DRAFT CONCEPT ALTERNATIVES TECHNICAL MEMORANDUM

FOR THE MIKE HORSE DAM AND TAILINGS IMPOUNDMENT

AT THE UPPER BLACKFOOT MINING COMPLEX

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1.0 Introduction

In 2002, ASARCO, LLC (ASARCO) and the United States Department of Agriculture, Forest Service-Northern Region (USFS) entered into an Administrative Order on Consent (AOC) for development of an Engineering Evaluation/Cost Analysis (EECA) at the Upper Blackfoot Mining Complex Site (UBMC). The purpose and scope of the EECA is to control and contain specific contributing sources of human health threats and environmental contaminants on National Forest System (NFS) lands. Specifically, the EECA will evaluate various removal action alternatives for mining related impacts on two major components: 1) The Floodplains of Lower Mike Horse Creek, Beartrap Creek and the Upper Blackfoot River, and 2) The Mike Horse Dam and Impounded Tailings.

The actions identified in the EECA alone will not address all contaminant sources or the impacts from all sources in the encompassing Upper Blackfoot Mining Complex Site. Additional actions may take place within the larger State Superfund site based on compliance with environmental laws and a site-wide, comprehensive remedial investigation and human health and environmental risk assessment that the Montana Department of Environmental Quality is overseeing.

This document provides descriptions of site conditions and conceptual removal alternatives for the Mike Horse Dam and Impounded tailings for review by involved agencies, companies and the public so that a suite of viable alternatives are carried forward into the more comprehensive EECA.

A previous technical alternative memorandum for removing wastes from the floodplain areas of Lower Mike Horse Creek, Beartrap Creek below the dam and the Upper Blackfoot River (Final Alternatives Technical Memorandum for Mine Waste Removal at the Upper Blackfoot Mining Complex, Hydrometrics, Inc. January 2005) described conceptual alternatives that would be carried forward into the EECA for those portions of the site. A public review period accompanied the release of a draft version of that document in the fall of 2004 and comments during that period led to the alternatives which appear in the January 2005 final document. This document, “Concept Alternatives Technical Memorandum for the Mike Horse Dam and Tailings Impoundment at the Upper Blackfoot Mining Complex”, is being released in a draft form in order to garner agency, company, and public review prior to development of a final slate of alternatives in the EECA for the dam and impounded tailings.

1.1 Purpose and Scope

This Draft Concept Alternatives Technical Memorandum addresses the alternatives for the Mike Horse dam and impounded tailings on NFS lands, and possible areas for development of mine waste repositories on both USFS and ASARCO lands in the headwaters area of the Blackfoot River above the confluence of Pass Creek (Figure 1-1).

The range of alternatives presented is consistent with the range of alternatives identified in the AOC. They have been identified based on known technologies and are consistent with the USFS’s delegated CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) authority to develop and implement response actions based on known contaminant sources. It is understood that monitoring following implementation of the selected alternative may result in identification of further removal actions.

The location of the dam and impounded tailings is the Beartrap Creek tributary of the Blackfoot River in T15N, R6W, Section 27 MPM (Figure 1-1). The alternatives presented in this document will be evaluated and screened in greater detail in the EECA to be prepared after finalization of this memorandum. This document has been prepared in accordance with the Statement of Work (Hydrometrics, 2001) and the AOC between the USFS and ASARCO for development of an EECA at the site.

1.2 Site Description and Project Background

The Upper Blackfoot Mining Complex (UBMC), also referred to as the Heddleston Mining District, is located approximately 15 miles east of Lincoln, Montana in Lewis and Clark County (Figure 1-1). The UBMC is characterized by heavily-forested, steep, mountainous terrain that is dissected by numerous perennial and ephemeral tributaries. Elevations range from approximately 5,200 feet above sea level to 7,500 feet above sea level along the continental divide. Climatic conditions are typical of intermediate to high elevation regions of the Northern Rocky Mountains with winter temperatures falling below 0 degrees Fahrenheit in the winter and exceeding 80 degrees Fahrenheit in the summer. Average annual precipitation is estimated at 18 inches and falls mainly as snow, with accumulations of several feet typical in the project area.

Mining activity in the Heddleston District began with the discovery of silver, lead, and zinc bearing ores in the late 1800’s. Individual historic mines include the Mike Horse, Anaconda, Edith, Paymaster, Carbonate, and several other smaller mines. Sporadic development and production occurred at these various mines between 1900 and 1945, with the most significant production occurring at the Mike Horse mine from the late 1930’s through the 1940’s. The tailings impoundment area was initially used for tailings disposal from the Mike Horse Mine mill in 1941. The sandy tailings were slurried from the mill downstream into the valley bottom of Beartrap Creek. Over the years this work resulted in the formation of a substantial, relatively flat-surfaced pile, typical of tailings disposal from this era of mines. Beartrap Creek was rerouted around the tailings by a constructed creek diversion to keep the tailings pile from actively eroding.

In the 1960’s, modern era exploration and development occurred while the property was under the control of the Anaconda Company. Numerous exploration drill holes, access roads, and two exploration tunnels were advanced during this period. This ended in about 1982 when ASARCO reacquired the property from the Anaconda Company. In 1975, heavy precipitation and snowmelt combined with the blockage of the Beartrap Creek diversion ditch caused the Mike Horse dam to breach. As a result, tailings from the impounded area were washed downstream and deposited along and in Beartrap Creek and its floodplain and the Upper Blackfoot River and its floodplain. The Anaconda Company undertook an engineered repair of the breached impoundment in the fall of 1975. This resulted in construction of a compacted earthen-fill dam that included an overflow pipe for flood control. The Anaconda Company merged with the Atlantic Richfield Company (ARCO) in 1979.

Historic and modern era mining activities have resulted in significant land disturbance and impairment of surface and groundwater quality at the UBMC. Numerous investigations identified adit discharges as significant sources of metals loading to the headwaters of the Blackfoot River. In addition, there were loadings associated with unconfined waste rock piles adjacent to the Blackfoot River and its tributaries, seeps from the base of Mike Horse dam and other areas and dispersed and concentrated tailings entrained in the Beartrap Creek and Upper Blackfoot River floodplain areas.

In 1993, ASARCO and ARCO began a reclamation program to address environmental impacts from historic mining activities at the UBMC. These past activities focused primarily on mining related impacts on privately held lands in ASARCO's ownership. The mine reclamation activities discussed in this memorandum and evaluated in detail in the EECA represent a continuation of this reclamation program onto National Forest lands. All of the AOC related reclamation activities are also being conducted under the Montana Department of Environmental Quality (MDEQ) –approved Temporary Standards Implementation Plan and Schedule (ASARCO, 1999; Hydrometrics, 2000). The UBMC is also a State of Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) facility. Table 1-1 includes a project task and tentative schedule for completion of the AOC and Implementation Plan mine waste removal activities covered in this Memorandum and the 2005 Technical Memorandum.

TABLE 1.1 Tasks and Schedule

Activity	Lead	Schedule
Finalize Tech Memo	USFS	March 30, 2006
Initiate EECA for Beartrap Creek and Blackfoot River floodplain wastes and Mike Horse dam and impounded tailings on NFS lands	ASARCO	April 2006
Draft EECA	ASARCO	May 2006
Final EECA	ASARCO	July 2006
Action Memorandum	USFS	August 2006

Document Organization

This paragraph concludes Section 1.0. Section 2.0 includes site characteristics and evaluations of the Mike Horse dam. Section 3.0 includes site characteristics and evaluations of the tailings impounded in Beartrap Creek by the Mike Horse dam. Section 4.0 discusses characteristics and evaluations of potential mine waste repository sites. Section 5.0 discusses the alternative options for the dam, impounded tailings, and repository sites. Section 6.0 includes references cited.

2.0 Mike Horse Dam

The Mike Horse dam is located entirely within the Beartrap Creek drainage, a perennial tributary that joins Anaconda Creek, which then becomes the upper Blackfoot River. It includes that portion of the area south of Lower Mike Horse Creek not included in the "Alternatives Technical Memorandum for Mine Waste Removal at the Upper Blackfoot Mining Complex" (Hydrometrics, January 2005), and the constructed dam feature as described in "Evaluation of the Mike Horse Dam" (USFS, Romero 2005), and "Report on Construction Inspection Mike Horse Dam and Spillway near Lincoln, Montana" for the Anaconda Company (Dames and Moore, 1976), (Figure 2-1). The original embankment structure built in 1975 following the breech was modified in 1980 with the plugging of the decant line, repairing the spillway pipe, and adding two feet of material to the crest of the structure (Dames and Moore, 1981).

2.1 Mike Horse Dam Characteristics and Data Collection

The Mike Horse dam, as described by Dames and Moore (1976) is an "Earthfill Dam with a Pipe Spillway." The dam crest elevation is approximately 5,492 feet with an average width of 25 feet. The height of the dam, as measured from the foundation at the centerline to the crest, varies between 45 feet at the west abutment and 60 feet near the east abutment. The dam is approximately 500 feet long and is oriented in a generally east-west direction.

The overall construction of the dam is that of compacted fill material placed over the downstream face and above the crest of the tailings pile to retain the tailings materials in place. The Mike Horse dam (Figure 2-1) consists of two primary components:

The reconstructed embankment structure: The eastern portion of the dam extends approximately 200 feet from the eastern abutment as depicted in the 1975 construction documents (Dames and Moore, 1975). This portion is engineered fill typical of modern dam construction. Portions of the contact with the native materials at the base of the dam had been prepared and resurfaced with dental concrete to prevent dam core erosion.

The original embankment structure: The portion of the dam extending west from the reconstructed section (approximately 300 feet long) is depicted in the 1975 construction documents. This section of the embankment remained after the 1975 failure with the reconstructed section keyed into it. The original embankment structure consists of tailings material overlain by coarser, compacted fill material. This portion of the embankment appears to have been constructed with native foundation materials with no intervening filter zone.

The pipe spillway was designed as a flood control feature for the facility. It is concrete, 54 inches in diameter, approximately 550 feet long, and is located on the westerly side of the impoundment.

Construction of the dam in 1975 resulted in the formation of a reservoir on top of the tailings pile. Water level fluctuates with the flow volumes of Beartrap Creek and generally a portion of the tailings pile is exposed around the perimeter of the reservoir as water levels drop. As reservoir levels increase, either by precipitation or runoff, and the reservoir level reaches the spillway pipe (elevation 5,482 ft.), reservoir water flows through the spillway pipe and discharges into Mike Horse Creek. In 1980, an additional two vertical feet of coarse type fill was placed on top of the dam to increase the operating level of the reservoir.

2.2 Data Collection for the Mike Horse Dam

Numerous data collection activities to evaluate the condition and operation of the Mike Horse dam have occurred since the original construction in 1975, including annual measurement of piezometer water levels, condition inspections of the spillway pipe and outlet, and the more recent data collection efforts and evaluations as described below.

Piezometers

During the 1980 construction effort, four piezometers (P1-P4, Figure 2-1) were installed on the eastern portion of the dam to collect data on the hydraulic gradients and seepage velocities within the dam, which in part determine the potential for sediment piping to occur. ASARCO has annually collected piezometer data since 1980 on a weekly to monthly basis between April and October. These measurements were intended to be compared against reservoir levels. However, the piezometers were not installed deep enough and the associated staff gauge which measures reservoir levels to correlate with the piezometers was usually perched above the reservoir surface by mid-summer.

In 2003, ASARCO installed two additional piezometers (P5, P6) and a new reservoir staff gauge that provides the ability to measure reservoir levels through a complete water year. In 2005, two additional piezometers were installed (P7-P8) to greater depths on the central and western portions of the dam. Water levels have been collected weekly from April through July and every other week from August through October since 2004.

Groundwater Wells

In 2001 ASARCO installed three groundwater wells at the base of the Mike Horse dam to evaluate groundwater quality and levels immediately down gradient of the dam. Samples are collected and evaluated twice a year. To date, none of the samples has exceeded State Water Quality Standards for metals.

Piezometer and groundwater well data is used in conjunction with the reservoir staff gauge to determine the correlation between the reservoir levels and the groundwater surface within the dam. The first year of complete data with the additional piezometers and new staff gauge was 2005.

Seepage Flow Measurement

In 2004, Hydrometrics constructed by hand a series of shallow trenches and installed weirs at the base of the dam to determine the rate of flow through the dam via seepage. Seepage fluctuates seasonally with greater flows during the wet season. The cumulative maximum seepage flow measured at the tailings dam toe during the period June 15- 25th in 2004 was nearly 400 gallons per minute and 516 gallons per minute in May 2005. (ASARCO Consulting Inc, January 2005; ASARCO Consulting, Inc. January 2006).

Seepage Water Quality

Numerous seeps occur at the base of the Mike Horse dam tied to increases in reservoir level during spring runoff and high stream flow conditions. Metals bearing seepages are restricted to the relatively low flow seeps along the central and east dam toe. Surface water sampling has been conducted at two seep sites (BRSW-3A, BRSW-3B) near the base of the dam for a number of years starting in 1994. These samples regularly show exceedences of State Water Quality standards for cadmium, iron, manganese, and zinc (Hydrometrics, 2001- 2002; ASARCO Consulting Inc. 2004-2006; Montana Bureau of Mines and Geology, April 1998). Other seeps have no detectable metals.

Exploratory Backhoe Pits

In November, 2003, four exploratory backhoe pits were excavated at the base of the Mike Horse dam to investigate for visual signs of piping within the embankment. One test pit showed significant signs of seepage flow that appeared to be coming from the direction of the east abutment. No significant seepage flow was encountered in the other three test pits and none showed signs of seepage erosion or piping (Hydrometrics, 2003).

Cone Penetration Testing

In August 2004, the USFS, Hydrometrics, and Dr. Robert Mokwa of Montana State University conducted seismic piezocone testing (CPT) of the dam. Three CPT boreholes were advanced during the two days of testing. Results of the CPT testing indicate the original dam/embankment is comprised of medium dense sand with occasional silty sand layers. Voids were encountered in two of the three boreholes. One void was within 15 feet of the crest and the other was encountered deeper within the dam (USFS, 2005).

2.3 Evaluation of the Condition of the Mike Horse Dam

Several evaluations of the condition of the Mike Horse dam have been conducted including Mike Horse Mine Tailings Impoundment Investigation (Hydrometrics, August 2001); Piping Investigation of Mike Horse Mine Tailings Dam (Hydrometrics, November 12, 2003), Evaluation of Mike Horse Dam (USFS Romero, 2005), and others. These investigations collectively include: evaluations of the design, construction, and operation meeting applicable USFS and State of Montana dam safety requirements; and evaluations of ground water level changes through the dam, existence of evidence for piping, evaluation of material type in vertical and horizontal profile, seismic stability, and general condition of dam features including the overflow spillway pipe.

The results of the hydrologic analysis conducted to evaluate compliance with dam safety requirements identified that the capacity of the existing spillway pipe is inadequate to pass the requisite design flood volume (Hydrometrics, August 2001). In addition, the identified seepage gradient appears to exceed appropriate levels for the embankment material. Hydrometrics (2001) identified that an emergency spillway is necessary to ensure that the dam remains stable during the design storm event.

Readings from piezometers P1-P4 were analyzed for years 1983 – 2004 and evaluated against 1975 dam construction documents. Seepage models were then developed. Modeling, data, and observation indicate seepage flow at deeper levels on the eastern portion of the dam (USFS, Romero, 2005).

Voids were detected in the original embankment structure (in place tailings part of the dam). The observation of voids suggests internal erosion by piping through the embankment or by erosion at the embankment/reconstructed foundation interface. Depression of the groundwater surface within the dam as measured by the piezometers and rapid piezometer changes lends support to the presence of voids and an internal erosion mechanism at work in the dam or at the embankment/foundation interface. Results of a dynamic stability evaluation indicate that the dam will liquefy and deform somewhat during a 500-2500 year seismic event (USFS, Romero 2005).

A formal peer review of the January 2005 USFS report on the condition of the Mike Horse Dam concurred with the findings of the USFS report that the dam should be repaired or taken out of service (NTL Engineering and Geoscience, Inc. March 2005).

3.0 Beartrap Creek Tailings Impoundment

The area/reservoir immediately south of the Mike Horse dam is called the Beartrap Creek tailings impoundment. This impoundment is located entirely within Beartrap Creek, a perennial tributary of the Blackfoot River (Figures 1-1 and 2-1). The impoundment is approximately 500 feet wide at the downstream end along the crest of the dam and approximately 1,600 feet in length. At full pool, the area included within the impoundment is approximately 17 acres.

Tailings were placed into Beartrap Creek starting around 1941 and continued through 1953 as part of the milling process for the Mike Horse mine. The tailings were piped/flumed from the mill site located in Mike Horse Creek in the form of slurry. This allowed for the tailings to spread in relatively horizontal layers. Over time, the deposition of tailings from the mill resulted in the construction of a tailings embankment (flat-topped pile) extending across the Beartrap Creek valley with a maximum height of about 60 feet. Beartrap Creek was diverted on the west side by a flume/ditch to provide for the tailings embankment in the drainage bottom to remain somewhat dry. A perforated pipe was installed at the bottom of the tailings on native gravel material (the Beartrap Creek streambed) prior to placement of tailings. This pipe served to dewater the tailings from the base to keep the pile as dry as possible (Dames and Moore, 1975).

In 1975 heavy rains led to a small landslide which covered the diversion ditch that held Beartrap Creek. The creek flowed onto the tailings pile and readily cut through the downstream face of the tailings pile on the eastern side. The tailings, primarily a sandy–type material, eroded easily during that event and the result was a deep, steep-sided headcut through the downstream face of the tailings pile. An estimated 100,000 tons of tailings material washed out of the pile during that event (Dames and Moore, 1975).

Following construction of the dam, the once dry tailings pile became variously inundated by Beartrap Creek and a reservoir is now impounded on top of the tailings. The following is a summary of recent site characterization activities relevant to removal planning.

3.1 Site Characteristics and Data Collection

Volume

Engineering investigations prior to construction of the dam in 1975 identified the volume of tailings to be up to 500,000 cubic yards (Dames and Moore, 1975). A site survey conducted in 2004 by USFS indicates that the volume of material, including the impoundment and the dam, as well as estimating 2 feet below the tailings to take into account subsurface contamination, is approximately 500,000 cubic yards (USFS, August 2004). The tailings are deposited in a wedge-shape configuration and are thicker (50-60 feet) near the dam and taper to approximately a foot in thickness on the south end (Hydrometrics, 2003).

Water Quality

Water quality within the impoundment has been investigated on several occasions and historic data has shown that surface water samples collected from the pond do not contain elevated metals concentrations (Hydrometrics, 2000). Deeper water testing was conducted in December, 2000 in two locations at four-foot intervals. Samples were analyzed for pH, specific conductance, temperature, dissolved oxygen, and dissolved and total recoverable metals. Iron and manganese concentrations increased with depth. Iron and lead values exceeded Montana Water Quality standards in a portion of the samples.

Engineering Properties of Tailings

Tailings material within the impoundment has been collected on numerous occasions (Dames and Moore, 1975; Hydrometrics, 2000, 2003; Montana Bureau of Mines and Geology, 1998). There appears to be two general types of material deposited in the area: relatively coarse textured waste that is deposited along the western shore area, and finer grained tailings. The coarse-textured material is believed to be about 100 cubic yards (Hydrometrics, 2000).

Tailings material samples have been collected along the exposed beach during low pond water periods, during piezometer installation, from cores through reservoir ice, and from borings done prior to construction of the dam. From borings drilled in 1975, the tailings are comprised of brown to gray, very fine to fine sand grading to silty fine sand and sandy silt. Clayey fine to coarse sand is found near the base of the tailings where they intersect with native material (silty sand and gravel and cobbles) (Dames and Moore, 1975). The tailings show a distinctive stratigraphy (layering pattern) including a layer of native mud or organic debris, yellow-brown sand-sized tailings, and a highly plastic blue-gray, pyrite bearing clay layer at the base. Tailings material, as described during piezometer and groundwater well installation, is consistently fine, sand-sized, pyrite-rich material (ASARCO Consulting, Inc., 2003).

Tailings Sampling Results

Analyses of metals content in the tailings along the reservoir perimeter when lake levels are lower has been conducted on several occasions (MBMG, 1998; Hydrometrics, 2000). Concentrations of most metals are relatively consistent. Ranges for total metals concentrations include (in mg/Kg):

Table 3.1 Tailings Metal Concentrations within Tailings Impoundment

METAL	Concentration Range (in mg/Kg)
Aluminum	3,820 – 5,140
Arsenic	257-313
Cadmium	19-57
Copper	520-815
Iron	57,800 –85,800

METAL	Concentration Range (in mg/Kg)
Lead	1,600-15,100
Manganese	2,750-10,800
Zinc	2,360-7,780

Bottom tailings/sediment samples were also collected from four locations on the tailings pond in August 2003. The purpose of collecting the samples was to define characteristics of sediments deposited from Beartrap Creek since installation of the dam. Cores indicate that a layer of organic, fluvial silt – up to one foot thick - overlies tailings in the reservoir. Metals concentrations within these silt samples for iron, copper, lead, manganese, and zinc are similar to concentrations found in the tailings (ASARCO Consulting, Inc., 2004).

Roll jar leach tests were conducted in 2001on tailings in Beartrap Creek that had been washed out of the impoundment during the 1975 erosion event. These tests showed that the concentrated tailings which had been deposited near the surface were most leachable and posed the greatest metals loading threat to surface waters. Extract concentrations for deeper dispersed tailings were generally low (Hydrometrics, 2005).

3.2 Summary of Beartrap Creek Tailings Impoundment Sampling and Data

In estimated 500,000 cubic yards are material (tailings and dam materials) are located within the valley bottom of Beartrap Creek. The tailings have a generally wedge-shaped configuration as a result of deposition in layers. They are primarily sand and fine sand sized particles and are heavily metal laden. They are variously inundated by the reservoir formed by the Mike Horse dam and flows from Beartrap Creek.

4.0 Mine Waste Repository Sites

Introduction

In 2004, field surveys and cursory GIS evaluations were conducted by the USFS to identify potential mine waste repository sites in the UBMC area. A mine waste repository is a site with appropriate intrinsic physical characteristics where wastes can be placed in an engineered fashion and remain in a stable and hazardous condition. Generally repositories include engineered caps or liners or both to keep moisture out. ASARCO lands and public lands administered by the USFS were considered as part of this evaluation which encompassed the tributary drainages of the UBMC area. Ten sites were field-visited by an interdisciplinary team of USFS and DEQ employees. A preliminary draft report (USFS, 2005, unpublished) was recently prepared. This report includes a summary table of all the sites and provides a more complete description of the sites currently considered having more favorable characteristics. However, detailed site investigation including test pits, groundwater wells, etc. would need to be conducted to confirm the appropriateness of any of the sites.

Other repository options that are not within the UBMC that may be suitable have not been specifically identified or characterized. However, for the purposes of evaluating a complete range of alternatives in accordance with the AOC, potential off-site repository locations will be included to provide a basis for comparison and public comment. Potential off-site repositories are identified, as these are part of the range of alternatives agreed to by ASARCO in the AOC.

4.1 Site Characteristics and Data Collection

Repository Site Screening Process

An initial identification and screening process was conducted by the USFS to provide some focus on possible repository sites. A GIS evaluation of the UBMC area (all lands) using slopes (< 10%), distance from drainage bottoms and live streams (greater than 500 feet), and 5 acres as a minimum size was prepared. Based on that exercise, no possible repository sites were identified. A follow-up exercise using USGS 7 ½' topographic maps led to the identification of eight sites based strictly on identification of suitable topography. In addition, ASARCO identified that two borrow areas located on the old Mike Horse townsite and above the road near the old townsite (NW1/4 Section 27) had potential for disposal of clean oversize material or for construction staging purposes. A final site, the Beartrap Creek site, was included just west of the reservoir because of its proximity to the tailings (Figure 4-1).

Volume of Material to be Placed in a Repository

As described above under tailings volume, the surveyed estimate of the total amount of material associated with the dam and impounded tailings area is just over 500,000 cubic yards. The volume includes the assumption that there is two feet of contaminated native material underlying the tailings impoundment. A portion of these wastes may not be automatically considered contaminated as they were imported as engineering fill during the construction of the dam in 1975. In the discussion of alternatives in Section 6.0, an assumption has been made that the 1975 Zone I clay fill material is uncontaminated because of its source location and physical characteristics. The estimated volume of Zone I fill material in the dam is 40,000 cubic yards based on the Special Use Permit and construction notes. For any of the alternatives that consider removal of the dam structure, this material is assumed to not warrant disposal in a repository. Material sampling would be conducted during design phase to validate that assumption.

The volume of waste materials identified in the Alternatives Technical Memorandum for Mine Waste Removal for Lower Mike Horse Creek, Beartrap Creek and the Blackfoot River (Hydrometrics, January 2005) are also included in Table 4.1, below.

TABLE 4-1 Waste Volume Summary on USFS Lands in UBMC

Waste Type/Location	Volume Estimate in cubic yards/source
Mike Horse Dam and Tailings Impoundment tailings and coarser material - wastes	463,000 / USFS 2005
Mike Horse Dam Zone 1 material – uncontaminated fill	40,000 / USFS 2006
Lower Mike Horse Creek – waste rock	15,000 / Hydrometrics 2005
Beartrap Creek – concentrated tailings	4,000 / Hydrometrics 2005
Beartrap Creek Tailings and intermixed native alluvial material	50,000 / Hydrometrics 2005
Flossie/Louise mine waste rock	1,500 / Hydrometrics 2005
Blackfoot River floodplain, scattered fine and coarse grain tailings*	2,500 / Hydrometrics 2005
Blackfoot River floodplain, coarser jig tailings	3,500 / Hydrometrics 2005
Blackfoot River floodplain, Shave Creek concentrated tailings area (includes potentially contaminated subsoil volume estimate)	24,000 / Hydrometrics 2005
TOTAL MATERIAL VOLUME	**603,500 CUBIC YARDS** (563,500 cubic yards waste; 40,000 cubic yards uncontaminated dam fill)

*Blackfoot River floodplain waste delineation is scheduled to be completed in summer, 2006. Volume identified is a preliminary estimate.

4.2 Repository Sites Characterization and Data Collection

As described above, a preliminary review and investigation of potential repository sites within the Upper Blackfoot area was conducted in 2004. The characteristics of each site were noted and included site geology, slope, vegetation, landownership, distance to Mike Horse dam, and apparent presence/absence of surface or near surface water. Three repository areas that were field reviewed and preliminarily evaluated are included in this report. Several sites were not incorporated in this Memorandum because of size limitations, indications of shallow groundwater, or indications that the site as part of the mineralized body that was identified through exploration drilling by the Anaconda Company.

Preliminary estimates of the capacity of the sites indicate that no single repository site could hold the estimated volume of wastes. Combinations of sites could be used to dispose of the entire volume.

Paymaster Repository Site

The Paymaster Repository site is located on the south side of the Blackfoot River on property owned by ASARCO in the south half of Section 20 (Figure 4-1). It was identified as a potential repository site because it had already been developed as a repository site and can be accessed by a good improved dirt road. The Paymaster Repository Site is approximately 2.5 miles from the Mike Horse dam. The developed portion of the site is approximately 5 acres. An additional area to the west that may be developed as an addition repository site is approximately 7 acres. Groundwater wells are proposed for installation in 2006 as part of the Temporary Water Quality Standards activities.

Slopes at the Paymaster site are favorable at roughly 10%. There is no evidence of slumps or seeps and relatively little understory brush. A primary concern about this site was visibility from U.S. Highway 200. The site was surveyed. Preliminary volume calculations show that the volume of material that could be placed on this site is approximately 218,000 cubic yards.

Beartrap Creek site

The area west and southwest of the Beartrap Creek Tailings Impoundment was identified as a potential repository site because it is the nearest location to the greatest volume of wastes. The site is located in the SW1/4 of Section 27 and is entirely on NFS lands (Figure 4-1). It includes two areas. The first area is just to the west of the west shore of the reservoir and upslope until slopes exceed 10%. It is approximately 4 acres in size above the current high reservoir line. However, a portion of the area currently underwater could also be suitable once the site is dewatered. This site includes the county access road and is primarily vegetated with mature lodgepole pine and Douglas-fir. The estimated potential volume of this site is approximately 82,000 cubic yards.

The second area is just to the southwest of the reservoir. It is approximately 9 acres in size. It is located above the county road and the residence located behind the locked gate. Slopes are steeper (20%) and a portion of the area is a small wetlands. Preliminary analysis indicates the site could hold an estimated 80,000 cubic yards.

Borrow Areas Near Old Mike Horse Townsite

Two areas located just north of Mike Horse Creek have potential for disposal of wastes or other clean materials such as Zone 1 fill or coarse oversize material from Beartrap Creek. The upper site is a coarse material pit located in the NW ¼ of Section 27 (Figure 4-1). It is approximately 150 ft wide and 300 ft long with good road access. The site is entirely on NFS lands. Geology of the site is well exposed and it includes fractured metamorphic Belt Supergroup shales that have been oxidized to a dark reddish brown color on the surface. The shale breaks into coarse fragments and appears to be nonmineralized. There is no vegetation on this site and it has a southeasterly aspect. The estimated volume of material that could be placed at this site is less than 30,000 cubic yards.

The old Mike Horse townsite area is located just downslope of the borrow pit discussed above. It is located in the SW1/4NW1/4 of Section 27 and lies just north of Mike Horse Creek (Figure 4-1). An existing access road enters the site from the north off of the county road. The site is generally cleared of trees and has an alluvial/soil surface as a result of reclamation and is generally low sloping, less than 5%. The cleared area is approximately 100 ft by 400 ft in size. This does not include the vegetated, uncleared area to the north. This site could also serve as a location for treating material or construction staging.

Nonlocal Repository

Identification of a suitable nonlocal repository for the identified wastes of the Mike Horse dam and impoundment, as well as the floodplain wastes on NFS lands is a possibility that was identified in the AOC Statement of Work. While no specific site has been identified, the use of a hypothetical site with an identified haul distance is useful for cost comparison purposes. Landownership was also not considered a factor at this stage of evaluation.

For the purpose of this Memorandum, an assumed haul distance of 10 miles was identified. This repository alternative also assumes that a single site of suitable size, with appropriate geology and physical characteristics could be identified in contrast to the potential need for multiple repositories within the AOC area.

5.0 Alternative Development

Alternatives were developed for the Mike Horse Dam and Beatrap Creek Tailings Impoundment utilizing the range of alternatives identified in the AOC and Statement of Work, including No Action/Institutional Controls, Partial Removal, and Total Removal. Disposal of wastes considers the above identified repository sites. Based on discussions with ASARCO following release of the Evaluation of the Mike Horse Dam (USFS, 2005), an alternative for stabilization of the dam in place is included.

Assumptions Used for Development of the Alternatives

1. Any selected action alternative would require extensive, detailed site investigation prior to completion of a removal design. Site investigation items vary by action alternative. However, the types of investigation work would be similar for Alternatives 3-5, including but not limited to, groundwater monitoring wells, test pits, leachate testing, soils evaluations, geology, and characteristics of potential removal wastes and repository areas.

2. Alternative 2 (dam stabilization) would necessitate specific engineering investigations related to the design for maintaining the dam in place. This includes additional CPT studies, additional piezometers, subsurface exploration program to establish shear strength parameters, seismic analysis in accordance with draft Seismic Analysis Guidelines currently proposed by Montana DNRC Dam Safety Division, and measures to respond to the soft soils identified in the 1976 Dames and Moore Construction Report (USFS, 2005).

3. The Mike Horse Dam and Impounded Tailings area includes contaminated and uncontaminated material. Contaminated material would necessarily require placement into a repository whether on-site or off-site. Uncontaminated material could be utilized in the reclamation remedy. Sampling would be conducted to validate assumptions of what is and is not contaminated material prior to and during removal actions.

4. Contaminated Material includes an estimated 563,500 cubic yards (Includes dam, impoundment, and floodplain waste volume estimates). Uncontaminated material includes an estimated 40,000 cubic yards (Table 4.1).

5. None of the identified repository locations within the AOC area has the capacity to hold the entire contaminated volume due to intrinsic physical limitations. A combination of sites would be needed for removal of all the contaminated wastes.

6. All of the above described repository locations appear to be suitable sites based on field reconnaissance. Detailed site investigations may result in the exclusion of a site from consideration or in increased costs of design and construction based on subsurface conditions.

7. All alternatives would incorporate evaluation and correction of road and other drainage problems on existing and contemplated new roads.

Alternative 1: No Action – Current Site Controls

Description

This alternative maintains the current situation for the dam and impounded tailings. Both features would remain in place. Annual piezometer monitoring, monitoring of intake pipe trash rack and debris removal would continue to be the responsibility of ASARCO. The Emergency Action Plan would remain in force and would be executed in the event of a high flow event. ASARCO is a primary contact in the event of an emergency event. A reservoir level remote monitoring system is also in place which is maintained by the USFS.

Objective

The objective of continuing with Alternative 1 is that it is the lowest cost option.

Results

There would be no change in the existing dam, reservoir and impounded tailings configurations with this alternative. Beartrap Creek would continue to flow into the reservoir until reservoir levels reach the intake pipe. At this and higher levels, the intake pipe functions as an overflow and the water is discharged at the outlet in Mike Horse Creek. Mike Horse Creek would continue to flow in an artificially constrained channel due to the construction of the dam. No repository(s) would be needed with this alternative.

The current annual maintenance and monitoring items would continue to be conducted by ASARCO, including removal of debris from the intake pipe trash rack, reading and recording piezometer levels and inspecting the overflow pipe. An Emergency Action Plan (EAP) would continue to be needed in the event of high spring or storm flows or other potential threat to the stability of the dam. The EAP includes response duties by local, State and Federal authorities, and ASARCO.

Alternative 1A: Interim Spillway and Beartrap Creek Diversion

Description

This alternative may arise as a result of longstanding concern for the dam not having the capacity to pass the one – half probable maximum flood. This would be an interim response to the concern for flood flows while a longer term response is developed. This alternative includes excavating a temporary breech in the crest of the dam to form an overflow spillway and placing riprap or other material to line and reinforce the spillway area. The spillway capacity would be sized to pass the design flood and ensure that water levels do not reach the dam crest and overflow.

Objective

The objective of this alternative is that it is a low cost, temporary option to prevent damage to the dam during a flood flow pending a more comprehensive long term solution.

Results

The dam would be largely the same as Alternative 1 with the exception of an interim spillway. The reservoir would largely be the same as Alternative 1 unless flood flows occur. The interim spillway would function in the event of a ½ probably maximum flood event or greater, otherwise, the intake pipe would handle higher reservoir flows. There would be no change to the impounded tailings and they would remain in place in Beartrap Creek. Beartrap Creek would flow into an engineered diversion above the reservoir and then discharge below the dam into Beartrap Creek. There would be no repository with this alternative.

The current annual maintenance and monitoring items would continue to be conducted by ASARCO, including removal of debris from the intake pipe trash rack, reading and recording piezometer levels and inspecting the overflow pipe. The spillway would also require periodic inspections and possibly maintenance. An Emergency Action Plan (EAP) would continue to be needed in the event of high spring or storm flows or other potential threat to the stability of the dam. The EAP includes response duties by local, State and Federal authorities, and ASARCO.

Alternative 2: Stabilization of the Dam in Place

Description

ASARCO has identified that suitable technologies are available to secure the Mike Horse dam in place. These technologies include installation of permanent spillway cut approximately 5 feet deep to provide for passage of the design flood flow and provide for water to pass should the reservoir level approach the dam crest. In addition, a synthetic liner would be installed on the upstream dam face to prevent seepage into the dam from the reservoir, and drains at the toe of the dam to dewater the base of the tailings. Additional engineering evaluations as described above under assumptions would be conducted to develop a suitable design. Human health risks due to exposed tailings when reservoir level is lowered would need to be addressed with this alternative. Overall, exposed tailings along the reservoir edge would be reduced due to installation of the dam liner on the upstream face.

Objective

This alternative provides for an emergency overflow spillway and reduces seepage into the dam (thus reducing potential for piping) by lining the interior face. It has the potential to be less costly than removal alternatives. Comprehensive pre-design engineering evaluations would be necessary for effective cost estimation and design.

Results

The resulting configuration of the dam in Alternative 2 is that it would remain in place. Beartrap Creek would continue to flow into the reservoir and drain via the spillway pipe. The impounded tailings would also remain in place. However, a portion of them would be covered by the liner on the dam face. This alternative would not require a repository.

The current annual maintenance and monitoring items would continue to be conducted by ASARCO, including removal of debris from the intake pipe trash rack, reading and recording piezometer levels, and inspecting the overflow pipe, spillway, liner and toe drains. The spillway, liner and toe drains may also require periodic maintenance. An Emergency Action Plan (EAP) would continue to be needed in the event of high spring or storm flows or other potential threat to the stability of the dam. The EAP includes response duties by local, State and Federal authorities, and ASARCO.

Alternative 3: Removal of Dam from Service and Partial Removal of Impounded Tailings from Historic Beartrap Creek

Description

Alternative 3 includes removing portions of the Mike Horse dam and impounded tailings to provide for placement of Beartrap Creek into the valley bottom as an engineered channel. Beartrap Creek flows would be controlled through engineering design. This alternative would not provide for a premining type channel and would not result in restoration of hydrologic function and riparian conditions. A portion of the tailings would have to be removed along the length of the impoundment to provide for controlled flow of Beartrap Creek. Removed tailings material would be placed on top of the tailings remaining in place. Removed dam material would also be placed on top of the tailings remaining in place and reshaped. These wastes would have an engineered cap and drain system similar to the Moon Gulch repository site in Idaho where contaminated material has been stabilized in a repository located adjacent to the drainage while providing for an engineered floodway. Mike Horse Creek would continue to flow in a modified channel that would not allow for natural channel and historic riparian conditions to develop.

Objective

This alternative provides a least cost option for removing the dam from service and stabilizing and containing the reshaped tailings and dam material as close to the site as possible.

Results

The Mike Horse dame would be removed from service. A portion of the dam would be reshaped, stabilized and capped into an adjacent repository. There would no longer be a reservoir as Beartrap Creek would flow through the site in a controlled channel. A portion of the impounded tailings would be removed from the valley bottom area to provide for the Beartrap Creek channel. Tailings and dam materials removed would be reshaped and capped in an repository located adjacent to Beartrap Creek.

Annual monitoring and periodic maintenance would occur to ensure channel stability and repository function.

Alternative 4: Partial Removal of Dam and Impounded Tailings from Historic Beartrap Creek Floodplain, Repository Disposal Options

Description

This alternative includes removal of the entire dam and all tailings that are within the historic floodplain of Beartrap and Mike Horse Creeks. Native material within the floodplain area that has been contaminated by mine waste would also be removed. Beartrap and Mike Horse Creeks would have enough valley bottom area to restore historic floodplain (sufficient to pass 100 and 500 year flood event) development and function. Portions of the removed dam and tailings would be placed in an adjacent repository (similar to Alternative 3 above) with the balance placed in one of the other identified repository sites in the UBMC area, as this alternative contemplates removing much more material from the valley bottom area. While the historic Beartrap Creek floodplain would be restored, a portion of the wastes from the impoundment would reside in a repository located along the valley slope area to the east. Mike Horse Creek would be provided a more natural channel configuration as dam material impinging on this channel would be pulled back from the channel area and placed in a repository.

Objective

The objective of this alternative is to remove the dam from service as well as restore a more natural channel and floodplain in Beartrap and Mike Horse creeks.

Results

In Alternative 4, the dam would be removed from service, there reservoir would no longer exist and the impounded tailings would be partially removed from the historic Beartrap Creek valley bottom so that the restored channel and floodplain could pass a 500 year flood event. A much greater portion of the dam and tailings would be reshaped, stabilized and capped into adjacent and other repository than is contemplated in Alternative 3.

There would be a need for more than one repository site as the amount of tailings and dam material to be removed from the valley bottom would likely exceed the repository capacity at Beartrap Creek. Annual monitoring would be conducted to ensure proper channel and vegetation restoration as well as proper function of the repositories

Alternative 5: Total Removal of Dam and Impounded Tailings from Historic Beartrap Creek Floodplain, On-site and Off-site Repository Disposal

Description

Alternative 5 includes the removal of all contaminated material located within the Mike Horse Dam and Beartrap Creek valley bottom that was not historically there, as well as any native material that might have been contaminated by mine wastes. Material would be excavated and hauled to either multiple local repositories and or to the hypothetical offsite repository identified in Section 4.0 above. Beartrap Creek and Lower Mike Horse Creek valley bottoms would be restored to the extent possible to premining condition.

Objective

The objective of Alternative 5 is to provide for the greatest stability of the valley bottom, restoration of water quality and premining hydrologic and riparian function. It could also result be the least cost for long term monitoring and maintenance.

Results

Alternative 5 results in removing the dam from service and removing the dam and impounded tailings material out of the historic Beartrap and Mike Horse Creek drainage bottoms. This alternative sets the stage for restoration of these drainage bottoms to a premining condition. The reservoir would no longer exist with this alternative. Dam and tailings material would be removed from site and placed in several repositories in the area or in an offsite repository. This alternative would result in the greatest costs as it includes the largest amount of material to move and place in a repository(s).

Annual monitoring would be limited as this alternative would attempt to provide for the greatest stability and restoration. Repository sites would require annual inspection and monitoring.

Table 5.1 Summary Comparison of the Alternatives

Features to Compare	Alternative 1	Alternative 1A	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Dam	No Change	Interim Spillway	Stabilize in place with spillway, liner and toe drain system	Partial Removal, dam no longer in service	Partial Removal, dam no longer in service. Dam materials placed in nearby repository(s)	Total Removal of all dam materials from valley bottom to nonlocal repository
Reservoir	No Change	No Change	No change	None	None	None
Impounded Tailings	No Change	No Change	Remain in place, less exposed along reservoir edge	Partial removal to provide for Beartrap Creek flow in a controlled channel. Removed tailings placed in adjacent repository	Partial removal from valley bottom. Removed tailings would be placed in nearby repository(s)	Would be removed to nonlocal repository
Beartrap Creek	Flows into Reservoir	Flows into Reservoir	Flows into Reservoir	Controlled flow channel	Provides for natural floodway and riparian development. Upslope portions of valley bottom would be part of the tailings repository	Provides for pre-mining stream and valley bottom configuration
Mike Horse Creek	No Change	No Change	No Change	No change	Channel reconfigured closer to premining gradient and hydrologic function	Channel reconfigured closer to premining gradient and hydrologic function
Repository	None	None	None	One Beartrap Creek area	One or More Beartrap Creek area and other site(s)	One nonlocal or multiple nearby repositories
Monitoring & Maintenance	EAP in force, ongoing monitoring with remote system. Maintenance of overflow pipe intake during spring runoff	EAP in force, ongoing monitoring with remote system. Maintenance of overflow pipe intake during spring runoff. Spillway condition monitoring needed.	EAP in force, ongoing monitoring with remote system. Maintenance of overflow pipe intake during spring runoff. Spillway liner and toe drain condition monitoring needed.	Moderate level to ensure channel is stable and repository is functioning properly	Low level – ensure channel is stabilizing. Ensure vegetation development	Lowest level at Beartrap and Mike Horse Creeks. Nonlocal repository would require periodic performance monitoring

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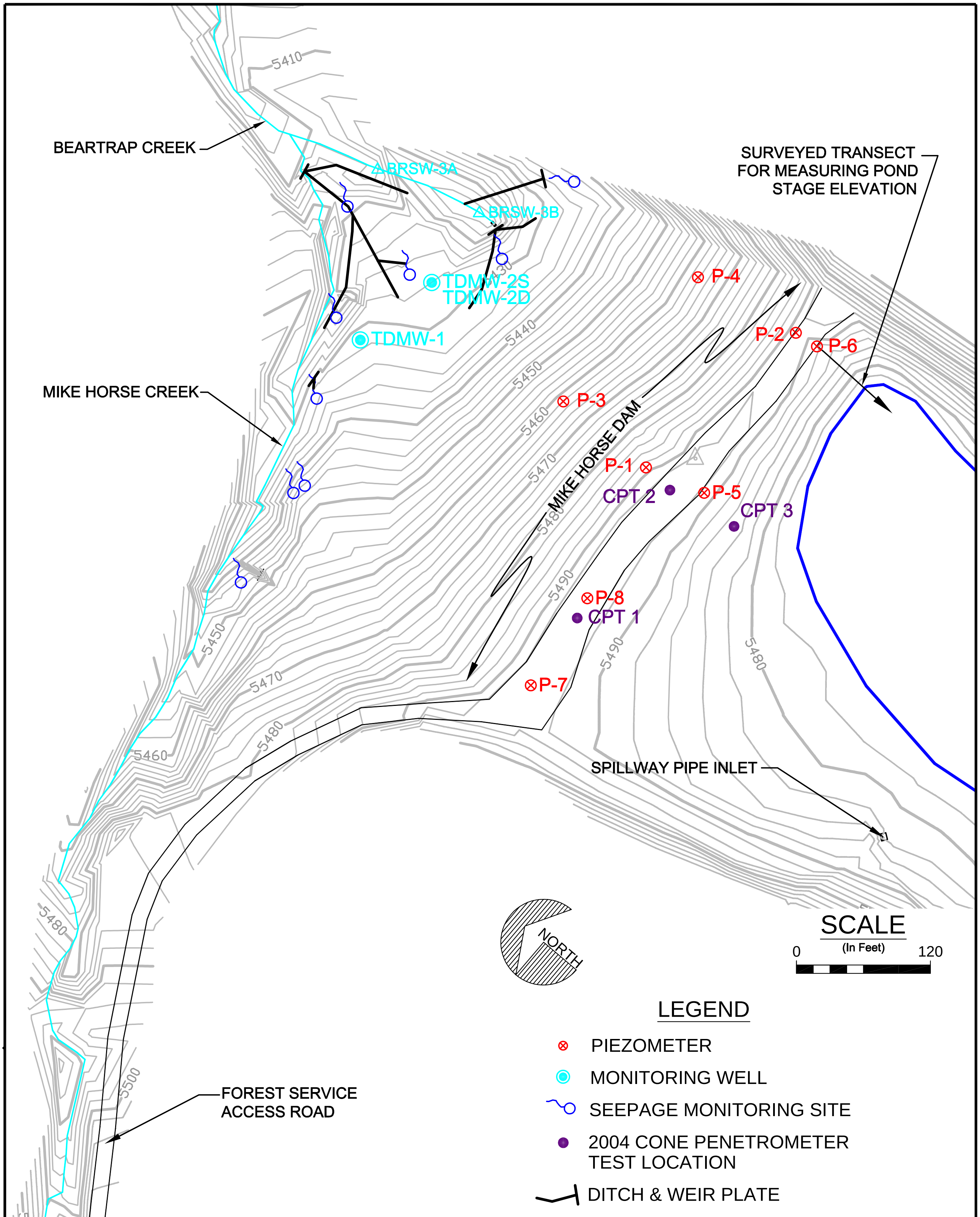

MONITORING SITES
MIKE HORSE TAILINGS IMPOUNDMENT

FIGURE **2-1**

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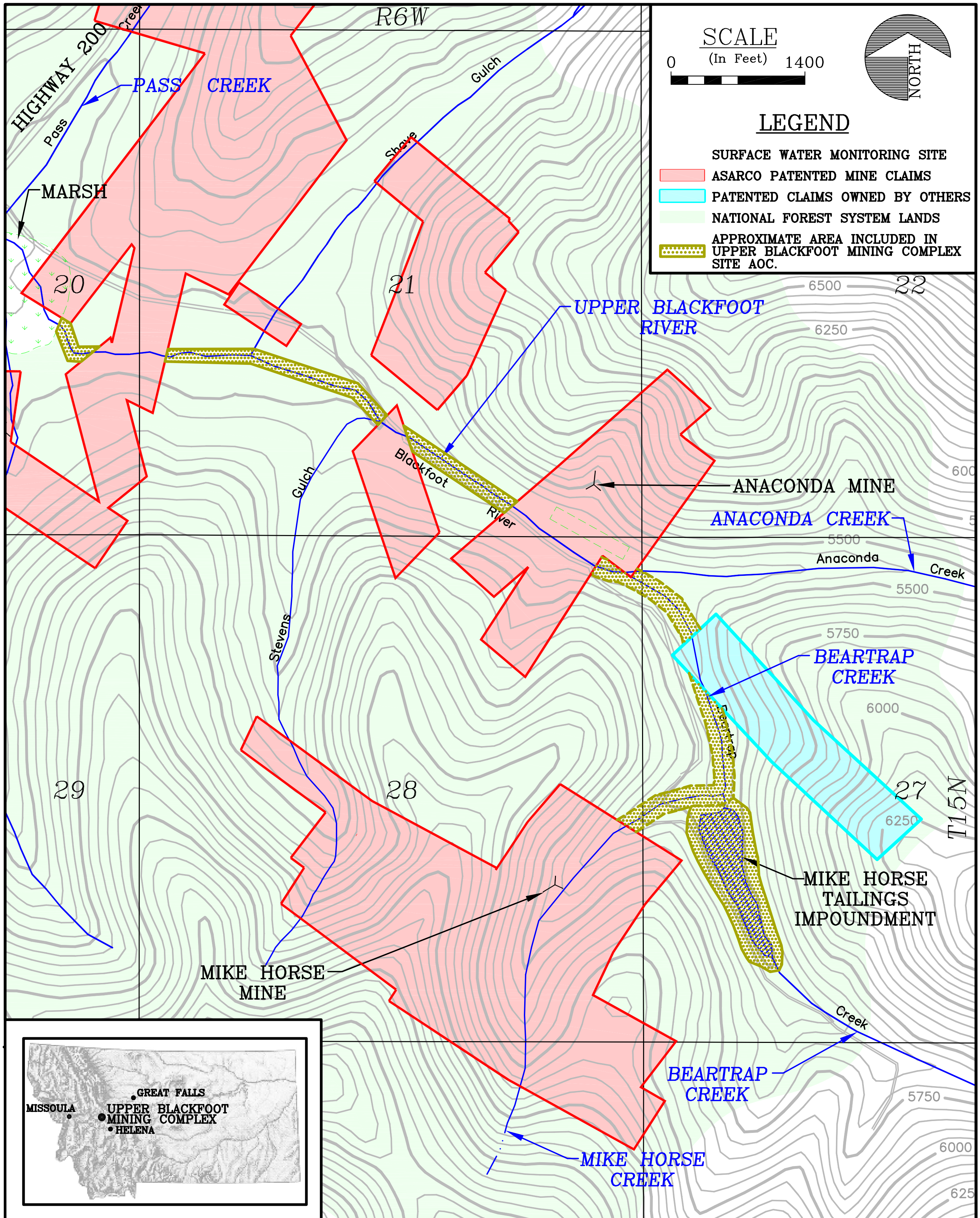

UPPER BLACKFOOT MINING COMPLEX AND SURROUNDING AREA

FIGURE 1-1

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