tailings from the floodplain and placement in a repository. Option 2 also ranks moderate for compliance with laws and requirements since it may not address water quality-related (and possibly other) laws and requirements. The technical feasibility of Option 2 is high since all components can be constructed with standard earth moving equipment and standard construction practices. Administrative feasibility is moderate because Option 2 would likely comply with some but not all environmental issues associated with the site since mine waste would be left in the floodplain.

Costs - Option 2 costs include $748,764 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Option 4: Overall protection of human health and the environment would be moderate to high for Option 4 since, in addition to the all concentrated tailings, all intermixed tailings/alluvium would be removed from the 100-year floodplain. Removal of mine waste material from the floodplain, and reconstruction of the Beartrap Creek channel, may afford a higher level of protection as compared to Option 2. Short-term effectiveness would be low to moderate due to the extensive amount of work in the stream channel and floodplain. Long-term effectiveness would be moderate to high, depending in part on the future quality of up gradient surface water. Reduction in toxicity, mobility and volume of source materials would be moderate to high. Option 4 ranks moderate for compliance with laws and requirements since it may not address water quality-related (and possibly other) laws and requirements. As with Option 2, the technical feasibility of Option 4 is high. Administrative feasibility is also moderate to high since Option 4 would be expected to address all environmental issues associated with the Beartrap Creek drainage bottom materials, but would leave some mine waste within the floodplain.

Costs - Option 4 costs include $1,735,897 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Option 5: Overall protection of human health and the environment, long-term effectiveness, reduction in toxicity, mobility and volume of source materials, and compliance with laws and requirements are all expected to be high for Option 5 since all mine waste would be removed from Lower Mike Horse drainage and clean backfill and cover soil imported for site restoration. However, this assumes that all potential up gradient sources of contaminants are also addressed. Short-term effectiveness is low to moderate for the same reasons expressed for Option 3. The technical feasibility of Option 5 is moderate to high. Although Option 5 would be completed using typical construction equipment and practices, challenges could arise due to the significant volume of tailings and soils requiring removal (approx. 60,000 cy), potentially saturated conditions in portions of the removal area, and the need for stream reconstruction. Administrative feasibility is high since all human health and environmental issues would be addressed.

Costs - Option 5 costs include $2,872,263 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Upper Blackfoot River

Three options were evaluated for the Upper Blackfoot River drainage including: Option 1: No Action; Option 2: Removal of Concentrated Tailings Deposits; and, Option 4: Complete Mine Waste Removal. The three options are screened against the three criteria listed above.

Option 1: Based on existing site conditions and the streamlined risk evaluation, Option 1 (No-Action) would not achieve the removal action goals and objectives, would not comply with the Laws and requirements, and would not be protective of human health and the environment. Option 1 would not reduce the toxicity, mobility, or volume of Contaminants at the site. For these reasons, Option 1 ranks low for effectiveness. Because Option 1 requires no actions to be performed, other than maintenance and monitoring, Option 1 ranks high for technical feasibility, and for availability of services and materials. Option 1 ranks low for administrative feasibility since it does not address environmental issues associated with the site.

Costs - There would be no capital or construction costs associated with Option 1. The net present worth of monitoring and maintenance costs for a 30-year period is $372,272

Option 2: Overall protection of human health and the environment is moderate for Option 2 since the majority of the floodplain mine waste would be removed, including the Shave Creek concentrated tailings which have the highest potential for exposure to site visitors and to surface water and runoff. Option does not rank higher for protection since some floodplain mine wastes would be left in place, and no stream stabilization or restoration work would occur. Short-term effectiveness is low to moderate since the Shave Creek concentrated tailings removal would require some stream bank and possibly streambed excavation, and a significant volume of material (approximately 30,000 cy) would have to be hauled and place in an on-site repository. Long-term effectiveness would be moderate to high since Option 2 would remove the majority, and most reactive,

of the floodplain mine waste but leave some mine waste in the floodplain. Reduction in toxicity, mobility and volume of source materials would be moderate. Although the toxicity and volume would not change, mobility would be reduced through removal of the concentrated tailings from the floodplain and placement in a repository. Option 2 also ranks moderate for compliance with Laws and requirements since it may not address water quality-related (and possibly other) Laws and requirements. The technical feasibility of Option 2 is high since all components can be constructed with standard earth moving equipment and standard construction practices. Administrative feasibility is moderate because Option 2 would likely comply with some but not all environmental issues associated with the site since mine waste would be left in the floodplain.

Costs - Option 2 costs include $1,491,745 for capital and construction expenses, and net present worth monitoring and maintenance costs.

Option 4: Overall protection of human health and the environment, long-term effectiveness, reduction in toxicity, mobility and volume of source materials, and compliance with Laws and requirements are all expected to be high for Option 4 since all mine waste would be removed from Lower Mike Horse drainage and clean backfill and cover soil imported for site restoration. However, this assumes that all potential up gradient sources of Contaminants are also addressed. Short-term effectiveness is low to moderate for the same reasons expressed for Option 2. The technical feasibility of Option 4 is moderate to high. Although Option 4 would be completed using typical construction equipment and practices, challenges could arise due to the significant volume of tailings and soils requiring removal (approx. 45,000 cy), potentially saturated conditions in portions of the removal area, and the need for stream reconstruction. Administrative feasibility is high since all human health and environmental issues would be addressed.

Costs - Option 4 costs include $2,532,806 for capital and construction expenses, and net present worth monitoring and maintenance costs.

The following tables provide a summary of the cost, effectiveness and implementability of the four removal areas and their identified options.

TABLE 7-1. COMPARATIVE ANALYSIS OF REMOVAL OPTIONS FOR THE MIKE HORSE TAILINGS IMPOUNDMENT UPPER BLACKFOOT MINING COMPLEX EE/CA

CRITERION	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
EFFECTIVENESS					
Overall Protection of Human Health and the Environment	LOW	MODERATE	MODERATE	MODERATE TO HIGH	HIGH
Short-Term Effectiveness	LOW	MODERATE TO HIGH	MODERATE	MODERATE	LOW TO MODERATE
Long-Term Effectiveness	LOW	MODERATE	MODERATE TO HIGH	MODERATE TO HIGH	HIGH
Reduction of Toxicity, Mobility, or Volume	LOW	LOW TO MODERATE	MODERATE TO HIGH	MODERATE TO HIGH	MODERATE TO HIGH
Compliance with ARARs	LOW	MODERATE	MODERATE	MODERATE TO HIGH	HIGH
IMPLEMENTABILITY					
Technical Feasibility	HIGH	HIGH	MODERATE TO HIGH	MODERATE TO HIGH	MODERATE
Availability of Services and Material	HIGH	HIGH	MODERATE	MODERATE	MODERATE REPOSITORY SITE/COVER SOIL SOURCE?
Administrative Feasibility	LOW	MODERATE TO HIGH	HIGH	HIGH	MODERATE
COST					
Capital	$0	$1,170,832	$3,366,255	$9,424,922	$22,476,172
O&M (Present Worth)	$372,272	$248,181	$206,095	$206,095	$127,654
TOTAL COST	**$372,272**	**$1,419,013**	**$3,572,350**	**$9,631,017**	**$22,603,826**

TABLE 7-2. COMPARATIVE ANALYSIS OF REMOVAL OPTIONS FOR LOWER MIKE HORSE CREEK UPPER BLACKFOOT MINING COMPLEX EE/CA

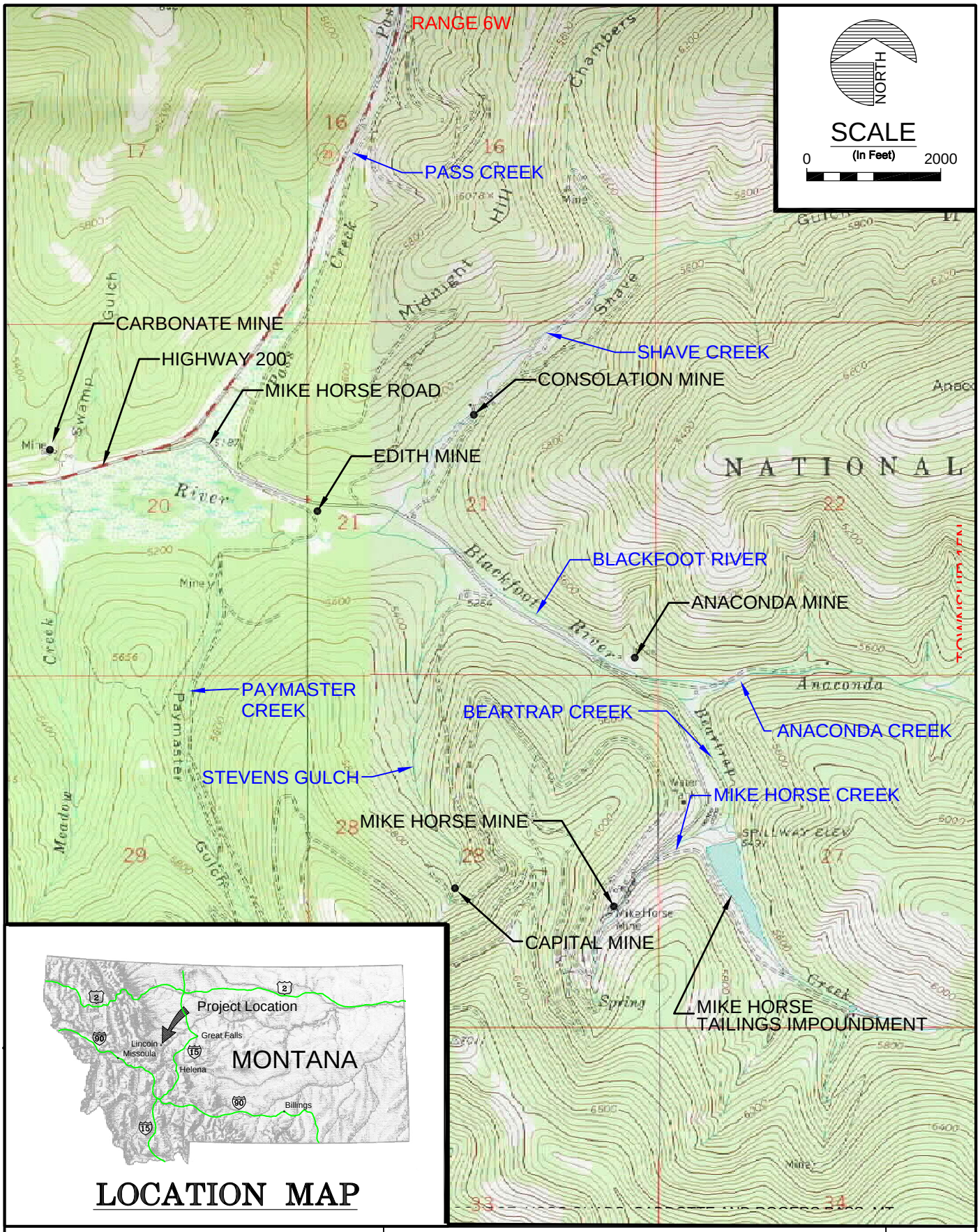
CRITERION	OPTION 1	OPTION 2	OPTION 3
EFFECTIVENESS			
Overall Protection of Human Health and the Environment	LOW	LOW TO MODERATE	HIGH
Short-Term Effectiveness	LOW	LOW TO MODERATE	LOW TO MODERATE
Long-Term Effectiveness	LOW	MODERATE	HIGH
Reduction of Toxicity, Mobility, or Volume	LOW	LOW TO MODERATE	HIGH
Compliance with ARARs	LOW	LOW TO MODERATE	HIGH
IMPLEMENTABILITY			
Technical Feasibility	HIGH	HIGH	HIGH
Availability of Services and Material	HIGH	HIGH	HIGH
Administrative Feasibility	LOW	LOW TO MODERATE	HIGH
COST			
Capital	$0	$395,630	$787,260
O&M (Present Worth)	$372,272	$206,095	$164,551
TOTAL COST	**$372,272**	**$601,725**	**$951,811**

TABLE 7-3. COMPARATIVE ANALYSIS OF REMOVAL OPTIONS FOR BEARTRAP CREEK UPPER BLACKFOOT MINING COMPLEX EE/CA

CRITERION	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
EFFECTIVENESS					
Overall Protection of Human Health and the Environment	LOW	MODERATE	NOT EVALUATED	MODERATE TO HIGH	HIGH
Short-Term Effectiveness	LOW	MODERATE TO HIGH	NOT EVALUATED	MODERATE	LOW TO MODERATE
Long-Term Effectiveness	LOW	MODERATE	NOT EVALUATED	MODERATE TO HIGH	HIGH
Reduction of Toxicity, Mobility, or Volume	LOW	MODERATE	NOT EVALUATED	MODERATE TO HIGH	HIGH
Compliance with ARARs	LOW	MODERATE	NOT EVALUATED	MODERATE TO HIGH	HIGH
IMPLEMENTABILITY					
Technical Feasibility	HIGH	HIGH	NOT EVALUATED	HIGH	MODERATE TO HIGH
Availability of Services and Material	HIGH	HIGH	NOT EVALUATED	MODERATE TO HIGH	MODERATE TO HIGH
Administrative Feasibility	LOW	MODERATE	NOT EVALUATED	MODERATE TO HIGH	HIGH
COST					
Capital	$0	$376,492	Not Evaluated	$1,529,802	$2,707,712
O&M (Present Worth)	$372,272	$372,272	Not Evaluated	$206,095	$164,551
TOTAL COST	**$372,272**	**$748,764**	**Not Evaluated**	**$1,735,897**	**$2,872,263**

TABLE 7-4. COMPARATIVE ANALYSIS OF REMOVAL OPTIONS FOR THE UPPER BLACKFOOT RIVER UPPER BLACKFOOT MINING COMPLEX EE/CA

CRITERION	OPTION 1	OPTION 2	OPTION 3	OPTION 4
EFFECTIVENESS				
Overall Protection of Human Health and the Environment	LOW	MODERATE	NOT EVALUATED	HIGH
Short-Term Effectiveness	LOW	LOW TO MODERATE	NOT EVALUATED	LOW TO MODERATE
Long-Term Effectiveness	LOW	MODERATE TO HIGH	NOT EVALUATED	HIGH
Reduction of Toxicity, Mobility, or Volume	LOW	MODERATE	NOT EVALUATED	HIGH
Compliance with ARARs	LOW	MODERATE	NOT EVALUATED	HIGH
IMPLEMENTABILITY				
Technical Feasibility	HIGH	HIGH	NOT EVALUATED	MODERATE TO HIGH
Availability of Services and Material	HIGH	HIGH	NOT EVALUATED	HIGH
Administrative Feasibility	LOW	MODERATE	NOT EVALUATED	HIGH
COST				
Capital	$0	$1,285,650	Not Evaluated	$2,368,255
O&M (Present Worth)	$372,272	$206,095	Not Evaluated	$164,551
TOTAL COST	**$372,272**	**$1,491,745**	**Not Evaluated**	**$2,532,806**



LOCATION MAP

ENGINEERING EVALUATION/COST ANALYSIS FOR THE UPPER BLACKFOOT MINING COMPLEX LEWIS & CLARK COUNTY, MONTANA	UPPER BLACKFOOT MINING COMPLEX PROJECT LOCATION AND VICINITY MAP	FIGURE 2-1

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