

**DRAFT**  
**EXPANDED ENGINEERING  
EVALUATION & COST ANALYSIS**

Lilly/Orphan Boy Mine  
Powell County, Montana

Prepared for:  
Trout Unlimited  
111 N. Higgins, Suite 500  
Missoula, Montana

Prepared by:  
NewFields Companies, LLC  
1120 Cedar Street  
Missoula, Montana 59802



**January 2016**  
**Project 350.0215**



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## LIST OF ABBREVIATIONS & ACRONYMS

AMSL	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	constituent of concern
COPC	constituent of potential concern
DEQ/MWCB	Montana Department of Environmental Quality, Mine Waste Cleanup Bureau
EE/CA	Engineering Evaluation and Cost Analysis
EPA	U.S. Environmental Protection Agency
FHC	Frontier Historical Consultants
GCL	geosynthetic clay liner
gpm	gallons per minute
GSM	Golden Sunlight Mine
GWIC	Montana Bureau of Mines and Geology Groundwater Information Center
HMI	hazardous materials inventory
LOB	Lilly/Orphan Boy
mg/kg	milligrams per kilogram
NCP	National Hazardous Substances Pollution Contingency Plan
NPV	net present value
PAET	Probable Apparent Effects Threshold
QA/QC	quality assurance/quality control
RAO	remedial action objective
RI	reclamation investigation
SHPO	Montana State Historic Preservation Office
SMS	sediment management standard
su	standard units
TCLP	toxicity characteristics leaching procedure
WDOE	Washington Department of Ecology
WRP	waste rock pile
XRF	x-ray fluorescence spectrum analyzer
yd <sup>3</sup>	cubic yards



## 1.0 INTRODUCTION

NewFields Companies, LLC (NewFields) prepared this Expanded Engineering Evaluation and Cost Analysis (Expanded EE/CA) for the Lilly/Orphan Boy Mine in the Little Blackfoot River watershed in Powell County, Montana (**Figure 1**) on behalf of Trout Unlimited. This report presents results of an engineering evaluation and cost analysis of several alternatives to address solid mine waste materials at the Lilly/Orphan Boy Mine Site that include waste rock, soil and sediment.

### 1.1 PURPOSE AND OBJECTIVES

This Expanded EE/CA was developed following the “non-time critical removal action” process outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the updated National Hazardous Substances Pollution Contingency Plan (NCP). A non-time critical removal action is implemented by the lead agency (the Montana Department of Environmental Quality, Mine Waste Cleanup Bureau [DEQ/MWCB] in this instance) to provide “the cleanup or removal of released hazardous substances from the environment... as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment...” (U.S. Environmental Protection Agency [USEPA] 1993). Following EPA’s Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (USEPA 1993), this Expanded EE/CA provides the logic, process, and cost estimate to develop and evaluate potential response action alternatives that may be used to address mine waste at the Lilly/Orphan Boy Mine Site. The objective of this Expanded EE/CA is to develop and evaluate potential response action alternatives to reduce or eliminate potential human health and environmental risks associated with solid waste materials at the Lilly/Orphan Boy Mine site. This Expanded EE/CA identifies the preferred alternative that best satisfies the criteria developed from removal action objectives and used to evaluate the suite of potential reclamation alternatives.

### 1.2 DOCUMENT ORGANIZATION

Following this introductory section, this Expanded EE/CA is organized as follows:

- **Section 2.0** provides a brief description of the mine site.
- **Section 3.0** summarizes key findings of previous assessments of the mine, as well as the results of recent investigation activities completed in November 2015.
- **Section 4.0** presents a streamlined evaluation of potential risks to human health and the environment resulting from historic mining activities.
- **Section 5.0** summarizes the applicable or relevant and appropriate requirements (ARARs) for potential response actions at the mine.
- **Section 6.0** describes the scope, goals, and response action objectives for the mine site.





- **Section 7.0** identifies potential remedial technologies, presents an initial screening of those technologies, and describes the potential response action alternatives developed for further evaluation for the mine.
- **Section 8.0** describes the criteria used to evaluate the alternatives and provides a detailed analysis of each alternative using those criteria.
- **Section 9.0** presents a comparative analysis of the anticipated performance and cost of the alternatives.
- **Section 10** identifies the preferred response action alternative for the Lilly/Orphan Boy Mine based on the comparative alternatives analysis.
- **Section 11.0** presents the references cited in the text.

Figures and tables follow the text of the report. Supporting information for the Expanded EE/CA are contained in three appendices, including:

- **Appendix A**, Preliminary Repository Siting Evaluation;
- **Appendix B**, Applicable or Relevant and Appropriate Requirements (ARARs); and
- **Appendix C**, Estimated Reclamation Action Costs.



## 2.0 SITE BACKGROUND

The Lilly/Orphan Boy Mine Site (LOB site, or site) is an abandoned hard rock mine located on private land approximately 10.5 miles south of Elliston in Powell County, Montana. The site is situated at an elevation of about 7,000 feet above mean sea level and approximately 1.5 acres was disturbed by mining activities. Development of the mine began in approximately 1893 and ended with the last shipment of ore in 1954 or 1955 (Newman, 2008 as cited in TerraGraphics, 2011). The site is contaminated from metal mining along Telegraph Creek and ranks tenth on the Montana Department of Environmental Quality (DEQ) Mine Waste Cleanup Bureaus' abandoned mine lands priority site list (<http://www.deq.mt.gov/AbandonedMines/priority.mcp>). DEQ commissioned a Phase I reclamation investigation in 2008 (Tetra Tech EM Inc. [Tetra Tech] 2009) and a subsequent Phase II reclamation investigation in 2010 (TerraGraphics 2010).

The abandoned mine is adjacent to Telegraph Creek, a tributary to the Little Blackfoot River. Site features are shown on **Figure 2** and include the following from east (upper) to west (lower) portions of the site: an upper collapsed adit; a wooden and steel headframe and shaft surrounded by a fence; upper Waste Rock Pile 1; a mid-slope collapsed adit; Waste Rock Pile 2; Bryan Creek Road; the discharging Lilly adit; and Waste Rock Pile 3 which is bisected by Telegraph Creek. There is about 100 feet of relief at the site. The Helena National Forest surrounds the site.

The remaining portion of this section provides background information on the site including brief summaries of: mining history; the physical setting; vegetation and wildlife; historic and archaeologically significant features; and ownership. Unless otherwise cited, information for this section was largely obtained from project documents produced for DEQ by Tetra Tech (2008 and 2009) and TerraGraphics (2010 and 2011). Trout Unlimited also provided NewFields an electronic copy of DEQ files containing several other reports cited herein with information regarding the LOB site.

### 2.1 MINING HISTORY

Grand Republic Mining Company likely discovered the Lilly and adjacent Orphan Boy lodes in the early summer of 1890. In late 1893, Empire State Mine Company (Empire State) acquired the mines from Grand Republic and began development. Due to a mortgage debt held by Empire State, the court ordered the Lilly/Orphan Boy Mine property to be sold at public auction in November 1899. The president of Empire State, T. H. Teall, obtained ownership of the Lilly/Orphan Boy Mine property and received a sheriff's deed in December 1900. Ownership of the mine remained under his name until 1927 when the taxes on the claims became delinquent. Powell County received a tax deed to the property early the following year.

Soon after the onset of the Great Depression, a rise in the price of metals re-energized active interest in the Lilly/Orphan Boy Mine. Powell County issued a new lease to Butte miner Ed Linqvist around 1934 and later to Dave and Leo Newman in 1943. Between 1934 and 1951, the mine produced a total of 1,228 tons of ore, yielding 333 ounces of gold; 12,520 ounces of silver; 2,753 pounds of copper; 85,377 pounds of lead; and 39,899 pounds of zinc. The last production of ore from the Lilly/Orphan Boy Mine was a 50-ton shipment of ore that occurred in either 1954 or 1955.





## 2.2 CLIMATE

The Helena, Montana airport, approximately 20 miles east of the site, is the nearest Western Regional Climate Center. As cited in TerraGraphics (2011) the average monthly temperature ranges from 85°F to 53°F in July, and from 30°F to 10°F in January. Average annual precipitation is 12 inches. May and June are, on average, the wettest months of the year, exceeding a monthly average precipitation of 3 inches. Precipitation is mostly in the form of snow in the winter months, snow and rain in the spring and fall, and rain in the summer.

## 2.3 GEOLOGY, HYDROGEOLOGY, AND HYDROLOGY

The following sections describe the geology, hydrogeology, and hydrology of the LOB site and the area surrounding the site.

### 2.3.1 Local and Regional Geology

In 1950, Mason Rankin reported on geologic conditions at the Lilly/Orphan Boy Mine (Rankin 1950). He described the property as being located within the Boulder Batholith, a granitic intrusion consisting primarily of quartz monzonite intruded by dike-like bodies of aplite. West of the site the batholith is in contact with andesite, an extrusive rock, and to the northeast near Elliston is in contact with Paleozoic sedimentary rocks. TerraGraphics (2011) reports that the Lilly/Orphan Boy Mine exploited a high-angle (80 degree), northeast trending mineralized vein. Galena, pyrite, sphalerite, arsenopyrite, and tetrahydrite were the main ore minerals for the mine. A detailed geologic description of the mine is found in Aitkin (1950).

### 2.3.2 Soils

The LOB site has a combination of Typic Cryoboralf and Typic Cryochrept soils, both located in slopes of 25 to 50 percent at elevations ranging from 5,500 to 7,500 feet above mean sea level (AMSL). Typic Cryoboralf soils are derived from moraines and glacial till and are typically defined as cobbly loams or cobbly clay loams. Typic Cryochrept soils are derived from granitic mountain slopes or weathered granite and are defined as very gravelly sandy loams (USDA-NRCS 2008; as cited in Tetra Tech 2008). The soil located in the immediate vicinity of the headframe and shaft area is classified as Typic Cryochrepts.

### 2.3.3 Hydrogeology

NewFields searched the Montana Bureau of Mines and Geology Groundwater Information Center (GWIC) web mapping application to identify wells with a one-mile radius of the site. Four wells, with domestic, monitoring or unknown uses, are recorded with GWIC as shown in **Chart 1**.

**Chart 1. GWIC Wells within a one-mile Radius of LOB Site**

GWIC ID	Total Depth	Reported Static Water Level	Date Completed	Purpose	Latitude	Longitude
154880	25	19.5	11/9/1995	Monitoring	46.442562	112.343955
178985	200	40	9/16/1998	Domestic	46.427231	112.347858
248185	63	6.5	9/24/2008	Unknown	46.443383	112.332733
284834	271	27	7/29/2015	Domestic	46.458010	112.340051

GWIC - Ground Water Information Center, Montana Bureau of Mines and Geology, <http://mbmgwic.mtech.edu/>; accessed December 29, 2015.

The monitoring well with GWIC ID 154880 shown in **Chart 1** was installed as part of an in-situ pilot test of sulfate-reducing bacteria to control acid generation from the Lilly/Orphan Boy Mine (MSE Technology Applications, Inc., 2008); the well intercepted underground workings at 15 feet. Well driller's logs for the other wells listed in **Chart 1** indicate that granitic rock was encountered at 8 to 15 feet below ground surface (bgs) and extended to the total depths of each well. Groundwater yields during one-hour air lift tests ranged from 0.03 to 12 gallons per minute (gpm).

TerraGraphics installed five monitoring wells and three shallow piezometers at the LOB site in 2010 as part of the Phase II reclamation investigation (TerraGraphics 2011). Wells ranged in depth from 25 to 122 feet bgs with weathered quartz monzonite bedrock encountered from 2.5 to 17 feet bgs. TerraGraphics (2011) recorded depths to groundwater in September 2010 from approximately 8 to 71 feet, and reports that the direction of groundwater flow in the fractured quartz monzonite rock is to the north-northwest. Based on groundwater samples obtained from the wells, TerraGraphics (2011) indicated that water quality was generally good with pH values ranging from 6.28 to 7.79 standard units (su). Highest total metals concentrations were measured in samples collected from monitoring wells nearest the mine shaft (the nearest monitoring well is about 40 feet northwest of the shaft).

The collapsed Lilly Adit, the lowermost adit at the LOB site (**Figure 2**), discharges water intercepted by underground mine workings. At the surface, water appears to flow through waste rock material, then along the eastern edge of Waste Rock Pile 3 where it enters the Telegraph Creek floodplain. MSE (2008) refers to the collapsed Lilly Adit as the mine portal they instrumented during their first year of pilot testing (1994). They report a fairly constant flow rate at less than 2 gpm in 1994, but noted a flow rate of 7.6 gpm during May 1995 spring runoff (MSE 2008).

### 2.3.4 Surface Water Hydrology

The LOB site is located near the headwaters of Telegraph Creek. The sub-watershed of Telegraph Creek is approximately 19 square miles. Telegraph Creek flows north 7 miles to its confluence with the Little Blackfoot River. Tetra Tech (2008) reports that the creek is perennial and near the LOB site flow is sustained by springs and seeps. Stream discharge measured by TerraGraphics (2011) during base flow conditions on October 1, 2010 indicated a flow of 0.38 cubic feet per second (cfs) at the downstream boundary of the LOB site.



### 2.3.5 Current Site Setting

The following subsections describe the current physical setting of the LOB site, as well as land ownership and use.

### 2.3.6 Location and Topography

The LOB site is located on the western edge of the Continental Divide in Powell County, south of Elliston, Montana, in Section 15, Township 8 North, Range 6 West. The site is composed of 1.5 acres of private land along Telegraph Creek, and is situated at an elevation of approximately 6,800 feet AMSL. Total relief from Telegraph Creek to the mine shaft area is about 100 feet. Rankin (1950) describes the topography as follows:

“The region generally is mountainous, with rather marked relief, but in the immediate vicinity of the properties the topography is rolling, and with very moderate slopes”.

Given the granitic geology, the LOB site is characterized by rounded boulder terrain.

### 2.3.7 Vegetation, Fish and Wildlife

In 2008, the Montana Natural Heritage Program compiled a report for DEQ’s Abandoned Mines Section on the status of endangered species or species of concern present in the vicinity of the LOB site; a summary of their results is presented in **Table 1**. There are five species of concern: Westslope Cutthroat Trout, Gray Wolf, Wolverine, Canada Lynx, and Hall’s Rush. A variety of other wildlife is found on or within the vicinity of the site: deer, elk, bobcat, black bear, and miscellaneous smaller mammals (rabbits, squirrels, mice, and voles). Many species of birds are known to be found on the site including songbirds, owls, and raptors (Montana Natural Heritage Program 2008).

TerraGraphics (2010) reports that Lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), and some Engelmann spruce (*Picea engelmannii*) are on or near the LOB site. Shrubs present include grouse whortleberry (*Vaccinium scoparium*), snowberry (*Symphoricarpos* sp.), Phlox (*Phlox* sp.), and several grasses in the meadows areas around Telegraph Creek. Little or no vegetation is present on waste rock piles.

The Helena-Lewis & Clark National Forest completed a fisheries biological assessment for their Divide Travel Plan which included Telegraph Creek (United States Department of Agriculture [USDA] 2015a). According to the biological assessment, bull trout have not been found in Telegraph Creek but the watershed “serves as adjunct habitat directly adjacent to bull trout focal habitat and an important source of water quality and habitat for the Little Blackfoot River”.

The Helena National Forest also completed a terrestrial biological assessment for their Divide Travel Plan in 2015 (USDA 2015b). They report that lynx, a threatened species (**Table 1**), were tracked in the winters of 2008-10 and numerous signs of adult lynx were found in the Telegraph Creek drainage. The Helena National Forest (USDA 2015b) comments that historic mining operations have altered local topography, altered stream flow, generated erosion and left toxic waste in the Forest. With respect to grizzlies and lynx, they state:



“Historic mining operations displaced grizzlies & lynx from otherwise suitable habitat because of their size, abundance, & the degree to which they used up local resources—in particular, timber. Some abandoned operations continue to exert a certain degree of local impact because of toxic wastes filtering into riparian areas”.

## 2.4 HISTORIC AND ARCHAEOLOGICALLY SIGNIFICANT FEATURES

Based on an assessment performed by Frontier Historical Consultants (FHC) in 2002 for DEQ’s Mine Waste Cleanup Bureau, the LOB site is eligible for inclusion on the National Register of Historic Places. FHC (2002) indicates the site meets two of the possible four criteria:

- 1) The site was associated with events that have made a significant contribution to the broad patterns of our history; and
- 2) The site embodied the distinctive characteristics of a type, period, or method of construction, or that represented the work of a master, or that possess high artistic values, or that represented a significant and distinguishable entity whose components may lack individual distinction.

During operations of the Lilly/Orphan Boy Mine, the mine produced enough ore to be a major part of the Elliston Mining District and solidify its contribution to the local mining history. Currently the site still houses sufficient historic features and structures to satisfy the second listed criteria: three collapsed adits; a dozer cut; three waste rock dumps; three collapsed load-outs; one standing log cabin; one collapsed log cabin; a partially collapsed frame building; remains of an outhouse; a head frame and shaft; and a hoist machinery platform. Despite the natural deterioration due to weather and aging, the site has retained a fair degree of integrity (FHC 2002). Should reclamation occur at the LOB site, it is expected that the DEQ would work with the Montana State Historic Preservation Office (SHPO) to provide for historical features.

### 2.4.1 Land Use and Population

The LOB site is privately owned inholding within the Helena National Forest. Primary land use in the vicinity is recreational although at least one rural home/cabin is located within ½-mile of the site. According to the U.S. Census Bureau in 2000 (cited in Tetra Tech 2008), the estimated population per square mile within a one-mile radius from the site is less than two people. With the exception of a fence surrounding the headframe and mine shaft in the upper portion of the LOB site, there are no road gates or other fences preventing site access.

### 2.4.2 Land Ownership

Based on a review of Montana cadastral information (<http://svc.mt.gov/msl/mtcadastral/>), the LOB site is currently owned by Lindsey and Jesse Chaquette of Helena, Montana. According to the DEQ Property Ownership Memo (2010), the property was granted to the Chaquettes on July 19<sup>th</sup>, 2005. The approximately 1.5 acre mine site is part of a 20.66 acre parcel with a geocode of 28-1681-15-1-01-01-0000 and physical address of 1485 Lower Telegraph Creek Road, Elliston, Montana 59728. The legal property description is Section 15, Township 8 North, Range 6 West.





### 3.0 WASTE CHARACTERISTICS AND SUMMARY OF EXISTING DATA

Several investigations have been conducted at the LOB site to characterize the nature and extent of mining related impacts at the site. The following lists previous investigations.

- Pioneer Technical Services, Inc. (Pioneer) completed a hazardous materials inventory (HMI) of the LOB site in 1993 on behalf of the Montana Department of State Lands (now the DEQ) that included the collection of soil and surface water samples for laboratory analysis (Pioneer 1994). Pioneer also collected water quality samples from the Lilly adit (classified as groundwater for the purposes of the HMI) and from ponded water above and below the waste rock dump in the Telegraph Creek drainage.
- Tetra Tech EMI, Inc. (Tetra Tech) completed a Phase I reclamation investigation (RI) of the mine site in 2008 for DEQ to characterize the nature and extent of mining-related impacts to soil, surface water, and sediment in Telegraph Creek (Tetra Tech 2009). Soil samples were collected to establish naturally occurring background metals concentrations in site soils.
- DJ&A P.C. (DJ&A) performed a topographic survey of the LOB site in 2009. Their work is presented in Tetra Tech (2009) and has been used in conjunction with soil/waste rock sample analytical results to estimate the volumes of waste rock and impacted soil present at the mine site.
- TerraGraphics Environmental Engineering, Inc. (TerraGraphics) completed additional reclamation investigation activities (Phase II) in 2010 for DEQ to further characterize conditions at the site (TerraGraphics 2011). These included collecting and analyzing soil, surface water and groundwater samples, measuring surface flows, and completing an evaluation of the underground mine workings.
- NewFields completed a sediment data gaps investigation along Telegraph Creek in November 2015 to further describe the extent and magnitude of mine-related impacts in Telegraph Creek sediment, and investigate the thickness of sediment at each sampling location (NewFields 2015a).

Screening levels were selected for the LOB site during the 2008 RI to evaluate concentrations of metals detected in surface water, waste rock, soil, and streambed sediment. The screening levels include risk-based guidelines for recreational users (based on a 50-days per year gold panner/rock hound exposure scenario; Tetra Tech 2004), Montana chronic aquatic life standards for surface water (MDEQ 2012), and Probable Apparent Effects Thresholds (PAETs) for sediment developed by the Washington Department of Ecology (WDOE 1997). Limited groundwater data have also been obtained at the LOB site and those data are screened against Montana Numeric Water Quality Standards in DEQ-7 (MDEQ 2012).

The following sections are organized according to media and provide results of the LOB site characterization studies conducted between 1993 and 2015. Screening levels for the various environmental media are provided in summary tables of metals concentrations detected in soil, waste



rock, sediment, surface water and groundwater during previous investigations (see **Tables 2** through **5**); and locations sampled during the previous investigations are shown on **Figure 3**. Refer to **Section 4.0**, below, for additional discussion of screening levels for the LOB site.

### 3.1 SOLID WASTE SAMPLES

Waste rock piles, surface soil proximal to waste rock piles, and background surface soil samples were collected during the Phase 1 (Tetra Tech 2009) and Phase II (TerraGraphics 2011) Reclamation investigations. The following sections provide sampling results.

#### 3.1.1 Mine Waste

Three waste rock piles are present at the LOB site (**Figure 2**) that contain an estimated 3,430 cubic yards ( $\text{yd}^3$ ) of waste rock (Tetra Tech 2009), as follows:

- Waste Rock Pile 1 (WRP 1): 1,630  $\text{yd}^3$ ;
- Waste Rock Pile 2 (WRP 2): 1,490  $\text{yd}^3$ ; and
- Waste Rock Pile 3 (WRP 3): 310  $\text{yd}^3$ .

The estimated volumes of waste rock piles were calculated using elevation data from the topographic survey completed by DJ&A in 2009 (Tetra Tech 2009). The elevation of the waste rock pile was compared to an assumed ground surface elevation (based on the elevation of undisturbed ground adjacent to the waste rock piles). Portions of WRP 1 appear to include native soil (non-mine waste) used to construct a support area for mine operations around the upper mine shaft. Although no discrete samples were collected of this apparent native soil material, it may contain lower metals concentrations than waste rock from the mine workings.

Tetra Tech collected five samples (LOB-SS-02, -03, -09, -12 and -13) from the surface (from depths of 0 – 3 inches bgs) of the three waste rock piles in October 2008 and submitted them for laboratory analysis of total metals (Tetra Tech 2009). Analytical results for the samples are summarized in **Table 2** and sample locations are shown on **Figure 3**. Total arsenic and lead were detected at concentrations above their associated screening levels (323 and 2,200 milligrams per kilogram [mg/kg], respectively) in all of the waste rock samples. Antimony was also detected above the screening level (586 mg/kg) in sample SS-03, which was collected from WRP 1.

TerraGraphics completed six test pits within the waste rock piles (two in each pile) at the site in October 2009 to evaluate the suitability of the mine waste for use in cemented backfill of the underground mine workings (TerraGraphics 2011). The test pits were completed to depths ranging from 7 to 12 feet below the surface of the mine waste. Material descriptions and observations regarding depths of mine waste were not recorded by field personnel observing excavation of the test pits. Material samples were collected from each test pit and submitted for analysis of geotechnical parameters. Based on results of gradation (sieve) analyses of the material samples completed by the geotechnical laboratory, the waste rock piles are comprised of a mixture of silty gravels and sand.



### 3.1.2 Surface Soil

Tetra Tech (2009) and TerraGraphics (2011) obtained surface soil samples (from 0 – 3 inches bgs) proximal to the waste rock piles (**Figure 3**). In total, 25 near-surface material samples were obtained at the LOB site for laboratory analysis of total metals. As shown in **Table 2**, more than half of the surface soil samples contain concentrations of arsenic that exceed the screening level (323 mg/kg). Lead was detected in one sample (SS-07) at a concentration of 2,300 mg/kg, which is above the screening level of 2,200 mg/kg. Based on the soil sample results, Terragraphics (2011) estimated that approximately 470 cubic yards of impacted soil (containing concentrations of arsenic or lead above screening levels, with a minimum thickness of 6 inches) is present proximal to waste rock piles.

Tetra Tech also submitted four of the surface soil samples collected in 2008 for laboratory analysis of agronomic properties to evaluate whether amendments could be added to on-site materials for use in site reclamation. The results of the analyses are provided in Phase 1 RI Report (Tetra Tech 2009) and indicate that adequate volumes of soil suitable for use as growth media in reclamation activities are not present on-site.

### 3.1.3 Background Samples

Three soil samples collected during the 2008 RI were taken from locations that exhibited no visual indication of prior disturbance (Tetra Tech 2009). These samples (designated LOB-BG-01 through LOB-BG-03; **Figure 3**) were collected to evaluate the naturally occurring concentrations of metals at locations that were apparently not impacted by mining activities. Metals concentrations detected in all three background soil samples were below the recreational cleanup guidelines (**Table 2**).

Hydrometrics (2013) presents background concentrations for metals in Montana surface soil and reports background concentration for arsenic state-wide at 40 mg/kg. Sampling results were not compared to the soil screening level in DEQ's Remediation Division Action Level for arsenic in surface soil (40 mg/kg) because background arsenic levels in mining areas are typically higher than this level.

## 3.2 SEDIMENT

Sediment samples were collected from the Telegraph Creek drainage at the LOB site on three occasions: 1993 (Pioneer 1994), 2008 (Tetra Tech 2009) and 2015 (NewFields 2015a). **Table 3** summarizes results of total metals analysis and provides Washington State Freshwater Sediment Quality Probable Apparent Effects Thresholds (PAET) screening values and recreational cleanup guidelines based on the 50-day gold panner/rock hound exposure scenario. **Figure 3** shows Tetra Tech and NewFields sediment sampling locations; locations of samples obtained by Pioneer were not mapped but were described relative to the waste rock pile in Telegraph Creek (WRP 3). Pioneer (1994) obtained sample SE-1 (see **Table 3**) approximately 200 feet downstream of WRP 3 and collected sample SE-2 upstream of a pond located above the waste rock pile. Information on the depth of the samples is not recorded.

Tetra Tech (2008) obtained five near-surface sediment samples. Samples SD-01 and SD-05 (**Figure 3**) were collected upstream of WRP 3 and sample SD-02 was obtained from sediments present in the



outfall from the lowermost adit (Lilly Adit). Sample LOB-SD-04 was collected just downstream and adjacent to WRP 3 and sample SD-03 was obtained at the downstream property boundary.

NewFields completed a sediment data gaps investigation along Telegraph Creek at the Lilly/Orphan Boy mine site in November 2015 (NewFields 20015a) which involved evaluating the approximate total depth of sediment at eight locations and collecting samples at each location for metals analysis. Six sampling locations were downstream of WRP 3 and two were upstream of WRP 3 (**Figure 3**).

Sediment described by NewFields (2015a) consisted of dark brown, organic-rich material with less than about 15 percent silt. Water was encountered in each borehole at depths ranging from 1 to 8 inches. Dark gray, silty clay is present beneath the organic-rich sediment. At several locations NewFields also observed fine to coarse angular sand with the silty clay material.

Below WRP 3 organic-rich sediment averaged 2.8 feet in thickness, with a maximum depth of 3.5 feet. At sample location SD-11 (**Figure 3**), organic-rich sediment was encountered in the upper 0.5 feet and then at a depth of 1.5 to 3 feet bgs. Between and below the two organic-rich sediment horizons, orange-brown, fine to coarse angular sand was present. No other borehole encountered oxidized materials. Location SD-11 is directly below the western lobe of WRP 3, and therefore it is possible that the orange-brown sandy material represents oxidized mine waste material eroded from the waste rock pile.

Analytical results for metals detected in the 15 LOB mine site sediment samples are presented in **Table 3**. Both PAETs for freshwater sediment from the Washington Department of Ecology (WDOE; 1997) and MDEQ's Recreational Cleanup Guidelines developed by Tetra Tech, Inc. (2004) are presented in **Table 3** for comparison to metals concentrations in Telegraph Creek sediment.

Based on analytical results for the sediment samples, arsenic and to a lesser extent lead (one sample) and manganese (one sample), are constituents of concern for potential exposure from recreational users (i.e., gold panner and/or rock hound; **Table 3**). Eight of the 10 sediment samples collected downstream of WRP 3 exceeded the Recreational Cleanup Guideline for arsenic of 323 mg/kg. The two exceptions (SD-09-18 and SD-03), were samples collected furthest downstream of WRP 3 (**Figure 3**). One sample collected just upstream of WRP 3 (SD-01) also exceeded the Recreational Cleanup Guideline for arsenic.

All 15 sediment samples exceeded the PAET for arsenic, including the five samples obtained upstream of WRP 3 (**Table 3**). The majority of sediment samples obtained downstream of WRP 3 also exceeded PAETs for cadmium, lead, manganese and zinc.

Several factors were considered and subjectively balanced in an effort to determine a reasonable boundary for sediment by the LOB site in the Telegraph Creek floodplain, including:

- It is desirable to retain some amount of the existing wetland habitat at the LOB site which may be currently functioning to attenuate metals being delivered to the wetland in mine site runoff and from the Lilly Adit discharge.





- It is likely that metals from erosion of LOB site mine waste is a primary source for elevated metals detected in sediment samples downstream of WRP 3.
- Metals detected in sediment sample SD-03 may be associated with the adjacent deposit of mine waste (i.e., soil) mapped by TerraGraphics (2011).
- Arsenic in upgradient (upstream of WRP 3) sediment sample SD-01 was detected above both the PAET and Recreational Cleanup Guideline levels.
- All 15 sediment samples exceeded the arsenic PAET, and a majority of samples also exceeded the PAET for cadmium, lead, manganese and zinc.
- Arsenic concentrations (and to a lesser extent lead concentrations) in solid material is a primary factor in determining removal actions at the LOB site; for all solid material samples (mine waste, soil and sediment), arsenic concentrations exceeded the Recreational Cleanup Guideline more frequently than any other metal.
- Mean metals concentrations in sediment samples collected above WRP 3 may be useful to evaluate background concentrations in Telegraph Creek sediment and should be considered when making removal action decisions.

Given the above factors and considerations, a reasonable approach to establish the removal boundary for sediments could be based on comparing sediment data to the mean upstream arsenic concentration (156 mg/kg) and the Recreational Cleanup Guideline for arsenic (323 mg/kg). For the purposes of this Expanded EE/CA, the boundary for impacted wetland sediment removal extends from WRP 3 to just north of sample SD-09-18 (**Figure 3**). Assuming an average sediment thickness of about 2.8 feet, there is an estimated 515 cubic yards of mine-impacted sediment present in the floodplain of Telegraph Creek.

### 3.3 SURFACE WATER QUALITY

Telegraph Creek samples have been collected at locations upstream and downstream of WRP 3 (locations denoted with a "SW-" prefix on **Figure 3**) by either Tetra Tech (2009) or TerraGraphics (2011). As part of the hazardous materials inventory in 1993, Pioneer (1994) obtained one surface water sample just upstream of WRP 3 and another 200 feet downstream of WRP 3 (note that locations were not mapped and are not included on **Figure 3**). In 2008 Tetra Tech (2009) collected two Telegraph Creek samples, one above WRP 3 and the other at the downstream property boundary (stations SW-01 and SW-03; **Figure 3**). During the Phase II reclamation investigation, TerraGraphics (2011) selected five locations to sample Telegraph Creek on several occasions in September, October and December 2010. These included station SW-05 located approximately at the upstream (southern) boundary of the LOB site and station SW-07 located about 275 feet downstream of the LOB site (**Figure 3**). Two other stations were the same as sampled by Tetra Tech (SW-01 and SW-03; **Figure 3**) and a third was located about 80 feet downstream of WRP 3 (SW-06; **Figure 3**). In total, Tetra Tech and TerraGraphics sampled Telegraph Creek at five locations.



In addition, Pioneer (sample GW-1; not shown on **Figure 3**) and Tetra Tech (sample SW-02; **Figure 3**) obtained samples of water discharging from the Lilly Adit. Tetra Tech (2009) also collected a surface water sample on the west edge of WRP 3 (sample SW-04; **Figure 3**). Because the Lilly Adit discharge eventually enters Telegraph Creek, analytical results for samples GW-1, SW-02 and SW-04 are presented in this section.

Analytical results for a suite of metals, pH and hardness from these surface water samples are presented in **Table 4**. Included in the table are Montana Numeric Water Quality Standards (DEQ-7; MDEQ 2012) for: acute aquatic life; chronic aquatic life; and human health. Also included are Recreational Cleanup Guidelines (Tetra Tech 2004) for surface water based on a 50-day gold panner/rock hound exposure scenario. The following are succinct summaries of surface water quality relative to DEQ-7 acute aquatic life standards:

#### Upstream Telegraph Creek, Stations SW-01 and SW-05

Telegraph Creek samples obtained upstream of WRP 3 and the Lilly Adit discharge exhibited near neutral pH. The only exceedence of an acute aquatic life standard was for zinc (estimated concentration, biased high) in two of the six samples.

#### Downstream Telegraph Creek, Station SW-03 and SW-07

At the two downstream stations, a total of 21 samples were collected in 2008 and 2010. pH ranged from 6.2 to 7 standard units (su), with the average pH of 6.46 su (acute aquatic life standard is 6.5 to 8.5 su). In most samples, acute aquatic life standards were exceeded for three metals: cadmium; copper; and zinc.

#### Telegraph Creek in Wetland Area , Station SW-6

In contrast to the downstream Telegraph Creek samples, the two samples collected from Telegraph Creek in the wetland area exhibited a neutral pH and the only metal with an exceedence was zinc. In this area, Telegraph Creek is on the west side of its floodplain. Because the majority of waste rock in the Telegraph Creek floodplain is on the east side of creek and the Lilly Adit discharge appears to enter the floodplain from the east, it is possible that the portion of the LOB site near station SW-6 is not severely impacted by mine wastes and discharge.

#### Lilly Adit Discharge and Toe of WRP 3, Stations SW-02 and SW-04

The two adit discharge samples (GW-1 and SW-02) and the single water sample collected at the downstream toe of WRP 3 (SW-04) exhibited the highest concentrations of metals relative to other surface water samples (note: pH data were not collected for these samples). Acute aquatic life standards were exceeded for arsenic, cadmium, copper, lead and zinc.

### **3.4 GROUNDWATER QUALITY**

Groundwater quality data for total metals are available from 2008 and 2010 from a total of eight groundwater monitoring points. Tetra Tech (2009) obtained samples from three wells installed into mine workings by MSE, including LOB-GW-01 (MW-Shaft well), LOB-GW-02 (MW-Injection 2), and LOB-



GW-03 (LOB-3). They referred to these samples as mine water samples. TerraGraphics (2011) collected samples from the five monitoring wells they installed as part of the Phase II reclamation investigation (see **Section 2.3.3**) for analysis. **Figure 3** shows locations of the eight wells.

**Table 5** summarizes groundwater quality data for total metals relative to DEQ-7 human health standards. Additional groundwater quality data are available in Tetra Tech (2009) and TerraGraphics (2011). Four metals exceeded groundwater standards in most samples including arsenic, cadmium, lead and zinc. Arsenic concentrations exceeded the DEQ-7 standard in six of the eight groundwater samples and were highest in the three samples obtained from wells completed in mine workings. Cadmium and zinc concentrations exceeded the DEQ-7 standard in over half the groundwater samples.

TerraGraphics (2011) potentiometric surface map shows a northward direction of groundwater flow. Samples from upgradient well LOB-MW-05 exhibited the lowest concentrations of metals relative to wells completed in or near underground mine workings. Well LOB-MW-04, completed to a depth of 25 feet with a 20-foot length of screen is the further well downgradient of the underground workings. However, concentrations of zinc and cadmium in the sample from LOB-MW-04 exceeded DEQ-7 standards (**Table 5**).

### 3.5 ASSESSMENT OF PHYSICAL HAZARDS

Due to the nature of an abandoned mine and the location the LOB Mine site, physical hazards are present on site. These hazards include potential slips, trips, and falls from:

- steep rock dumps slopes and variable site terrain;
- loose rock from the rock dumps;
- debris and other obstacles, such as fallen trees; and
- collapsed underground workings including adits, shafts, and drifts.

Any further investigation into the remaining mine facilities come with the potential significant hazard of tunnel collapse due to soft timber or dry rot. Many of the underground mining facilities were filled with water for many years, until dewatered in 2010 which also tends to destabilize mine workings.

### 3.6 REPOSITORY SITING EVALUATION

NewFields completed a preliminary repository siting evaluation for the LOB site to support this Expanded EE/CA. Work was performed using ArcGIS and involved a study area generally consisting of the Telegraph Creek watershed with a slight extension on the west side. Trout Unlimited requested that the area around the Tramway Creek Mining Complex in Section 6, Township 8 North, Range 6 West be evaluated for potential repository locations. **Chart 2** below identifies the resources evaluated and siting criteria for each resource, and **Appendix A** provides sources of publically available data used for the analysis.

**Chart 2. Siting Criteria**

Resource	Siting Criteria
Surficial Geologic Materials	Repository cannot be located in mapped alluvial material
Mapped Faults	Greater than 500 feet from any mapped fault
Streams, Lakes and Ponds	Greater than 500 feet from flowing or ponded water
Wetlands	Greater than 500 feet from mapped wetlands
Depth to Groundwater	Greater than 20 feet
Existing Roads	Sites accessible by existing roads are preferred
Slope	Less than 20 percent
Aspect	Compass direction from 157 to 248 degrees, clockwise from north
Site size	Minimum of 5 acres
Land Ownership	USDA-Forest Service administered land preferred over private land

Data layers for the resources identified in **Chart 2** were simultaneously analyzed using ArcGIS to identify sites that met the criteria assigned to each resource. Because only a few of the potential repository locations were accessible by existing roads, the “existing roads” criteria was dropped from further consideration. Locations that met all criteria are shown on Figure 1 in **Attachment A** and are differentiated between those located on USDA Forest Service lands (red) and those located on private land (orange).

With a few exceptions, most of the potential repository sites on USDA-Forest Service lands and all potential repository sites on private land are located near the Telegraph Creek watershed boundary. The nearest potential repository site to the Lilly/Orphan Boy mine is located approximately 1.8 miles north of the mine. As noted, only a few potential repository sites are adjacent to existing roads.

### 3.7 CONCEPTUAL SITE MODEL

This section addresses the conceptual understanding of solid media (i.e., mine waste, impacted soil and impacted sediment present in the Telegraph Creek drainage) affected by mining operations at the LOB site. The LOB site is an abandoned hard rock mine, with approximately 1.5 acres of mining-related disturbance on private land surrounded by the Helena National Forest. The site is situated at an elevation of about 6,800 feet above mean sea level near the headwaters of Telegraph Creek, a tributary to the Little Blackfoot River. The area is characterized by granitic country rock with thin soils.

The abandoned mine is located on a west-facing slope with about 100 feet of relief between the upper (eastern) reaches and Telegraph Creek. Miners accessed ore via a shaft and three adits. The shaft and headframe are still present but previous investigators note that all three of the adits have collapsed. Adjacent to and below the shaft and each adit are piles of waste rock. Investigators mapped the extent of three distinct waste rock piles (WRP 1, 2 and 3) based on topography. The lowermost waste rock pile is associated with the lowest adit (known as the Lilly Adit), and is bisected by Telegraph Creek.

Boundaries of mine-impacted solid material at the LOB site were defined by: physical observations of waste rock, soil and sediment characteristics; topographic evaluations; and results of chemical analyses of waste rock, soil and sediment. Metals concentrations in waste rock and soil were compared to a





recreational user cleanup guideline endorsed by DEQ which is based on a 50-day per year exposure scenario for a gold panner/rock hound. Physical locations where exceedences of arsenic (but also associated lead) were measured in waste rock and soil helped define the boundary of impacts. Based on the topographic expression of waste rock and adjacent soil, and a minimum assumed impacted soil thickness of 6 inches assumed by TerraGraphics (2011), previous investigators have estimated volume the volume of impacted waste rock and soil exceeding the cleanup guidelines at 3,900 cubic yards.

The approximate boundary of metal-impacted sediment at the LOB site is based on several considerations including a comparison of analytical testing results for 15 sediment samples to PAETs, Recreational Cleanup Guidelines and mean concentrations of five upstream sediment samples. In establishing a sediment removal boundary, consideration was given to retaining some of the existing wetland habitat in the lower reach of Telegraph Creek on the LOB site. Based on these factors and an average sediment thickness of about 2.8 feet, an estimated volume of mine-impacted sediment in the floodplain of Telegraph Creek is approximately 515 cubic yards.



## 4.0 RISK EVALUATION

In 2008, Montana DEQ commissioned an RI for the Lilly/Orphan Boy Mine site to delineate the nature and extent of wastes on site and assess the associated risks this contamination may pose to human and health and the environment via both a human health and ecological risk assessment. To this end, Tetra Tech (2009) conducted an RI to support human health and ecological risk assessments, including determining the magnitude and extent of metal contamination from waste in surface soil; evaluating the magnitude and extent of metal contamination in sediment; delineating the magnitude of metal contamination in surface and mine water and establishing the background concentrations of metals in soil. The results of the screening-level human health and ecological risk assessments are summarized below, along with supplemental soil, surface water, and sediment sampling results collected by TerraGraphics (2010) and NewFields (2015a).

### 4.1 POTENTIALLY EXPOSED POPULATIONS

Human populations that may potentially be exposed to mine waste or metals-impacted water at the LOB site include recreational users such as gold panners/rock hounds, hunters and hikers. Tetra Tech (2009) determined that recreational use at the site is high based on its location off Telegraph Creek road, its proximity to the surrounding communities of Elliston, Avon, and Helena, and due to the presence of two actively used recreational cabins located within a half-mile radius of the site.

As outlined in TetraTech (2009), three groups of ecological receptors are potentially affected by metal contamination at the LOB site, as summarized below:

- Terrestrial plant communities – The absence of vegetation has been documented previously on some of the waste rock piles. Potential causes may be attributable to toxic and inhibitory levels of metals in the plant root zone, along with other detrimental physical and chemical (infertility) properties of the soil. Plant communities represent the first trophic level in the food chain and are consumed by many higher trophic level animals, thus they are of concern as an ecological receptor.
- Terrestrial wildlife – Evidence of both elk and mule deer use of the site has been previously documented (Tetra Tech 2009). Grazing by wildlife species at this site is a concern because of the potential to consume contaminated vegetation, ingest soil and evaporative salts; and they also may directly consume creek water containing elevated metals concentrations.
- Aquatic life communities. Telegraph Creek provides suitable habitat for aquatic life, though the flow rate of this perennial stream is low (Tetra Tech 2009).

### 4.2 EXPOSURE PATHWAYS

Humans may be exposed to elevated concentrations of arsenic and lead in the mining complex by ingestion or dermal exposure to mine waste, surface water, or sediment; and by inhalation of dust or ingestion of mobilized sediment. For instance, recreational forest users could be exposed to mine waste



if they rested or stopped to eat in the relatively open mine areas, and ingested mine waste that had accumulated on their hands and/or food. In addition, recreational users could obtain drinking water out of the stream, which contains dissolved metals and may also contain entrained sediment.

Ecological receptors could be affected by high concentrations of metals in the waste rock and adit discharge. Tetra Tech (2009) reported that the vegetative communities on site have been affected by metals toxicity, as evidenced by the lack of vegetation on the waste rock piles. Aquatic ecological receptors at the Site could be completely immersed in and continually ingesting surface water (e.g., in Telegraph Creek). Aquatic receptors would have direct contact with streambed sediment at multiple life stages, including eggs and juvenile life forms. Waste materials and vegetation in the area are easily accessible to humans and wildlife, and consumption of or contact with either could result in significant ecological effects.

### 4.3 SELECTED SCREENING LEVELS

Screening levels used to assess human and ecological exposure to metals are discussed below. The discussion includes description of the sources of reference concentrations such as adopted regulatory criteria, evaluation of the exposure models of the screening levels to determine if the models correspond with exposure scenarios at the Lilly/Orphan Boy Mine Site, and comparison of screening levels to detected concentrations of metals at the mine sites.

#### 4.3.1 Human Health

The primary source of human health screening levels used in the RI (Tetra Tech 2009) and carried forward in this assessment is a document entitled Risk- Based Cleanup Guidelines for Abandoned Mine Sites (Tetra Tech 2004). The 2004 guidelines were produced for the Montana DEQ Abandoned Mine Reclamation Bureau, and were designed to address potential exposure to metals at abandoned mine sites in Montana. Screening levels derived from the 2004 guidelines for the human health-associated constituents of potential concern (COPCs) are presented in **Table 6**.

#### 4.3.2 Ecological Risk

The criteria used for evaluation of ecological risk in surface water are the Montana Numeric Water Quality Standards (MDEQ 2012). In the case of metals, the Montana surface water quality criteria are typically based on recommended water quality criteria for protection of aquatic life in a freshwater environment (USEPA 2015). As shown in **Table 7**, Montana criteria for cadmium, chromium, copper, lead, nickel, silver, and zinc in surface water are hardness-dependent.

Washington State PAET values were used as reference values during the RI (Tetra Tech 2009) and carried through for review of 2015 analytical results because the state of Montana does not have established sediment quality standards. The WDOE issued new sediment management standards (SMSs) in 2013, which include screening levels and cleanup objectives for sediment in freshwater environments (WDOE 2015). However, the WDOE guidance allows the continued use of PAETs if it can be demonstrated that PAETs are sufficiently protective of benthic organisms. For the purposes of this Expanded EE/CA, the PAETs were selected as the sediment screening criteria for the site to maintain continuity with previous



investigations completed at the site (Tetra Tech 2009 and TerraGraphics 2011) and the ecological risk assessment completed by Tetra Tech (2009).

The surface water and sediment screening levels listed above apply to fish and aquatic life. As previously discussed, terrestrial animals may also be exposed to metals at the LOB site.

## 4.4 CONTAMINANTS OF CONCERN

### 4.4.1 Human Health

Tetra Tech (2009) conducted a hazard identification to identify potential COPCs at the LOB site based on the following criteria established by USEPA (1989), which included: (1) the constituent is present at the site; (2) the measured concentrations of the constituent are significantly above background concentrations; (3) 20 percent of the measured concentrations of the constituent must be above the method detection limit; and (4) the analytical results for each constituent must meet the quality assurance/quality control (QA/QC) criteria established for the data set. These analytical data were then screened against the DEQ risk-based recreational cleanup levels for metals at sites with maximum use (50-day gold panner/rock hound scenario; see **Section 4.3** for details).

Based on this hazard identification and associated recreational risk assessment, arsenic and lead were found to be the metals that pose the greatest risks to recreational users (e.g., human health) at the Lilly/Orphan Boy Mine Site (Tetra Tech 2009). Data from the 2010 Phase II RI (TerraGraphics 2011) and 2015 sediment sampling completed by NewFields (**Section 3.4**), confirm that arsenic is present in soil, mine waste, and sediment at the LOB site at concentrations that pose potential risks to human health (see **Tables 2** and **3**). Lead was also detected in the 2015 sediment samples at concentrations that exceed the human health screening level. No constituents were detected in surface water samples collected during the 2010 Phase II RI at concentrations that exceed the risk-based recreational screening levels.

### 4.4.2 Ecological Health

Similarly, Tetra Tech (2009) performed a baseline ecological risk assessment at the Lilly/Orphan Boy Mine Site for terrestrial plant communities, aquatic life communities, and terrestrial wildlife exposure scenarios using contaminant concentrations identified during the RI. Supplemental surface water samples were collected by TerraGraphics during the 2010 Phase II RI (TerraGraphics 2011) and additional sediment sampling was conducted by NewFields in 2015 (**Section 3.4**). Upon review of results and in light of Tetra Tech's baseline ecological risk assessment, five metals meet the COC criteria for ecological risk. These included arsenic, cadmium, copper, lead, and zinc.

Both aluminum and iron were detected in surface water samples at concentrations above Montana chronic aquatic life standards. However, aluminum has not been detected above the acute aquatic life standard for surface water and there is no acute aquatic life standard for iron. Sediment samples collected to date have not been analyzed for aluminum and a PAET has not been established for iron. Therefore, aluminum and iron were not considered COCs for ecological risk.





## 4.5 HEALTH EFFECTS OF CONTAMINANTS OF CONCERN

The health effects of arsenic, cadmium, copper, lead, and zinc are discussed below. The discussion includes details regarding effects for human and ecological receptors as applicable based on the results of the human health and ecological risk assessments (Tetra Tech 2009) discussed in **Section 4.4** above.

### *Arsenic*

Arsenic is considered a carcinogen, teratogen and possible mutagen in mammals (including humans; USEPA 2015). Arsenic (and arsenic compounds), especially organic arsenicals, are readily absorbed into the body after inhalation, ingestion, or dermal contact (Tetra Tech 2009). Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. Ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. Ingesting or breathing low levels of inorganic arsenic over a long time period can cause a darkening of the skin and the appearance of small wart-like bumps on the palms, soles, and torso and skin contact with inorganic arsenic may cause redness and swelling according to the Agency for Toxic Substances and Disease Registry (ATSDR 2007a).

The effects of arsenic on mammals vary by species, exposure route or pathway, and the physical and chemical form of the arsenic (Tetra Tech 2009). Terrestrial plants accumulate arsenic by root uptake from the soil and by adsorption of airborne arsenic deposited on the leaves (Tetra Tech 2009). USEPA (2015) reports that both cancer-causing and genetic mutation-causing effects can occur in aquatic organisms; with aquatic bottom feeders being the most susceptible. Exposure to arsenic can affect behavior, reduce growth, lessen appetite and result in metabolic failure.

### *Cadmium*

Cadmium is a known human carcinogen. ATSDR (2012) reports that cadmium exposure can damage the kidneys, lungs, and bones. Breathing high levels of cadmium can severely damage the lungs, while consumption of food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long term exposure can lead to buildup of cadmium in the kidneys (causing kidney disease) and result in lung damage and fragile bones. Animal studies indicate that children are more susceptible to loss of bone and decreased bone strength from cadmium exposure.

As reported by USEPA (2015), cadmium is highly toxic to wildlife and is considered a carcinogen, teratogen and possible mutagen in mammals with severe sub-lethal and lethal effects at low concentrations (USEPA 2015). Cadmium can affect respiratory function, enzyme level, growth and reproduction and is known to bioaccumulate at all trophic levels. Cadmium accumulates in the livers and kidneys of fish and can be toxic to plants at soil concentrations lower than other heavy metals. Cadmium is also noted to be more readily taken up than other metals.



### **Copper**

Small amounts of copper are essential for good health in humans. However, breathing high levels can cause irritation of the nose and throat, and ingestion can cause vomiting, diarrhea, stomach cramps, nausea, and even death (ATSDR 2004).

USEPA (2015) reports that copper is a micronutrient and toxin and is toxic in aquatic environments with highly toxic effects on fish, invertebrates and amphibians. Copper is considered the most toxic common heavy metal to aquatic organisms with toxicity inversely related to the hardness of the water. The harder the water, the less toxic copper is to aquatic organism (Tetra Tech 2009). Studies indicate that copper is highly toxic to plants and will cause chlorosis and root malformation (Tetra Tech 2009). There is moderate potential for bioaccumulation in plants but no biomagnification (USEPA 2015). Mammals are not as sensitive to copper as aquatic organisms but toxicity can be associated with liver cirrhosis, necrosis in kidneys and the brain, gastrointestinal problems, lesions, and fetal mortality in mammals. Continued ingestion of copper by animals can lead to accumulation in tissues, particularly in the liver (Tetra Tech 2009).

### **Lead**

Human health effects from exposure to lead are typically related to elevated blood-lead concentrations that can result in a variety of toxicological effects, such as damage to the nervous system, kidneys and reproduction system, depending on the level of exposure. The general symptoms of chronic lead poisoning include gastrointestinal disturbances, anemia, insomnia, weight loss, motor weakness, muscle paralysis, and nephropathy (Tetra Tech 2009). Human health effects of lead include decreased nervous system function, weakness in fingers, wrists, and ankles, anemia, and damage to the brain and kidneys, which can lead to death at high exposure levels. Children are more vulnerable to lead poisoning than adults. Lead is most dangerous for young and unborn children with potential effects including premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children (ATSDR 2007b).

Lead can negatively affect fish, aquatic invertebrates, and algae, with limited adverse effects in amphibians, (e.g., loss of sodium, developmental problems). Exposure to lead can cause fish to exhibit muscular degeneration, reduced growth, reproductive problems, paralysis, and death. Lead can impair reproduction of invertebrates, and can reduce algal growth (USEPA 2015).

At elevated levels in plants, lead can cause reduced growth, photosynthesis, mitosis, and water absorption. Similar to humans, mammals can suffer effects from lead poisoning including damage to the nervous system, kidneys, liver, sterility, growth inhibition, developmental retardation, and detrimental effects in blood (USEPA 2015).

### **Zinc**

As with copper, zinc is an essential human nutrient. However, high doses of zinc in the short term can cause stomach cramps, nausea, and vomiting while chronic exposure can cause anemia and changes in cholesterol levels (ATSDR 2005). Preliminary animal studies showed development of infertility in rats exposed to high doses of zinc. Inhaling large amounts of zinc dust can cause a short-term condition



called metal fume fever, which resembles the flu. Zinc is likely to cause skin irritation. Zinc has not been classified regarding its human carcinogenicity.

Although zinc is an essential nutrient to aquatic biota, toxic effects at high concentrations can include mortality, reduced growth, and inhibited reproduction. Embryos and juveniles have been found to be most sensitive to the effects of zinc. In addition, the effects of zinc on aquatic organisms are increased by the presence of other metals such as cadmium and mercury (Tetra Tech 2009). In mammals, elevated levels can cause cardiovascular, developmental, immunological, liver and kidney problems, neurological, hematological, pancreatic, and reproductive problems (USEPA 2015).

Soluble forms of zinc are easily taken up by plants, particularly by the root systems. Zinc will commonly accumulate in the upper soil horizons during weathering processes (Tetra Tech 2009). Elevated levels of zinc are associated with adverse effects on plant growth, survival and reproduction (USEPA 2015). Growth, survival and reproduction are adversely affected in many types of aquatic plants and animals (USEPA 2015).



## 5.0 SUMMARY OF APPLICABLE OR RELEVANT & APPROPRIATE REQUIREMENTS

Section 300.415(i) of the NCP requires response actions meet applicable or relevant and appropriate requirements (ARARs) to the extent practicable, considering the exigencies of the situation at the site (USEPA 1992). “Applicable” requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the COPCs, cleanup action, location or other circumstance at the site. “Relevant and appropriate” requirements are regulatory requirements or guidance that do not apply to the site under law but address problems or situations sufficiently similar to those at the site that their use is well suited to the site. Once the agency determines that a requirement is relevant and appropriate, the agency must comply with the requirement to the same extent as if it were applicable. Exception to the requirement for compliance with ARARs is provided in the case of removal actions, which are limited in scope compared to remedial actions. This difference is briefly summarized in the following excerpt from the NCP:

*The purpose of removal actions generally is to respond to a release...so as to prevent, minimize, or mitigate harm to human health and the environment. Although all removals must be protective...removals are distinct from remedial actions in that they may mitigate or stabilize the threat rather than comprehensively address all the threats at a site. Consequently, removal actions cannot be expected to attain all ARARs. Remedial actions, in contrast, must comply with all ARARs or obtain a waiver.*

The State of Montana has the authority, delegated by the U.S. Office of Surface Mining, Reclamation, and Enforcement, to administer the Abandoned Mines Reclamation Program in accordance with the State of Montana’s Reclamation Plan. The DEQ/MWCB has developed a summary of federal and state ARARs for abandoned mine lands reclamation projects (MDEQ/MWCB 2008) that would apply to the LOB Mine. A preliminary list of ARARs for the removal action at the LOB Mine is provided in **Appendix B**.

The response action under consideration for the LOB Mine is an initial response to the release of hazardous substances. The scope of the response action is focused on the reduction or elimination of uncontrolled releases of metals to soil, surface water, and sediment from mine waste present at the site. This removal action may not be the sole response taken at the mine; however, no additional response actions are currently planned.



## 6.0 RECLAMATION GOALS & OBJECTIVES

The primary goal of the response action under consideration for the LOB Mine is to limit potential human and ecological exposure to mine-related contaminants through the reduction or elimination of uncontrolled releases of metals to soil, surface water, and sediment from mine waste present at the site.

### 6.1 ARAR-BASED RECLAMATION GOALS

Alternatives presented in the EXPANDED EE/CA are reclamation actions to mitigate threats from uncontrolled mine waste. A preliminary list of ARARS for the LOB site is provided in **Appendix B**. ARAR-based cleanup goals are limited to groundwater and surface water because no contaminant specific ARARs exist for soils, mine waste, or sediment.

Surface water ARARs include established aquatic life and human health water quality standards. Montana aquatic life standards include both chronic and acute criteria. Chronic standards are applicable to long-term exposure scenarios and are lower than acute aquatic life standards. Therefore, chronic aquatic life standards were used for this ARAR evaluation. The more stringent of the human health or chronic aquatic life water quality standard was selected as the ARAR-based reclamation goal for surface water for each COC at the LOB site. The ARAR-based reclamation goals for surface water are summarized in **Table 8**. Several constituents, including arsenic, cadmium, copper, lead, and zinc have been detected in surface water samples collected from Telegraph Creek at concentrations that exceed the ARAR-based reclamation goals. Although surface water treatment is not addressed by this Expanded EE/CA, the mine waste mitigation measures under consideration may affect COPC concentrations in Telegraph creek through the removal of mine waste in contact with the creek, as well as sediment with elevated metals concentrations.

Although groundwater (and mine water) remediation is not addressed by this Expanded EE/CA, ARAR-based groundwater reclamation goals are included in **Table 8** for informational purposes. ARAR-based reclamation goals for the LOB site are based on Montana DEQ-7 human health standards for groundwater.

### 6.2 RISK-BASED RECLAMATION GOALS

Reclamation goals for project COCs in sediment and soil are listed in **Table 9**. The results of the human health and ecological risk assessment for the site indicate that arsenic, cadmium, copper, lead, and zinc are COCs for the LOB site. Risk-based reclamation goals for soil at the LOB site were selected for recreational users of the site (50-day gold panner/rock hound scenario). These reclamation goals are from the *Risk-Based Cleanup Guidelines for Abandoned Mine Sites* developed by DEQ/MWCB (Tetra Tech, 2004).

The WDOE issued new SMSs in 2013, which include screening levels and cleanup objectives for sediment in freshwater environments (WDOE 2015). However, the WDOE guidance allows the continued use of PAETs developed by the WDOE (1997) if it can be demonstrated that PAETs are sufficiently protective of



benthic organisms. For the purpose of this Expanded EE/CA, the PAETs were selected as the sediment reclamation goals for the site to maintain continuity with previous investigations completed at the site (Tetra Tech 2009 and TerraGraphics 2011) and the ecological risk assessment completed by Tetra Tech (2009).





## 7.0 DEVELOPMENT & SCREENING OF RECLAMATION ALTERNATIVES

This section of the Expanded EE/CA identifies reclamation technologies that could be implemented alone or in conjunction with other technologies to reduce or eliminate potential human health and environmental risks associated with waste rock and soil with elevated metals concentrations at the LOB mine. The technologies were initially screened according to their ability to meet the reclamation goals presented in **Section 6.0** and practical considerations of their implementation at the site. The technologies retained from the initial screening process were then used to develop reclamation alternatives for detailed analysis based on their effectiveness, implementability, and cost. The detailed evaluation of alternatives is presented in **Section 8.0**.

### 7.1 IDENTIFICATION AND PRELIMINARY SCREENING OF RECLAMATION TECHNOLOGIES

Reclamation technologies with potential to address elevated concentrations of metals in waste rock and soil at the LOB Mine were identified based on NewFields experience at similar sites, engineering judgement, and a review of available literature. The technologies identified for preliminary screening can be classified into four general categories:

- Institutional Controls – measures that restrict or control access to or use of a site as means to reduce exposure of the public to COCs.
- Engineering Controls – technologies that reduce contaminant mobility and eliminate exposure pathways through the use of physical barriers.
- Excavation and Disposal – excavation of contaminated material for disposal at either an on-site repository or an off-site permitted disposal facility.
- Treatment – destruction or immobilization of contaminants by treatment of soils and waste rock with elevated metals concentrations. This includes reprocessing of mine waste for extraction of metals and disposal of the resulting tailings.

Reclamation technologies for soil and mine waste are summarized in **Table 10** with the preliminary screening results and discussed below.

### 7.2 INSTITUTIONAL CONTROLS

Institutional controls include physical barriers, signs, and land use restrictions to control or restrict access to a site and are potentially applicable to mine waste at the LOB site. Institutional controls provide some measure of protection of human health by limiting exposure to contaminants. However, institutional controls do not prevent contaminant migration, reduce COC concentrations, or achieve cleanup goals. In addition, institutional controls would not address ecological impacts associated with the site.



A deed restriction could be placed on the property that includes the LOB site to restrict future use of the site. Physical barriers, such as fences, are readily implementable around the waste rock piles to control access by the public. The shaft opening at the LOB site is currently fenced off. Posting of signs notifying the public of potential hazards associated with the LOB site may also be potentially effective deterrents to public use of the mine site.

Institutional controls would not be effective as stand-alone reclamation actions. However, when combined with other actions institutional controls may increase the protectiveness of the alternative. Therefore, institutional controls were retained for further consideration through inclusion with other reclamation actions.

### 7.3 ENGINEERING CONTROLS

Engineering controls use physical barriers to reduce contaminant mobility and eliminate (or mitigate) exposure pathways. Engineering controls typically include containment, run-on/runoff controls, and revegetation. As discussed below and in **Table 10**, these reclamation actions would not reduce contaminant concentrations or the volume of impacted media. This reclamation action could be used with another action, but by itself will not receive further consideration.

#### 7.3.1 Containment

Containment (i.e., capping) of mine waste and impacted soil in place would prevent direct contact with contaminated media, eliminate fugitive emissions from wind-blown dust, and prevent erosion of the mine waste into Telegraph Creek. Capping would also reduce contaminant mobility by decreasing the infiltration of precipitation into mine waste. Cap designs range from simple monolithic soil covers to composite cover systems with compacted clay layers, geomembranes, and vegetative covers. The cover design is selected based on the hazards posed by the contaminated media, site characteristics (e.g., annual precipitation, site slope, etc.) and cost.

Waste Rock Pile 3 is in direct contact with Telegraph Creek and would need to be excavated back from the creek channel prior to capping. All three waste rock piles would need to be regraded to reduce their slopes and limit the potential for erosion of the cap. In addition, it would be necessary to import cover materials to the site because sufficient volumes of suitable soils for cover construction are not present at the LOB site.

In-place containment of mine waste and impacted soil at the LOB site was not retained for further consideration because steep site slopes, slope aspects, and proximity of mine waste to Telegraph Creek make the site unsuitable for on-site containment.

#### 7.3.2 Surface Controls

Surface controls include grading to reshape and reduce the slopes of waste areas, construction of diversion channels to control run-on/runoff, revegetation of waste areas, and erosion controls. Surface controls are implemented to control erosion of mine waste, reduce windblown dust, and decrease infiltration of surface water. These measures are not typically used as stand-alone response actions at



sites where direct human contact is a concern, but may be integrated with other measures (such as containment) to provide additional protection. Periodic maintenance may be necessary to repair erosion that occurs following closure.

At the LOB site, it may be possible to revegetate the waste rock piles to control water and wind erosion of mine wastes and reduce infiltration of precipitation through evapotranspiration. It would necessary to add soil amendments to the mine waste at the site to establish vegetation due to the absence of organic materials in mine waste. Mulching and/or chemical stabilization, as well as fertilization, would also be necessary to promote revegetation. Periodic maintenance, including weed control, may be necessary following initial revegetation efforts until a self-sustaining plant community is established.

Erosion control measures include the use of run-on/runoff diversion channels and placement of erosion resistant materials on mine waste, such as mulch and natural or synthetic fiber mats. Run-on/runoff diversion channels are constructed to direct storm water runoff away from mine waste. Erosion control products are strategically placed in areas considered likely to be subject to water erosion.

Surface control measures, including grading, revegetation, and erosion control are retained for further evaluation through inclusion with other response action alternatives.

## 7.4 EXCAVATION AND DISPOSAL

Excavation and disposal of impacted media in an on-site or off-site repository or at an off-site permitted landfill is a permanent source control measure. An estimated 3,430 cubic yards of mine waste is present in three waste rock piles at the site and an additional approximately 470 cubic yards of impacted soil (containing concentrations of arsenic or lead above screening levels) is present on site around the waste rock piles. In addition, an estimated 515 cubic yards of sediment containing arsenic concentrations above screening levels is present in the wetland area along Telegraph Creek downstream of Waste Rock Pile 3. It would also be necessary to import growth media to reclaim the excavation areas following removal of the mine waste and impacted soil.

### 7.4.1 On-Site Disposal

Under this scenario, mine waste and impacted soil / sediment would be excavated and placed in a repository constructed on-site. The repository would include a cover system designed to limit infiltration of precipitation into the underlying mine waste and soil/sediment. Diversion channels would be constructed to direct storm water run-on/runoff away from the repository to prevent erosion of the soil component of the cover system and further limit infiltration. It would be necessary to import cover materials and growth media to the LOB site because suitable quantities of growth media are not present on-site for cover construction and reclamation of excavation areas.

As discussed in **Section 3.7**, NewFields conducted a repository siting evaluation to identify potential sites in proximity to the LOB site that would be suitable for construction of a mine waste repository. Sites within the Telegraph Creek watershed were evaluated based on the following criteria:



- The site cannot be located in mapped alluvial material;
- Potential repository locations must be more than 500 feet from any mapped fault;
- Sites must be greater than 500 feet from surface water or mapped wetlands;
- The depth to water must be more than 20 feet;
- Site slopes must be less than 20 percent and the aspect must have a compass direction between 157 to 258 degrees (clockwise from north);
- Sites located in proximity to existing roads are preferred; and
- A minimum of five acres must be available on the property for construction of the repository.

The parcel that encompasses the LOB site is approximately 20.7 acres in size (Montana Cadastral Mapping Project 2016). As shown on **Figure 2**, the parcel is bisected by Telegraph Creek. The portion of the parcel on the east side of the creek is not suitable for an on-site repository because it has slopes up to 43 percent, slope aspects ranging from approximately 60 to 90 degrees (clockwise from north), and the majority of this portion of the property is less than 500 feet from Telegraph Creek.

The portions of the parcel on the west side of Telegraph Creek have slopes greater than 20 percent. This area also has a north facing slope thus does not meet the criteria for slope aspect. In addition, a pond is located approximately 400 feet from the southwest property boundary, and five acres of area are not available west of Telegraph Creek that are more than 500 feet from either the creek or the pond.

Based on this analysis the parcel that encompasses the LOB site does not meet the repository siting criteria. Therefore, excavation of mine waste for placement in an on-site repository was not retained for further evaluation.

#### **7.4.2 Off-Site Disposal**

Under this scenario, excavated mine waste and impacted soil/sediment would be hauled to a repository constructed off-site or a permitted landfill for disposal. Mine waste and site soils have not been sampled to determine the leachability of metals present in the material using the toxicity characteristic leaching procedure (TCLP; USEPA Method 1311). However, total metals concentrations of some COCs (e.g., arsenic, cadmium, lead, zinc) have been detected in mine waste / soil samples collected from the site that indicate the material may exceed the regulatory levels for toxicity characteristics. Therefore, it is unlikely that municipal solid waste landfill (permitted under 40 Code of Federal Regulations [CFR] Part 258 - Subtitle D of the Resource Conservation and Recovery Act [RCRA]) could accept the waste. Disposal in a licensed hazardous waste facility would likely be cost prohibitive and is not considered further.

NewFields conducted a repository siting evaluation to identify locations within the Telegraph Creek watershed (and a slight extension on the west side) that would potentially be suitable for the



construction of a repository for mine waste and impacted soil/sediment (containing concentrations of COCs above site reclamation goals). A number of locations were identified during the evaluation that met the siting criteria (refer to **Section 3.7**). The majority of these sites are located on land administered by the USDA-FS, although some privately-owned parcels were identified at the north end of the Telegraph Creek watershed that also satisfied the preliminary evaluation criteria. Approval of the USDA-FS would be required for the construction of a repository on land administered by them. It would be necessary to purchase property or obtain a long-term agreement for construction of an off-site repository on privately-owned land.

Another potential off-site repository site was identified during the siting evaluation. The LOB site is located in relatively close proximity (approximately 6.6 road miles) to the Luttrell Abandoned Mine Waste Repository, which is located in the Luttrell Pit of the historic Basin Creek Mine (**Figure 4**). The Luttrell Repository is a multi-agency collaborative effort and can receive mine waste from abandoned mine sites located within the Boulder-Elkhorn and Upper Tenmile Creek Watershed (located in the Lake Helena Watershed; USDA-FS 2005). The LOB site is located in the Little Blackfoot watershed, which is adjacent to the Boulder-Elkhorn watershed. However, the agreement between the DEQ, USDA-FS, and USEPA for the operation of the repository has expired and is currently being renegotiated. NewFields understands that DEQ/MWCB intends to include mine waste from the LOB site in the new agreement.

Excavation and off-site disposal of mine waste was retained for further evaluation.

## 7.5 IN-SITU TREATMENT

In-situ treatment consists of remediating impacted media in place to reduce contaminant mobility and toxicity. The only in-situ treatment method evaluated for the mining complex is chemical fixation/stabilization.

Chemical fixation/stabilization involves mixing a solidifying or chemical precipitating agent (or mixture of agents) to cause a physical or chemical change in the mobility and/or toxicity of contaminants. Potential fixation/stabilization agents include portland cement, other pozzolans, and phosphate. Tailings and waste rock have been successfully treated with phosphate amendments to reduce leachable concentrations of copper, lead, and zinc. Chemical fixation/stabilization was not retained for further evaluation due to associated high implementation costs.

## 7.6 EX-SITU TREATMENT

Ex-situ treatment of mine waste involves the physical removal of impacted media for treatment at either an on-site or off-site facility to reduce contaminant mobility and/or toxicity. The treated media may then either be placed back on site or disposed of at an off-site facility. Treatment processes may include chemical, physical, or thermal methods.

### 7.6.1 Reprocessing

Reprocessing consists of subjecting mine waste to physical/chemical extraction processes for the beneficial recovery of metals, which reduces the concentrations of the contaminants in the mine waste



(and after processing, the waste is often not returned to the site). One potential reprocessing facility is Barrick Gold Corporation's (Barrick) Golden Sunlight Mine (GSM), which is an open pit gold mine and milling operation located near Whitehall, Montana. GSM's mill has accepted ore from outside sources in the past for processing. The resulting tailings from reprocessing in GSM's mill would be disposed of in the active tailings storage facility at GSM.

It would be necessary to conduct assay tests on samples of the mine waste from the LOB site to determine whether recoverable metal concentrations in the waste are high enough to make reprocessing economical. It is unlikely that all mine waste at the site contains metal concentrations that are high enough to warrant economic reprocessing and recovery, and therefore, reprocessing is not a stand-alone reclamation action for the LOB site. The amount of screening and crushing (if necessary) the mine waste would require, as well as the haul distance from the site to the reprocessing mill, would also affect the economic viability of reprocessing.

In addition to the viability concerns, Barrick restricts metals concentrations in outside ore / mine waste it accepts for processing at the GSM mill to the following limits:

- Mercury – 1 mg/kg
- Arsenic – 200 mg/kg
- Lead – 100 mg/kg
- Zinc – 200 mg/kg
- Total Copper – 1,000 mg/kg
- Cyanide Soluble Copper – 250 mg/kg
- Selenium – 1 mg/kg
- Barium – 500 mg/kg
- Chromium – 100 mg/kg
- Cobalt – 100 mg/kg
- Nickel – 100 mg/kg
- Cadmium – 1 mg/kg

Arsenic, cadmium, lead, and zinc have been detected in mine waste samples from the LOB site at concentrations that exceed these limits (**Table 2**). It is unlikely that GSM would accept mine waste from the LOB site. Therefore, reprocessing was not retained for further evaluation.

### 7.6.2 Re-Use

Re-use of mine waste, either directly or following reprocessing or other treatment, as a beneficial product that is environmentally safe and stable is another potential response action. Examples of re-use include:

- The use of mine waste as aggregate in asphalt or concrete mixes;
- The re-use of contaminated soil as a cover material for site remediation; and
- The use of waste rock as a construction material (either directly or following treatment/reprocessing).





Re-use of mine wastes was not retained for further consideration due to potential liability concerns associated with using contaminated materials at off-site locations and the lack of an identified use for the materials.

### 7.6.3 Physical/Chemical Treatment

Physical treatment technologies rely on the physical properties of the contaminant and/or impacted media to readily separate the contaminants from the media, thereby reducing the waste volumes for disposal or additional treatment. Chemical treatment technologies rely on chemical reagents to precipitate or immobilize contaminants. Potentially applicable technologies include soil washing and acid extraction.

Soil washing is a physical treatment technology that separates contaminants sorbed onto fine soil particles from bulk soil in a water-based system on the basis of particle size (USEPA 2016). Contaminated media and wash water are mixed ex situ in a tank or treatment unit. A leaching agent, surfactant, or chelating agent may be added to the wash water or the pH of the wash water may be adjusted to enhance the removal of metals. The wash water and various soil fractions are usually separated by gravity settling.

Acid extraction is similar to soil washing, but an acidic solution is applied to the contaminated media in a mixing tank instead of water to extract metals from media. The extraction solution and treated media are separated using physical processes. Following separation, the treated media is rinsed with water to remove entrained acid and metals. Dissolved metals are subsequently removed from the extraction solution and rinse water using precipitants for additional treatment and/or disposal.

These processes were not retained for further evaluation due to their associated high costs, as well as the fact that these technologies would generate waste streams that would require additional treatment or disposal.

## 7.7 RECLAMATION ALTERNATIVE DEVELOPMENT

The technologies that were retained through the initial screening process are summarized in **Table 10**. These technologies are proven, effective, and implementable over a range of costs. USEPA guidance for non-time critical removal actions (USEPA 1993) recommends that only a limited number of reclamation alternatives be developed for detailed analysis. USEPA guidance also recommends that only the most qualified technologies that apply to the media or source of contamination be included in the reclamation alternatives. Based on this guidance, a limited number of alternatives were developed for further evaluation using the technologies that were retained during the initial screening process summarized in **Section 7.1** of this Expanded EE/CA. **Table 11** lists the reclamation alternatives that were developed for soils and waste rock at the LOB Mine.

In accordance with USEPA guidance (1988), the next step in the reclamation evaluation and selection process is a screening evaluation of the reclamation alternatives developed following the initial technology screening. The alternatives are evaluated against three broad criteria (effectiveness, implementability, and cost) in order to reduce the number of alternatives that are carried forward for a



more detailed analysis. As shown in **Table 11**, three reclamation alternatives were developed for the LOB site following the initial technology screening step. The alternative screening step was not performed due to the already limited number of alternatives identified for the LOB site, and because it is unlikely that any of the three alternatives would be eliminated during an additional screening step. All three reclamation alternatives were carried forward for detailed analysis (**Section 8.0**).



## 8.0 DETAILED ANALYSIS OF RECLAMATION ALTERNATIVES

Reclamation alternatives developed in **Section 7.7** incorporate technologies retained following a preliminary screening of their ability to meet reclamation goals and practical considerations of their implementation at the site. These alternatives represent a range of potential actions or process options that will reduce or eliminate potential human health and ecological risks associated with mine waste and impacted soil / sediment to varying degrees over a range of estimated costs. This section presents a detailed evaluation of the individual reclamation alternatives.

The following alternatives were identified for detailed analysis:

- Alternative 1: No action
- Alternative 2: Excavation and disposal in an off-site repository
- Alternative 3: Excavation and disposal in the Luttrell Repository

These reclamation alternatives only address solid media (i.e., mine waste and soil/sediment containing COCs at concentrations above reclamation goals) at the LOB site, and do not address the discharge from the Lilly adit. Therefore, each of these alternatives is classified as an interim or removal action and is not considered a complete reclamation. It is anticipated, however, that removal of mine waste from the site will reduce the mass of contaminants reaching Telegraph Creek and the adjacent wetland area.

### 8.1 EVALUATION CRITERIA

The three reclamation alternatives developed in **Section 7.7** were evaluated against the following criteria in accordance with the NCP:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction in toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

Supporting agency and community acceptance are modifying criteria that will be evaluated after the DEQ and the public have reviewed and commented on the Expanded EE/CA.



These criteria fall into three categories, each with distinct functions in selecting the preferred alternative:

- **Threshold Criteria** – overall protection of human health and the environment and compliance with ARARs.
- **Primary Balancing Criteria** - Long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.
- **Modifying Criteria** – supporting agency and community acceptance.

### 8.1.1 Threshold Criteria

A reclamation alternative that does not satisfy the threshold criteria (overall protection of human health and the environment and compliance with ARARs) cannot be selected as the preferred alternative.

Overall Protection of Human Health the Environment: This criterion is used to evaluate whether an alternative provides adequate protection of human health and the environment. As described in USEPA guidance (1988):

*“The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.”*

Compliance with ARARs: Alternatives are evaluated against this criterion to determine whether they will satisfy state and federal ARARs that have been identified for the project. ARARs for the LOB site are discussed in **Section 5.0** and a preliminary list of ARARs for this site is provided in **Appendix B**.

### 8.1.2 Primary Balancing Criteria

Primary balancing criteria take into account technical considerations of each alternative’s ability to achieve long-term reductions in risks to human health and the environment, whether the alternative is technically and administratively feasible, and the overall cost of the alternative. Threshold and primary balancing criteria serve as the basis for the detailed analysis of alternatives and selection of the preferred alternative.

Long-term Effectiveness and Permanence: This criterion is used to evaluate alternatives based on the anticipated risk that remains at the site after reclamation objectives have been achieved (USEPA 1988). The magnitude of residual risk at the site, the adequacy and suitability of controls used to manage untreated waste and treatment residuals, and the long-term reliability of the alternative is assessed.

Reduction in Toxicity, Mobility, or Volume through Treatment: Alternatives are assessed against their ability to permanently reduce principal threats at a site through the destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total contaminated media volume (USEPA 1988). Factors considered include:



- Treatment process used and the media that will be treated;
- The expected reduction in contaminant toxicity, mobility, or volume, and the degree to which the treatment will be irreversible;
- Treatment residual types and volumes remaining after reclamation; and
- Whether the alternative would satisfy the statutory preference for treatment as a principal element.

***Short-term Effectiveness:*** This criterion is used to evaluate the potential risks posed to human health and the environment by construction and implementation of the alternative until reclamation objectives (e.g., clean-up goals) have been met (USEPA 1988). Factors that are considered include the protection of workers implementing remedial actions, threats to the surrounding community (e.g., generation of dust during excavation, spills of hazardous materials during transportation, etc.), and the time required to meet reclamation objectives.

***Implementability:*** The technical and administrative feasibility of implementing an alternative is examined under this criterion, including the availability of the required materials and services. Technical feasibility refers to the ability to construct, operate, maintain, and monitor treatment technologies associated with the alternative, as well as the ease of implementing future reclamation actions. Administrative feasibility considers the need (and ability) to obtain permits and regulatory approval for components of the action.

***Cost:*** The capital, operation, and maintenance costs of reclamation alternatives are evaluated under this criterion, as well as costs associated with monitoring and reporting. Cost estimates were prepared for each alternative considered in this Expanded EE/CA. The costs estimates include future costs for each alternative over a life of 30 years using present worth analysis. The net present value (NPV) calculations include an annual discount rate (assumed to be 4.2 percent for this Expanded EE/CA) that addresses the time value of money. The discount rate is typically described as the interest rate that could be realized from a prudent investment. An escalation rate of 3.5 percent was used to estimate the annual increase in future costs due to inflation. Cost estimates were prepared in accordance with USEPA guidance on preparing cost estimates for response actions under CERCLA (USEPA 2000).

### **8.1.3 Modifying Criteria**

DEQ's technical and administrative issues and concerns related to the preferred alternative will be formally considered after agency and public comment on the proposed plan. Any public concerns with the reclamation alternative will also be evaluated following the public comment period.

## **8.2 QUANTITATIVE EVALUATION OF THRESHOLD CRITERIA**

Each reclamation alternative, with the exception of the no-action alternative, is designed to achieve risk-reduction necessary to achieve the reclamation objectives for the LOB site and the risk-based cleanup



goals. No additional evaluation or comparison of relative reductions in risk between reclamation alternatives was performed.

### **8.3 ALTERNATIVE 1: NO ACTION**

The no action alternative was carried forward for detailed analysis to serve as a baseline against which the other reclamation alternatives are compared. Under this alternative the LOB site would be left in its existing condition. Mine waste would be left in place and no action would be taken to control contaminant migration from the site, reduce toxicity, or reduce waste volumes.

#### **8.3.1 Overall Protection of Human Health and the Environment**

The no action alternative would do nothing to mitigate current and future risks to human health and the environment associated with mine waste and impacted soil / sediment at the site.

#### **8.3.2 Compliance with ARARs**

Several constituents, including aluminum, cadmium, copper, lead, and zinc have been detected in surface water samples collected from Telegraph Creek at concentrations that exceed the ARAR-based reclamation goals (refer to **Section 6.1**). The no action alternative would not reduce concentrations of these constituents in Telegraph Creek and would not meet state or federal contaminant-specific ARARs that are applicable to surface water at the LOB site.

#### **8.3.3 Long-term Effectiveness and Permanence**

Risks to human health and the environment posed by the LOB site would remain unchanged under the no action alternative. No administrative or engineering controls would be implemented at the site. Therefore, the no action alternative does not offer long-term effectiveness or permanence.

#### **8.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment**

This alternative does not reduce the toxicity, mobility, or volume of mine waste and impacted soil / sediment at the LOB site.

#### **8.3.5 Short-term Effectiveness**

No actions would be implemented under this alternative, and therefore, no short-term risks would be created.

#### **8.3.6 Implementability**

Implementation of the no action alternative is both technically and administratively feasible.

#### **8.3.7 Cost**

No capital costs would be incurred under this alternative. Site conditions are unlikely to change under this scenario, and therefore, long-term monitoring and associated reporting costs would be unnecessary and unlikely to be incurred. External costs were not considered for this alternative, but may include the





loss of certain ecological functions for portions of Telegraph Creek, including a healthy, viable aquatic community immediately downstream of the LOB site.

#### 8.4 ALTERNATIVE 2: EXCAVATION AND DISPOSAL IN OFF-SITE REPOSITORY

Alternative 2 would include the excavation of mine waste, as well as soil and sediment containing COCs at concentrations that exceed cleanup goals, from the LOB site for disposal in a repository constructed off-site. Preliminary discussions with USDA-FS personnel indicate that it may be difficult to obtain approval to construct a repository on land administered by the USDA-FS for waste from a site not located on USDA-FS land. Therefore, it was assumed that the repository would be located on privately-owned land for the purpose of this alternatives analysis. The preliminary repository siting evaluation (**Section 3.7**) identified several potential repository locations on private land approximately 5 air miles north of the LOB site.

An estimated 4,415 cubic yards of waste and impacted media would be removed from the site, including the three waste rock piles (approximately 3,430 cubic yards), approximately 470 cubic yards of impacted soil, and 515 cubic yards of impacted sediment in the wetland area downstream of WRP-3. Excavation efforts would continue until native soil is exposed beneath the three waste rock pile locations. An x-ray fluorescence spectrum analyzer (XRF) may be used to screen remaining soil and sediment on site to evaluate whether cleanup goals have been met.

**Figure 5** shows a conceptual cross-section of the design for the off-site repository. It was assumed that the repository cover system would consist of a geosynthetic clay liner (GCL) overlain by a drainage layer and two feet of cover soil / growth media. The drainage layer would direct meteoric water that infiltrates through the soil cover off the GCL and away from the repository. Depending on the suitability of materials at the repository site, the drainage layer may be constructed using coarse grained soil salvaged on-site or synthetic materials (e.g., geonet).

Alternative 2 would include the following additional elements:

- Repository Site Preparation - Clearing and grubbing the repository site; separating combustible and non-combustible debris; and debris disposal.
- Construct Repository - Items to be completed under this task include:
  - Strip and stockpile topsoil within the footprint of the repository for re-use during cover construction and reclamation;
  - Excavate subsoil to a depth of approximately four feet within the footprint of the repository;
  - Compact the subgrade at the base of the repository to a specified density;
  - Place and compact the waste rock in the repository;
  - Grade and shape waste rock to suitable slopes for cover construction;



- Install repository cover system;
  - Construct run-on/runoff control ditches around the perimeter of the repository; and
  - Seed repository cover and disturbance area, including application of appropriate fertilizer and mulch.
  - The repository would cover an area of approximately 0.6-acres.
- Surface Water Diversion System - It would be necessary to divert Telegraph Creek around the excavation areas for WRP-3 and impacted sediment downstream of WRP-3. The diversion system would include a temporary dam installed across Telegraph Creek upstream of the excavation area. Water in Telegraph Creek would be piped from the temporary diversion dam around the excavation areas to temporary sediment basins prior to discharge back into the creek. Excavation would be completed in late summer / early fall when Telegraph Creek flows are low and the Lilly adit is not discharging.
  - Excavate, Load, and Haul Waste - Excavate mine waste and impacted media at the LOB site to the approximate lateral limits shown on **Figure 3**. The excavations would extend to native soils beneath the waste rock piles. The mine waste and impacted media would be loaded into haul trucks and transported to the off-site repository for disposal.

The LOB site would be regraded to match pre-existing site slopes. Approximately 300 linear feet of Telegraph Creek would be reconstructed and graded to provide a slope consistent with upstream and downstream portions of the creek that have not been affected by mining activities. Grade control structures would be constructed using materials (e.g., logs, rock, etc.) salvaged from on-site. Imported growth media would be spread over the recontoured excavation areas. Disturbed areas would then be revegetated using soil amendments, re-seeding, streambank plantings, and mulching. Disturbed areas at the LOB site, as well as the repository, would be monitored and maintained (if necessary) until vegetation is fully established. Weed control measures would be employed as necessary.

Note that Alternative 2 (as well as the other alternatives under consideration) does not address the seasonal discharge from the Lilly adit, which would continue to impact surface water quality in Telegraph Creek. Following removal of mine waste and impacted soil around WRP-3, the drainage channel for the adit discharge would be reconstructed.

#### **8.4.1 Overall Protection of Human Health and the Environment**

Excavation of mine waste, soil, and sediment containing COCs at concentrations above cleanup goals for disposal at an off-site repository would significantly reduce risks to human health and the environment. This alternative would also substantially meet reclamation objectives and goals for the project (refer to **Section 6.0**). Exposure of human and ecological receptors to contaminants through direct contact with mine waste would be eliminated. In addition, the response action would eliminate a source of metals impacts to surface water and sediment in Telegraph Creek. The stream function and aquatic life habitat in Telegraph Creek would be also be improved through removal of mine waste in contact with the creek and reconstruction of the streambed.



## 8.4.2 Compliance with ARARs

Although this alternative would reduce the load of contaminants discharged to surface water at the LOB site, it may not fully achieve surface water quality ARARs alone because it does not address the discharge from the Lilly adit. Contaminant-specific ARARs for ambient air are expected to be met because the mine waste will be placed in a repository with an engineered cover system and disturbed areas will be revegetated. Dust control measures would be implemented during construction activities to control generation of fugitive dust.

Metals, including arsenic, cadmium, lead, and zinc, have been detected in groundwater at the LOB site at concentrations that exceed DEQ-7 human health standards for groundwater. Groundwater levels in several on-site monitoring wells were affected by mine dewatering activities conducted in October 2010, which indicates some level of interaction between water in the mine workings that contain elevated metals concentrations and groundwater on site. The degree to which groundwater quality on site is affected by the presence of the waste rock piles (through infiltration of meteoric water through the piles to underlying groundwater) is unknown. Removal of mine waste with elevated metals concentrations (above cleanup goals) may improve groundwater quality at the LOB site. However, site groundwater will continue to be affected by interaction with mine water and may not meet groundwater ARARs.

Location-specific ARARs would be met to a substantial degree. Several potentially historic features are present at the mine site (refer to **Section 2.4**). DEQ would work with SHPO during reclamation activities to preserve historical features to the extent practical. The response action would improve habitat for migratory birds, endangered species, and aquatic life. Work would be performed within the floodplain of Telegraph Creek; however, reconstruction of Telegraph Creek will be performed in a manner that does not result in lasting impacts to the floodplain. Potential wetlands at the LOB site (a wetland inventory has not been performed) would be removed by the reclamation action. It may be necessary to conduct a wetland delineation and file a Pre-Construction Notification with the U.S. Army Corps of Engineers for a Nationwide Permit (Section 404 of the Clean Water Act).

Action-specific ARARs are expected to be met by this alternative. Best management practices (BMPs) would be employed during construction activities to prevent discharge of sediment to surface water. Dust suppression and control measures would be implemented to control fugitive dust generation during construction. Construction personnel would have current Hazardous Waste Operations and Emergency Response training as necessary under 29 Code of Federal Regulations (CFR) 1910.120.

## 8.4.3 Long-term Effectiveness and Permanence

Alternative 2 would achieve a high degree of long-term effectiveness and permanence because mine waste containing concentrations of metals above cleanup goals would be permanently removed from the LOB site. The repository cover would be designed to minimize infiltration of meteoric water into the underlying mine waste. Once vegetation has been re-established in disturbed areas, minimal long-term monitoring and maintenance would be required.



#### 8.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Mobility of contaminants would be significantly reduced under this alternative by removing mine waste with elevated metals concentrations from the site and placing it in an off-site repository with a cover system that limits infiltration of precipitation and is constructed with BMPs to direct surface run-on / runoff away from the repository. Metals would no longer be susceptible to mobilization due to infiltration of meteoric water through the waste rock piles, erosion into Telegraph Creek, sediment mobility in Telegraph Creek, wind erosion, or human disturbance. However, no reduction in the toxicity or volume of contaminants would be achieved by this alternative.

#### 8.4.5 Short-term Effectiveness

The alternative would not create significant short-term risks to human health or the environment. Some limited risks associated with construction activities would occur. However, these risks would be effectively managed through the implementation of appropriate engineering and administrative controls. Construction would be completed in a single construction season and is anticipated to take less than 90 days to complete.

#### 8.4.6 Implementability

Removal of mine waste containing concentrations of metals above site cleanup goals at the LOB site for disposal at an off-site repository is both technically and administratively feasible. However, the implementability of Alternative 2 is reduced by:

- The limited availability of privately-owned land that meets repository siting criteria in proximity to the LOB site;
- Uncertainty associated with whether privately-owned land that meets siting criteria can be purchased or whether a long-term agreement can be reached with the existing property owner for construction of the repository; and
- Uncertainty associated with whether a repository could be constructed on land administered by the USDA-FS.

No power would be required at the site or repository during or post-construction. This alternative uses proven technologies that are reliable, relatively simple, and would not require long-term maintenance following the establishment of vegetation in disturbed areas. The area has a short construction season due to heavy winter snows; however, the construction activities proposed under this alternative could be easily implemented in single construction season through advanced planning.

#### 8.4.7 Cost

As shown in **Table 12**, the total estimated NPV cost to implement Alternative 2 is \$901,800. The estimated NPV cost of Alternative 2 includes five years of maintenance and monitoring costs in addition to estimated capital expenditures during construction. Typically, 30 years of estimated future costs are included in NPV analyses for reclamation actions. In this case it was assumed that no maintenance or



monitoring costs would be incurred after vegetation is fully established on the repository cover and disturbed areas. The maintenance and monitoring costs included in the NPV cost of Alternative 2 include invasive weed control and repairs to the repository cover due to erosion/rilling that may occur before vegetation is established. Detailed cost estimates for all three alternatives under evaluation are provided in **Appendix C**.

## 8.5 ALTERNATIVE 3: EXCAVATION AND DISPOSAL IN LUTTRELL PIT

Similar to Alternative 2, this alternative includes the excavation of mine waste, soil, and sediment containing COCs at concentrations that exceed cleanup goals from the LOB site. However, the material would be transported to the Luttrell Repository for disposal instead. Although the agreement between the DEQ, USDA-FS, and USEPA for the operation of the repository has expired, it is currently being renegotiated. NewFields understands that DEQ/ MWCB intends to include mine waste from the LOB site in the agreement.

Mine waste and impacted media would be excavated at the LOB site to the approximate lateral limits shown on **Figure 3**. An estimated 4,415 cubic yards of impacted media would be removed from the site for disposal in the Luttrell Repository. Excavation efforts would continue until native soil is exposed beneath the three waste rock pile locations. An XRF may be used to screen remaining soil and sediment on site to evaluate whether cleanup goals have been met.

Following placement in the Luttrell Repository, a temporary cover (20-mil polyethylene Dura-Skrim® liner) would be placed over the mine waste, soil, and sediment from the LOB site at the end of the operating season. A permanent cover system will be placed over the repository at the end of its operational life (estimated to be an additional 15 years) that will include a geosynthetic component (e.g., 60-mil high density polyethylene liner).

Telegraph Creek would be diverted around the WRP-3 and sediment excavation areas (**Figure 3**) using the same diversion system described for Alternative 2 (**Section 8.4**). Excavation would be completed in late summer / early fall when Telegraph Creek flows are low and the Lilly adit is not discharging.

The LOB site would be regraded to match pre-existing site slopes. Approximately 300 linear feet of Telegraph Creek would be reconstructed and graded to provide a slope consistent with upstream and downstream portions of the creek that have not been affected by mining activities. Grade control structures would be constructed using materials (e.g., logs, rock, etc.) salvaged from on-site. Imported growth media would be spread over the recontoured excavation areas. Disturbed areas would then be revegetated using soil amendments, seeding, streambank plantings, and mulching. Disturbed areas at the LOB site, as well as the repository, would be monitored and maintained (if necessary) until vegetation is fully established. Weed control measures would be employed as necessary.

Alternative 3 would not address the seasonal discharge from the Lilly adit, which would continue to impact surface water quality in Telegraph Creek. Following removal of mine waste and impacted soil around WRP-3, the drainage channel for the adit discharge would be reconstructed.



### 8.5.1 Overall Protection of Human Health and the Environment

Excavation of mine waste, soil, and sediment containing COCs at concentrations above cleanup goals for disposal at the Luttrell Repository would significantly reduce risks to human health and the environment. This alternative would also substantially meet reclamation objectives and goals for the project (refer to **Section 6.0**). Exposure of human and ecological receptors to contaminants through direct contact with mine waste would be eliminated. In addition, the response action would eliminate a source of metals impacts to surface water and sediment in Telegraph Creek. The stream function and aquatic life habitat in Telegraph Creek would be also be improved through removal of mine waste in contact with the creek and reconstruction of the stream.

### 8.5.2 Compliance with ARARs

Alternative 3 would reduce the load of contaminants discharged to surface water at the LOB site. However, it may not fully achieve surface water quality ARARs alone because it does not address the discharge from the Lilly adit. Contaminant-specific ARARs for ambient air are expected to be met because the mine waste will be placed in a repository with an engineered cover system and disturbed areas will be revegetated. Dust control measures would be implemented during construction activities to control generation of fugitive dust.

Similar to Alternative 2, this alternative may improve groundwater quality at the site by removing a potential source of impacts (i.e., infiltration of meteoric water through waste rock piles to underlying groundwater). However, it would not address the potential interaction of mine water containing elevated metals concentrations (above groundwater standards) and site groundwater. Groundwater ARARs may not be met under this alternative due to this interaction.

Location-specific ARARs would be met to a substantial degree. Several potentially historic features are present at the mine site (refer to **Section 2.4**). DEQ would work with SHPO during reclamation activities to preserve historical features, to the extent practical. The response action would improve habitat for migratory birds, endangered species, and aquatic life. Work would be performed within the floodplain of Telegraph Creek; however, reconstruction of Telegraph Creek will be performed in a manner that does not result in lasting impacts to the floodplain. Potential wetlands at the LOB site (a wetland inventory has not been performed) would be removed by the response action. It may be necessary to conduct a wetland delineation and file a Pre-Construction Notification with the U.S. Army Corps of Engineers for a Nationwide Permit (Section 404 of the Clean Water Act).

Action-specific ARARs are expected to be met by this alternative. BMPs would be employed during construction activities to prevent discharge of sediment to surface water. Dust suppression and control measures would be implemented to control fugitive dust generation during construction. Construction personnel would have current Hazardous Waste Operations and Emergency Response training as necessary under 29 CFR 1910.120.

### 8.5.3 Long-term Effectiveness and Permanence

Alternative 3 would achieve a high degree of long-term effectiveness and permanence because mine waste containing concentrations of metals above cleanup goals would be permanently removed from





the LOB site. Once vegetation has been re-established in disturbed areas, minimal long-term monitoring and maintenance would be required.

#### 8.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Mobility of contaminants would be significantly reduced under this alternative by removing mine waste with elevated metals concentrations from the site and placing it in an off-site repository with controls that limit infiltration and direct surface run-on / runoff away from the repository. Metals would no longer be susceptible to mobilization due to infiltration of meteoric water through the waste rock piles, erosion into Telegraph Creek, sediment mobility in Telegraph Creek, wind erosion, or human disturbance. However, no reduction in the toxicity or volume of contaminants would be achieved by this alternative.

#### 8.5.5 Short-term Effectiveness

The alternative would not create significant short-term risks to human health or the environment. Some limited risks associated with construction activities would occur. However, these risks would be effectively managed through the implementation of appropriate engineering and administrative controls. Construction would be completed in a single construction season and is anticipated to take less than 90 days to complete.

#### 8.5.6 Implementability

Removal of mine waste containing concentrations of metals above site cleanup goals at the LOB site for disposal in the Luttrell Repository is both technically and administratively feasible. Although the existing agreement between the DEQ, USDA-FS, and USEPA for the operation of the repository has expired, it is currently being renegotiated and the new agreement is anticipated to allow mine waste from the LOB site to be placed in the repository.

Alternative 3 uses proven technologies that are reliable, relatively simple, and would not require long-term maintenance following the establishment of vegetation in disturbed areas. The area has a short construction season due to heavy winter snows; however, the construction activities proposed under this alternative could be easily implemented in single construction season through advanced planning.

#### 8.5.7 Cost

As shown in **Table 12**, the total estimated cost to implement Alternative 3 is \$433,500. No future costs are included in this estimate. It was assumed that no future monitoring or maintenance costs would be incurred after the mine waste is removed from the LOB site and placed in the Luttrell Repository. Detailed cost estimates for all three alternatives under evaluation are provided in **Appendix C**.



## 9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the reclamation alternatives developed in **Section 7.0** and evaluated in detail in **Section 8.0**. Comparative analyses were performed for the alternatives using threshold and primary balancing criteria.

As discussed in **Section 8.1**, threshold criteria include:

- Overall protection of human health and the environment; and
- Compliance with ARARs.

Primary balance criteria include the following:

- Long-term effectiveness and cost;
- Reduction in toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

Costs for each reclamation alternative were estimated for comparative purposes only since many design details that would affect costs are preliminary. Actual costs for selected alternatives may range from 30 percent lower to 50 percent higher than the comparative costs estimated in this Expanded EE/CA. Summaries of the alternative cost comparisons are provided in **Table 12**. The results of the comparative analysis of the three alternatives under consideration are summarized in **Table 11**.

### 9.1 THRESHOLD CRITERIA

Alternative 1 (no action) would do nothing to mitigate current and future risks to human health and the environment associated with mine waste and impacted soil / sediment, and therefore would not be protective of human health and the environment. Under this alternative, the LOB site would be left in its existing condition. The no action alternative would not reduce concentrations of COCs in Telegraph Creek and would not meet state or federal contaminant-specific ARARs applicable to surface water at the LOB site.

Alternative 2 (excavation and disposal in an off-site repository) would significantly reduce risks to human health and the environment through removal of mine waste, soil, and sediment containing COCs at concentrations above cleanup goals for disposal in an off-site repository. The design of the repository would include a cover system that would limit the infiltration of meteoric water through the mine waste to underlying groundwater. Removal of mine waste and impacted media from the LOB site would eliminate a source of metals impacts to surface water and sediment in Telegraph Creek. However, this



alternative may not fully achieve surface water quality ARARs alone because it does not address the discharge from the Lilly adit. Alternative 2 would comply with location- and action-specific ARARs (see **Appendix B**).

Alternative 3 (excavation and disposal in the Luttrell Repository) is rated equally to Alternative 2 for achieving threshold criteria. This alternative consists of the removal of mine waste, soil and sediment containing COCs at concentrations that exceed cleanup goals for disposal in the Luttrell Repository. Removal of impacted media from the site would eliminate the potential exposure of human and ecological receptors to mine waste through direct contact. The response would also eliminate of source of metals impacts to Telegraph Creek. Similar to Alternative 2, this alternative does not address the discharge from the Lilly adit and may not fully achieve surface water quality ARARs as a result. The alternative would comply with location- and action-specific ARARs.

## 9.2 PRIMARY BALANCING CRITERIA

As shown in **Table 11**, Alternative 1 (no action) does not satisfy any of the primary balancing criteria:

- It does not provide long-term effectiveness or permanence;
- It provides no reduction in toxicity, mobility, or volume of contaminants through treatment;
- It is not effective in the short-term;
- No actions would be implemented; and
- There would be no costs associated with the alternative.

Therefore, Alternative 1 was not considered further during the comparative analysis.

The long-term effectiveness and permanence of Alternatives 2 and 3 rank relatively equally. Under both alternatives, mine waste, soil, and sediment containing COCs at concentrations above cleanup goals would be removed from the LOB site. The cover system for the off-site repository would be designed to minimize infiltration of meteoric water into the underlying mine waste. The temporary liner (20-mil polyethylene) placed over the mine waste in the Luttrell Repository at the end of each operating season would also minimize infiltration of meteoric water through the materials in the repository until the final cover system is placed. No long term monitoring or maintenance would be required for Alternative 2 once vegetation is established at the repository site and areas disturbed by excavation activities at the mine site. A long-term monitoring and maintenance program is currently in place for the Luttrell Repository and would continue in the event that Alternative 3 is selected for implementation.

Alternative 2 and 3 also rank equally in terms of reducing the mobility of contaminants through the removal of mine waste, soil, and sediment with elevated metals concentrations from the site for placement whether in an off-site repository (Alternative 2) or in the Luttrell Repository. Metals would no longer be susceptible to mobilization due to infiltration of meteoric water through the waste rock piles, erosion into Telegraph Creek, sediment mobility in Telegraph Creek, wind erosion, or human



disturbance. However, there would be no reduction in the toxicity or volume of contaminants by implementing either alternative.

Neither Alternative 2 nor 3 would not create significant short-term risks to human health or the environment. There would be some risk associated with hauling mine waste off-site for disposal over narrow unpaved roads. However, the risk of releases due to accidents or spills of materials from haul trucks would be reduced by limiting the speed of the haul trucks, careful route planning, and covering the haul trucks on site after loading. The estimated haul distances are roughly equal for both alternatives, depending on the location of the off-site repository in Alternative 2 (approximately 7.6 miles for Alternative 2 and approximately 6.6 miles for Alternative 3). There are also some limited risks associated with construction activities for both alternatives. However, these risks would be effectively managed through the implementation of appropriate engineering and administrative controls. Construction would be completed in a single construction season and is anticipated to take less than 90 days to complete. Therefore, Alternatives 2 and 3 are also ranked equally in terms of short-term effectiveness.

Implementation of both Alternative 2 and 3 is technically and administratively feasible. However, the implementability of Alternative 2 is reduced by the limited availability of privately-owned land in proximity to the LOB site that meets repository siting criteria. Considerable uncertainty also exists regarding whether the privately-owned land that does meet repository siting criteria can be purchased or whether a long-term agreement can be reached with the existing property owner. It was assumed that it would be necessary to construct the off-site repository on privately-owned land due to uncertainty associated with whether a repository could be constructed on land administered by the USDA-FS. Although the existing agreement between the DEQ, USDA-FS, and USEPA for the operation of the Luttrell Repository (Alternative 3) has expired, it is currently being renegotiated and the new agreement is anticipated to allow mine waste from the LOB site to be placed in the repository. Therefore, Alternative 2 is ranked lower in terms of implementability than Alternative 3.

The estimated costs to implement Alternatives 2 and 3 are \$901,800 and \$433,500, respectively (**Table 12**). Construction and materials costs associated with Alternative 2 would be higher than Alternative 3 for the following reasons:

- The costs associated with purchasing land for the off-site repository or obtaining a long-term agreement with an existing land owner for construction of the repository.
- The slightly longer haul distance associated with Alternative 2 (approximately 7.6 miles versus 6.6 miles for Alternative 3).
- Materials and construction costs associated with constructing the off-site repository (including the cover system) that would not be incurred by using the existing Luttrell Repository (Alternative 3). It was assumed that there would be no tipping fees for disposal of mine waste in the Luttrell Repository.

Detailed cost estimates for these alternatives are provided in **Appendix C**.



## 10.0 PREFERRED ALTERNATIVE

Based on the results of the detailed and comparative analyses of the three reclamation alternatives considered for the LOB site, Alternative 3 is the preferred alternative. As described in **Section 8.5**, this alternative consists of the excavation and removal of approximately 4,415 cubic yards of mine waste, soil, and sediment containing metals concentrations above cleanup goals for disposal in the Luttrell Repository. Following removal of the impacted media, the site would be regraded to match existing undisturbed site slopes. Growth media would be spread over the disturbed areas and seeded to encourage revegetation. Approximately 300 linear feet of Telegraph Creek would be reconstructed and graded to provide a slope consistent with upstream and downstream portions of the creek that have not been affected by mining activities.

Alternative 3 provides the same level of protection as Alternative 2, but is less costly. In addition, Alternative 3 would be easier to implement because there is no requirement to either purchase land or obtain a long-term agreement with an existing property owner for the construction of a repository. The proposed reclamation activities included in Alternative 3 would achieve project goals of minimizing the potential exposure of human and ecological receptors to contaminants associated with mine waste at the LOB site and reducing the mobility of contaminants.



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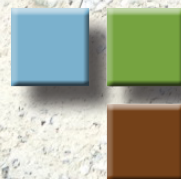
**Washington State Department of Ecology (WDOE), 1997.** Creation and Analysis of Freshwater Sediment Quality Values in Washington State. Publication Number: 97-323a. July.

**WDOE, 2015.** Sediment Cleanup Users Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC. Publication No. 12-09-057. March.

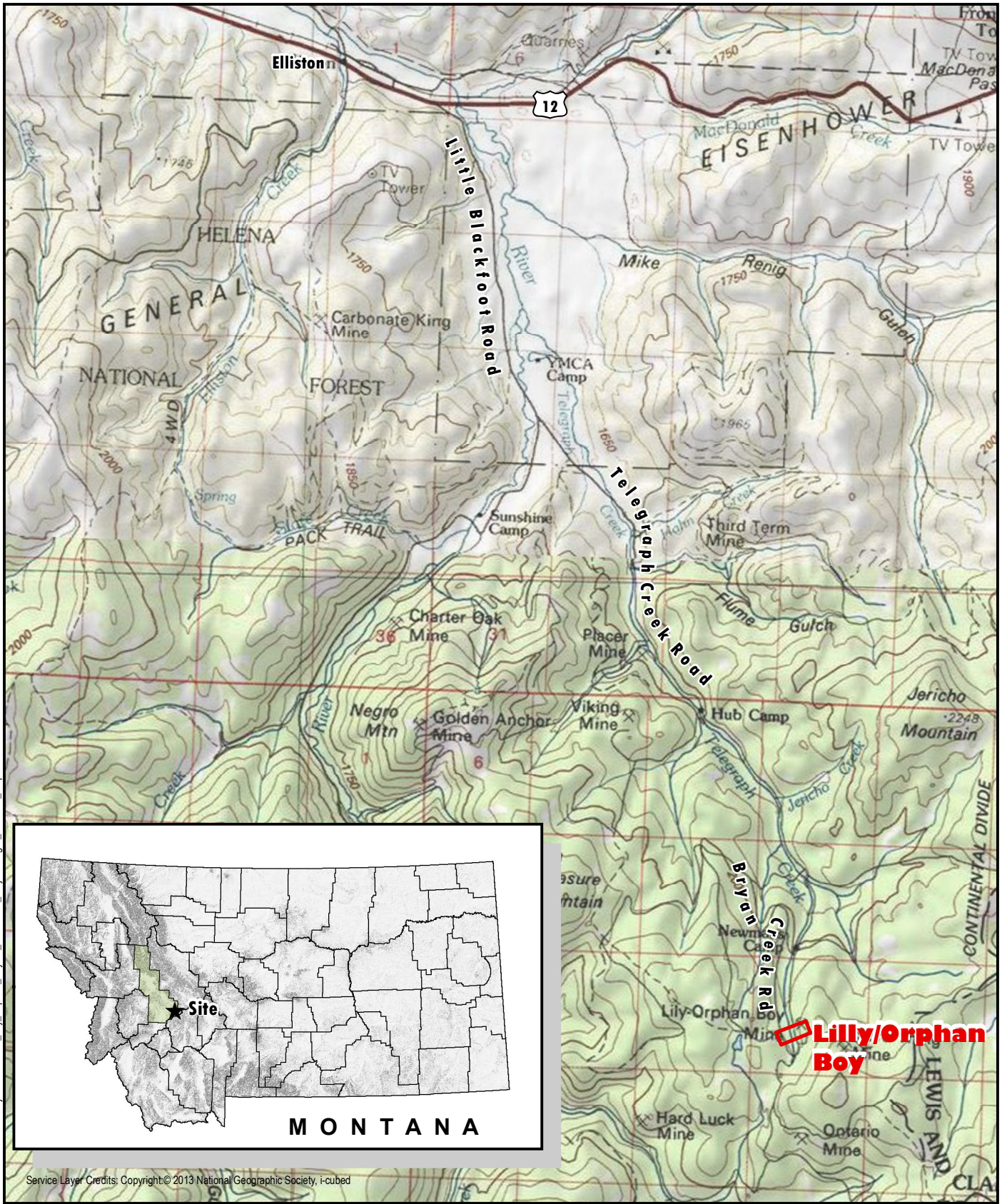




# FIGURES







I:\NF\HELENA\shares\Projects\350.0215\_Lilly\_Orphan\_Boy\05\_GIS\05.01\_Projects\Fig-1\_Location\_Map.mxd

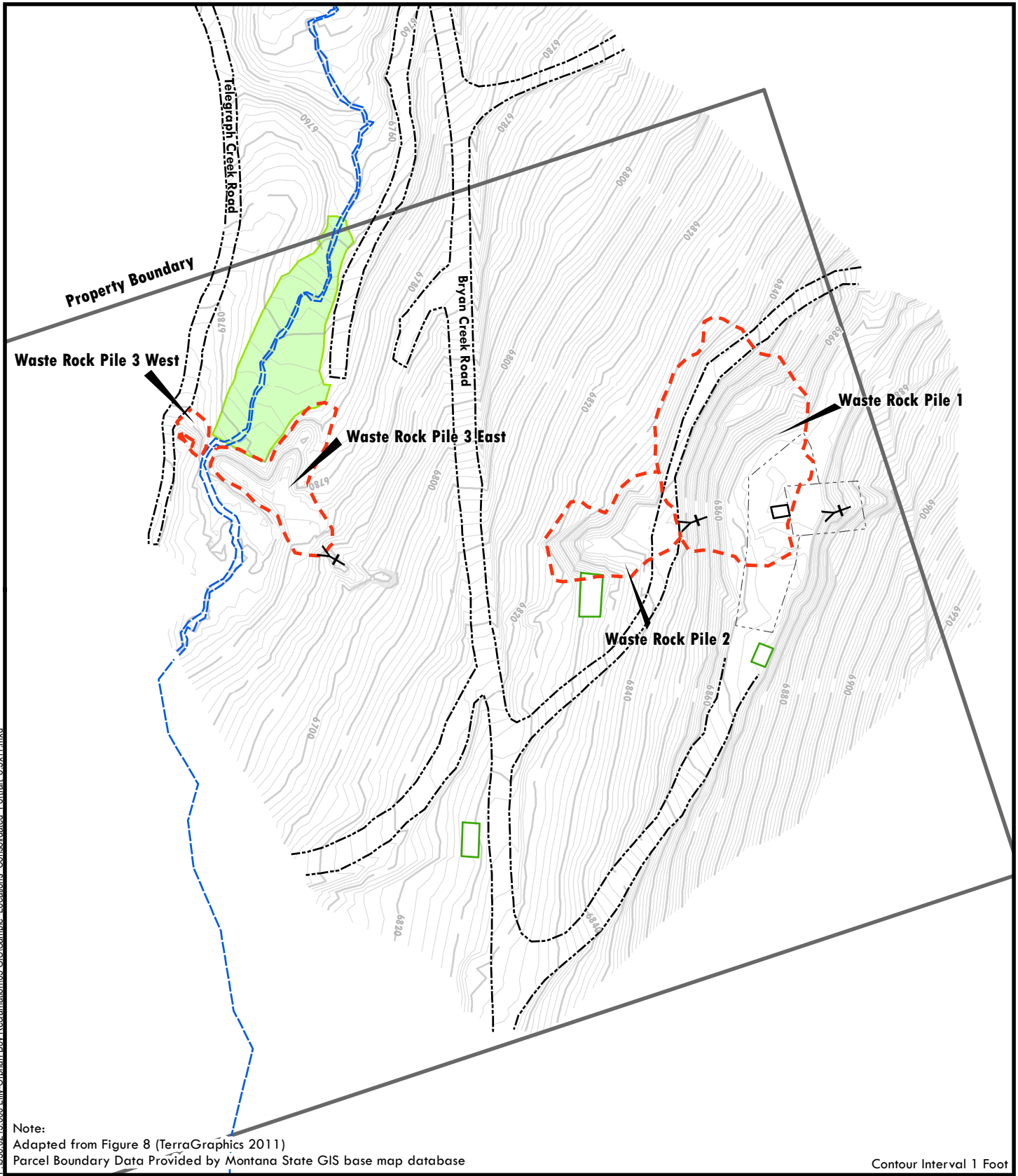
Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed



**NewFields**

Location Map  
 Lilly/Orphan Boy Mine  
 Powell County, Montana  
 FIGURE 1

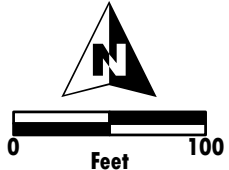




P:\350.02\15.000.Lilly-Orphan.Boy.Reclamation\05.GIS\Sample\_Locations.Consolidated.Parcel.8.5x11.mxd

Note:  
 Adapted from Figure 8 (TerraGraphics 2011)  
 Parcel Boundary Data Provided by Montana State GIS base map database

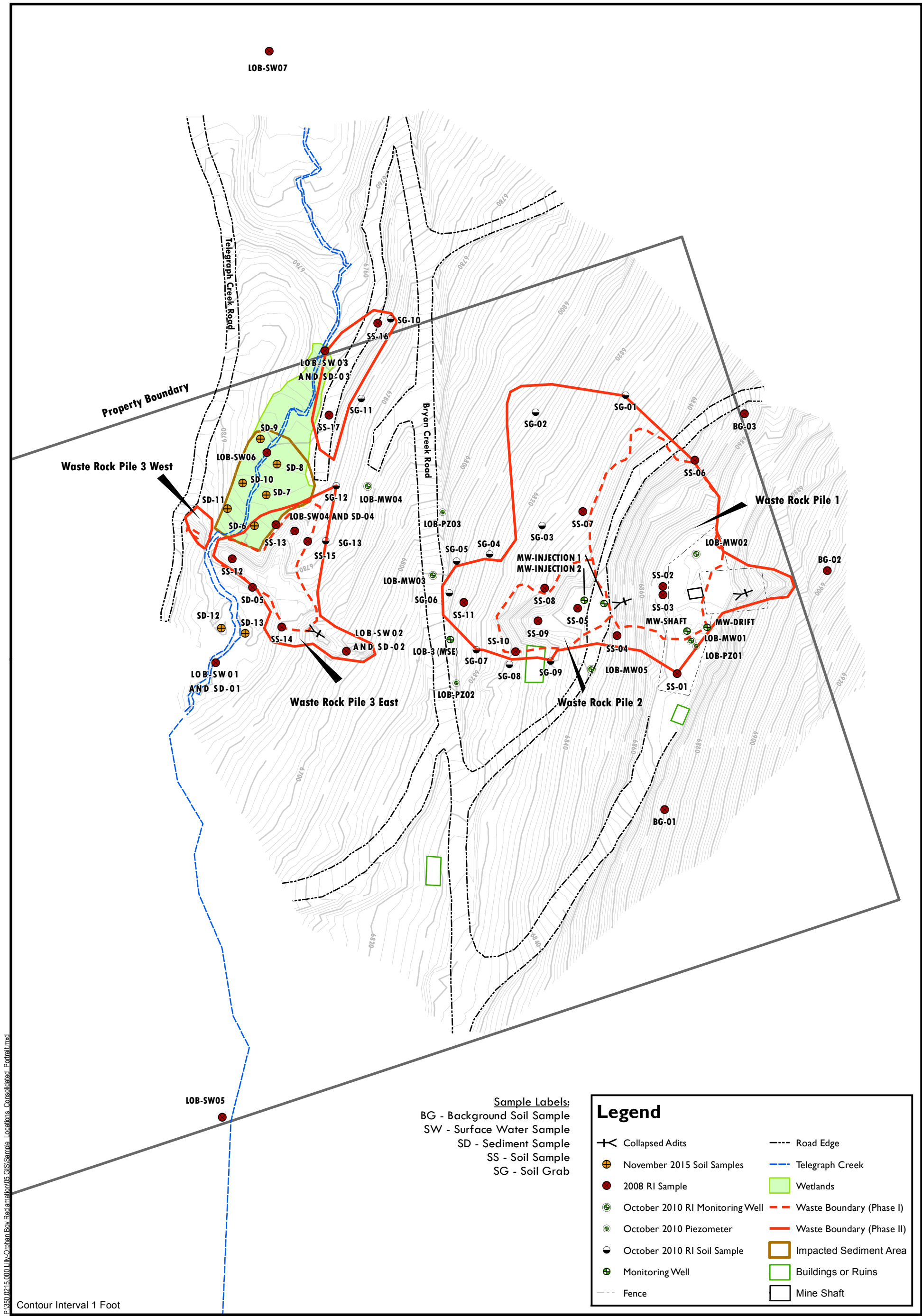
Contour Interval 1 Foot



- Collapsed Adit
- Fence
- Road Edge
- Telegraph Creek
- Wetlands
- Waste Rock Boundary
- Buildings or Ruins
- Mine Shaft



**Site Map**  
 Lilly / Orphan Boy Mine  
 Powell County, Montana  
 Figure 2



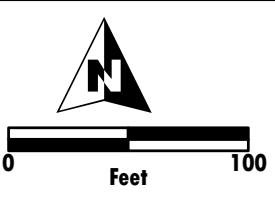
P:\350\_0215\_0001\_Lilly-Orphan Boy Reclamation\05\_GIS\Sample Locations - Consolidated - Portrait.mxd

Contour Interval 1 Foot

**Sample Labels:**  
 BG - Background Soil Sample  
 SW - Surface Water Sample  
 SD - Sediment Sample  
 SS - Soil Sample  
 SG - Soil Grab

**Legend**

	Collapsed Adits		Road Edge
	November 2015 Soil Samples		Telegraph Creek
	2008 RI Sample		Wetlands
	October 2010 RI Monitoring Well		Waste Boundary (Phase I)
	October 2010 Piezometer		Waste Boundary (Phase II)
	October 2010 RI Soil Sample		Impacted Sediment Area
	Monitoring Well		Buildings or Ruins
	Fence		Mine Shaft

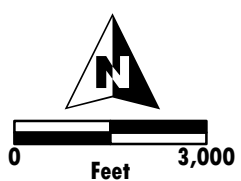
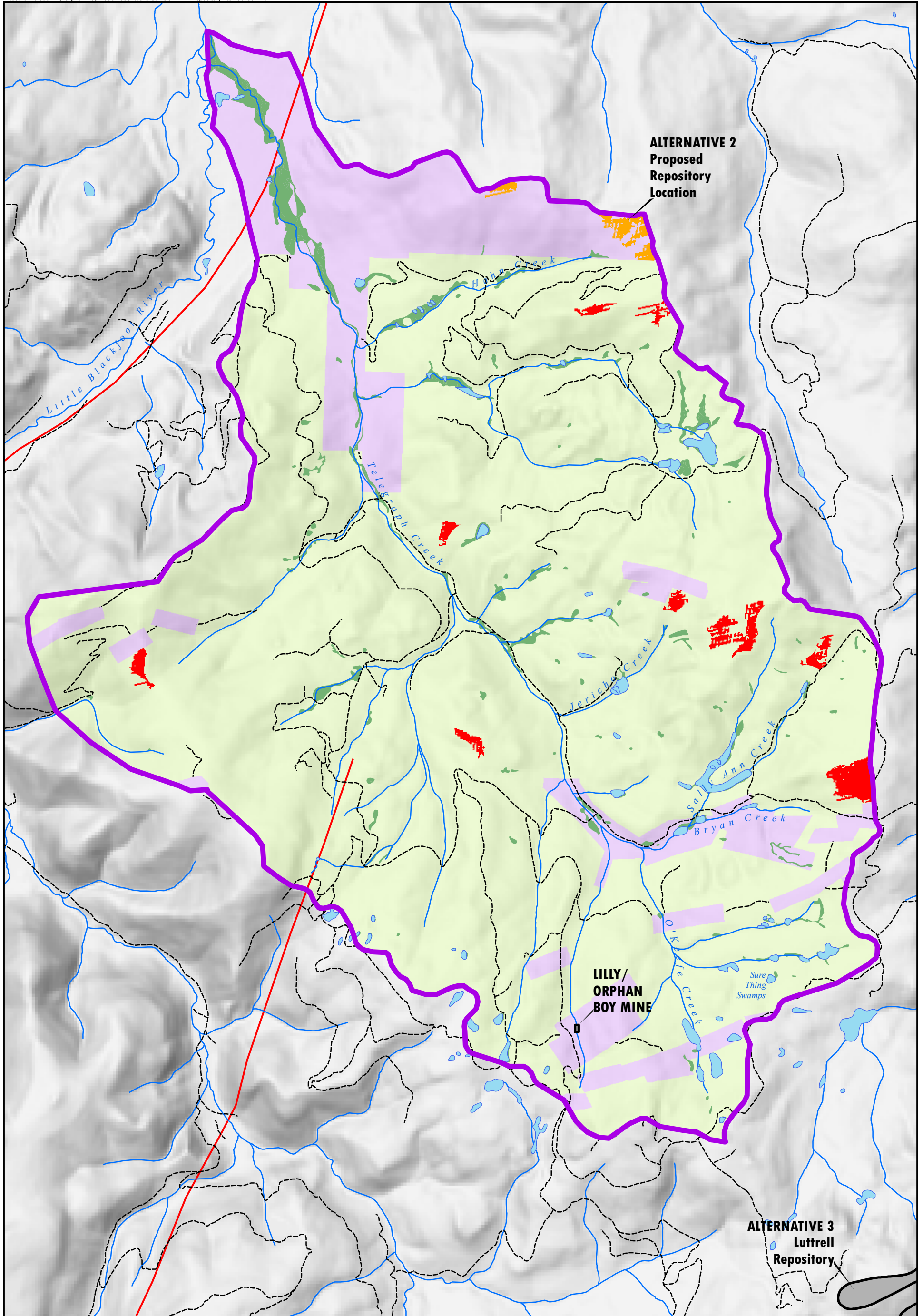


**Note:**  
 Adapted from Figure 8 (TerraGraphics 2011)  
 Parcel Boundary Data Provided by Montana State GIS base map database  
 Phase I and II reclamation results reported in Tetra Tech (2009) and TerraGraphics (2011)  
 2015 Sediment Data reported in NewFields (2015a)

**Environmental Sample Locations**  
 Lilly / Orphan Boy Mine  
 Powell County, Montana  
 Figure 3



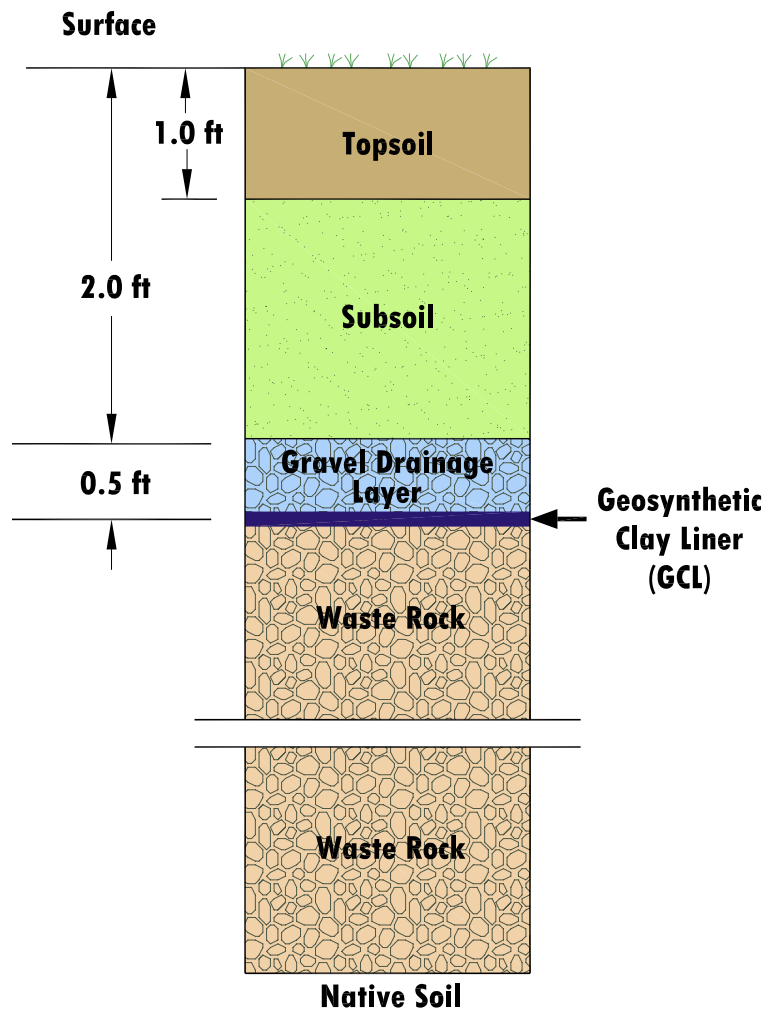




- |                                                                                                      |                                                                                                                      |                                                                                                               |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| --- National Forest System Roads                                                                     | <span style="border: 2px solid purple; padding: 2px;"> </span> Study Area Boundary                                   | <span style="background-color: orange; border: 1px solid black; padding: 2px;"> </span> Private Land          |
| — Steam/Creek                                                                                        | <span style="background-color: green; border: 1px solid black; padding: 2px;"> </span> Wetland                       | <span style="background-color: red; border: 1px solid black; padding: 2px;"> </span> USDA Forest Service Land |
| — Fault                                                                                              | <span style="background-color: lightpurple; border: 1px solid black; padding: 2px;"> </span> Private Land            |                                                                                                               |
| <span style="background-color: lightblue; border: 1px solid black; padding: 2px;"> </span> Pond/Lake | <span style="background-color: lightgreen; border: 1px solid black; padding: 2px;"> </span> USDA Forest Service Land |                                                                                                               |

**Alternatives 2 & 3**  
**Proposed Off-Site Repository**  
**Locations and Luttrell Repository**  
**Lilly/Orphan Boy Mine**  
**Powell County, Montana**  
**FIGURE 4**

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Conceptual Off-Site Repository Design - Cross-Section  
Lilly/Orphan Boy Mine Site  
Expanded Engineering Evaluation/Cost Analysis  
FIGURE 5



# TABLES





**TABLE I**  
Summary of Montana Natural Heritage Program's Species of Concern Data Report  
Lilly/Orphan Boy Mine Site

Species of Concern	Common Name	Description	Natural Heritage Ranks		Federal Agency Status		
			State	Global	U.S. Fish & Wildlife Service	U.S. Forst Service	U.S. Bureau of Land Management
<i>Oncorhynchus clarkii lewisi</i>	Westslope Cutthroat Trout	Vertebrate Animal	S2	G4T3		SENSITIVE	SENSITIVE
<i>Canis lupus</i>	Gray Wolf	Vertebrate Animal	S3	G4	LE, XN	ENDANGERED	SPECIAL STATUS
<i>Gulo gulo</i>	Wolverine	Vertebrate Animal	S3	G4		SENSITIVE	SENSITIVE
<i>Lynx canadensis</i>	Canada Lynx	Vertebrate Animal	S3	G5	LT	THREATENED	SPECIAL STATUS
<i>Juncus hallii</i>	Hall's Rush	Vascular Plant	S2	G4G5		SENSITIVE	

Notes:

**Natural Heritage Rank Definitions**

G2/S2 At risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state.

G3/S3 Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.

G4/S4 Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.

G5/S5 Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

**Federal Status Designations**

U.S. Fish and Wildlife Service

This value indicates status under the federal Endangered Species Act of 1973 based on categories defined by the U.S. Fish and Wildlife Service (16 U.S.C.A. §1531-1543 (Supp. 1996)).

LE Listed Endangered

LT Listed Threatened

XN Experimental Nonessential

U.S. FOREST SERVICE

The U.S. Forest Service Manual (2670.22) defines the status of Sensitive species on Forest Service lands. The Regional Forester (Northern Region) designates Sensitive species on National Forests in Montana. This designation applies only on USFS-administered lands.

**SENSITIVE** Any animal and plant species identified by the Regional Forester for which population viability is a concern as evidenced by significant downward trend in population or a significant downward trend in habitat capacity.

**ENDANGERED**<sup>1</sup> Any species in danger of extinction throughout all or a significant portion of its range.

**THREATENED**<sup>1</sup> Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and that the appropriate Secretary has designated as a threatened species. (Some states also have declared certain species as threatened through their regulations or statutes.)

U.S. BUREAU OF LAND MANAGEMENT

The BLM 6840 Manual defines the status of species on Bureau of Land Management lands. They apply only on BLM-administered lands.

**SENSITIVE** species that are proven imperiled in at least part of their ranges and are documented to occur on BLM lands.

**SPECIAL STATUS**<sup>2</sup> collectively, federally listed or proposed and Bureau sensitive species, which include both Federal candidate species and delisted species within 5 years of delisting.

Definitions obtained from Montana Natural Heritage Program, Species of Concern Data Report. September 30, 2008.

<sup>1</sup> - Definition from Forest Service Manual 2670.5 Amendment No. 2600-2005-1, accessed 1/11/2016

<sup>2</sup> - Definition from BLM 6840 Rel. 6-125 12/12/2008, accessed 1/11/16

**TABLE 2**  
**Summary of Soil and Mine Waste Results**  
**Lilly/Orphan Boy Mine Site**

Sample ID	Collection Date	Media	Sample Depth (inches)	Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
SS-01	10/9/2008	Soil	0 - 3	---	5 UJ	140	68	1 U	5 U	29	11900	117	579	0.5 U	5 U	5 U	123
SS-02	10/9/2008	Soil	0 - 3	---	117	6420	70	6	5 U	116	33300	7840	764	0.5 U	0.5 U	43	322
SS-03	10/9/2008	Soil	0 - 3	---	972	36600	17	15	5 U	267	66900	43800	13	0.5 U	0.5 U	302	1250
SS-04	10/9/2008	Soil	0 - 3	---	14	444	44	3	5 U	45	14200	501	838	0.5 U	0.5 U	5 U	241
SS-05	10/9/2008	Soil	0 - 3	---	21	1370	78	3	6	60	15800	1190	234	0.5 U	0.5 U	5 U	143
SS-06	10/9/2008	Soil	0 - 3	---	5UJ	188	46	2	5	29	11800	244	389	0.5 U	0.5 U	5 U	186
SS-07	10/9/2008	Soil	0 - 3	---	21	11600	36	3	5 U	48	28600	2300	164	0.5 U	0.5 U	8	218
SS-08	10/9/2008	Soil	0 - 3	---	5UJ	793	31	3	5 U	61	15200	608	202	0.5 U	0.5 U	5 U	254
SS-09	10/9/2008	Soil	0 - 3	---	95	8180	31	4	5 U	91	19300	19900	9	0.5 U	0.5 U	97	220
SS-10	10/9/2008	Soil	0 - 3	---	23	734	40	1 U	5 U	75	12400	909	247	0.5 U	0.5 U	5 U	137
SS-11	10/9/2008	Soil	0 - 3	---	19	6640	33	1	5 U	58	27000	622	624	0.5 U	0.5 U	5 U	172
SS-12	10/9/2008	Soil	0 - 3	---	30	5060	43	4	5 U	107	34900	6040	22	0.5 U	0.5 U	6	386
SS-13	10/9/2008	Soil	0 - 3	---	456	74100	7	35	5 U	94	171000	7440	<5	0.5 U	0.5 U	66	453
SS-14	10/9/2008	Soil	0 - 3	---	31	5120	81	7	5 U	103	24100	1610	277	0.5 U	5 U	7	757
SS-15	10/9/2008	Soil	0 - 3	---	15	31200	54	3	5 U	38	185000	1320	44	0.5 U	11	5 U	129
SS-16	10/27/2008	Soil	0 - 3	---	12	725	34	1 U	5 U	28	9910	534	197	0.5 U	5 U	5 U	142
SS-17	10/27/2008	Soil	0 - 3	---	5 UJ	641	24	1	5 U	78	16800	834	130	0.5 U	5 U	5 U	326
BG-01	10/9/2008	Soil	0 - 3	---	5 UJ	21	94	2	7	45	9990	35	759	0.5 U	9	5 U	120
BG-02	10/9/2008	Soil	0 - 3	---	5 UJ	159	79	2	8	47	15800	228	1240	0.5 U	6	5 U	205
BG-03	10/9/2008	Soil	0 - 3	---	5 UJ	57	74	1 U	9	26	16000	42	259	0.5 U	8	5 U	160
SG-01	10/4/2010	Soil	0 - 3	14,900	---	230	---	5	---	31	16,100	142	467	---	---	---	257
SG-02	10/4/2010	Soil	0 - 3	4,550	---	6,470	---	103	---	48	27,400	1,300	582	---	---	---	158
SG-03	10/4/2010	Soil	0 - 3	23,500	---	439	---	8	---	21	19,000	607	165	---	---	---	550
SG-04	10/4/2010	Soil	0 - 3	15,500	---	204	---	5	---	29	16,400	137	170	---	---	---	378
SG-05	10/4/2010	Soil	0 - 3	11,600	---	197	---	7	---	271	12,400	127	593	---	---	---	315
SG-06	10/4/2010	Soil	0 - 3	8,720	---	1,090	---	17	---	52	16,000	188	342	---	---	---	218
SG-07	10/4/2010	Soil	0 - 3	8,760	---	229	---	6	---	44	12,600	139	762	---	---	---	179
SG-08	10/4/2010	Soil	0 - 3	10,400	---	61	---	1	---	24	14,200	51	493	---	---	---	84
SG-09	10/4/2010	Soil	0 - 3	9,580	---	49	---	1	---	26	13,100	32	499	---	---	---	95
SG-10	10/4/2010	Soil	0 - 3	9,460	---	362	---	7	---	76	15,600	130	173	---	---	---	268
SG-11	10/4/2010	Soil	0 - 3	5,760	---	133	---	3	---	24	12,200	50	385	---	---	---	121
SG-12	10/4/2010	Soil	0 - 3	10,100	---	138	---	4	---	27	12,800	54	373	---	---	---	274
SG-13	10/4/2010	Soil	0 - 3	8,220	---	421	---	13	---	156	14,300	97	465	---	---	---	371
<b>Recreational Cleanup Guideline</b>				---	<b>586</b>	<b>323</b>	<b>103,000</b>	<b>1,750</b>	<b>1,470,000</b>	<b>54,200</b>	---	<b>2,200</b>	<b>7,330</b>	<b>440</b>	<b>29,300</b>	---	<b>440,000</b>

**Notes:**

█ - Exceeds Recreational Cleanup Guideline based on a 50-day gold panner/rock hound exposure scenario (Tetra Tech 2004).

- < - Not detected. Reporting limit shown.
- U - the compound was analyzed for, but not detected.
- UJ - Analyte was not detected, but is considered estimated for quality control reasons.
- 
- 

mg/kg - Milligrams per kilogram  
 1993 Data obtained from Pioneer (1994)  
 2008 data obtained from Tetra Tech (2009)  
 2010 data obtained from TerraGraphics (2011)

**TABLE 3**  
**Summary of Sediment Results**  
**Lilly/Orphan Boy Mine Site**

Sample Location	Sample Date	Antimony mg/kg	Arsenic mg/kg	Barium mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Iron mg/kg	Lead mg/kg	Manganese mg/kg	Zinc mg/kg
SE-1	6/28/1993	15 UJ	4,450	283	38	4.1 U	440	61,800	550	14,200	1,200
SE-2	6/28/1993	4 UJ	104	63	0.5 U	3.5	12	18,300	65	1,570	164
SD-01	10/9/2008	5 UJ	327	80	1	---	9	24,600	34	1,670	362
SD-02	10/9/2008	11	19,300	6	4	---	27	113,000	298	29	140
SD-03	10/9/2008	5 U	294	48	21	---	52	11,300	50	5,930	823
SD-04	10/9/2008	31	24,400	5 U	13	---	42	106,000	562	55	554
SD-05	10/9/2008	5 U	160	47	6	---	14	12,300	13	768	967
SD-06-18	11/16/2015	10	818	262	3	---	116	50,300	152	3,440	1,130
SD-07-24	11/16/2015	6	352	278	9	---	79	31,700	110	914	1,070
SD-08-18	11/16/2015	4	563	202	75	---	121	19,900	949	1,780	4,420
SD-09-18	11/16/2015	4	237	266	27	---	77	32,700	132	5,130	1,310
SD-10-12	11/16/2015	5	1,010	99	34	---	98	10,700	1,580	630	1,720
SD-11-24	11/16/2015	8	886	80	20	---	105	19,100	2,390	2,760	1,300
SD-12-24	11/16/2015	3	129	168	3	---	33	22,600	127	886	442
SD-13-16	11/16/2015	1 U	58	112	2	---	26	19,800	41	1,020	335
<b>Washington Freshwater Sediment PAET</b>		<b>35</b>	<b>19</b>	<b>---</b>	<b>8</b>	<b>70</b>	<b>340</b>	<b>---</b>	<b>240</b>	<b>1,400</b>	<b>500</b>
<b>Recreational Cleanup Guideline</b>		<b>586</b>	<b>323</b>	<b>103,000</b>	<b>1,750</b>	<b>2,200,000</b>	<b>54,200</b>	<b>---</b>	<b>2,200</b>	<b>7,330</b>	<b>440,000</b>
<b>Mean Upstream Concentration<sup>a</sup></b>		<b>2</b>	<b>156</b>	<b>94</b>	<b>3</b>	<b>---</b>	<b>19</b>	<b>19,520</b>	<b>56</b>	<b>1,183</b>	<b>454</b>

**Notes:**

<sup>a</sup> Mean of five upstream sediment sample results (samples SE-2, SD-01, SD-05, SD-12-24, and SD-13-16)

- Exceeds Washington State Freshwater Sediment Quality Probable Apparent Effects Thresholds (PAET) screening values (Washington State Department of Ecology, 1997).

- Exceeds Recreational Cleanup Guideline based on a 50-day gold panner/rock hound exposure scenario (Tetra Tech 2004) AND Washington State Freshwater Sediment Quality PAET.

J - estimate

U - the compound was analyzed for, but not detected.

UJ - Analyte was not detected, but is considered estimated for quality control reasons.

--- - Sample not analyzed, or Recreational Cleanup Guideline or PAET not available.

mg/kg - Milligrams per kilogram

1993 data obtained from Pioneer (1994)

2008 data obtained from Tetra Tech (2009)

2015 data obtained from NewFields (2015a)

**TABLE 4**  
**Summary of Surface Water Results**  
**Lilly/Orphan Boy Mine Site**

Sample ID	Collection Date	Aluminum, dissolved (mg/L)	Antimony <sup>3</sup> (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Silver (mg/L)	Zinc (mg/L)	pH	Hardness
SW-1	1993	---	0.0183 U	0.0205	0.0157	0.0073 J	0.00793	0.0117	1.9	0.00477	0.226	---	0.011	---	0.635	---	---
SW-2	1993	---	0.0183 U	0.0043	0.00887	0.00255 J	0.007	0.00157	0.552	0.00138	0.0415	---	0.00878 U	---	0.0234	---	---
GW-1	1993	---	0.037	0.881	0.0145	0.342 J	.005 U	0.62	19.2	0.398	5.41	U	0.0326	---	22.5	---	---
LOB-SW01	10/9/2008	---	0.005 U	0.005 U	0.1 U	0.001 U	0.01 U	0.01 U	0.37	0.01 U	0.18	0.001 U	0.01 U	0.005 U	0.03	---	---
LOB-SW01	9/29/10	0.062	---	0.003 U	---	0.00008 U	---	0.0014	0.5 J+	0.0005 U	0.14	---	---	---	0.022 J+	7	16.9
LOB-SW01	12/6/10	0.089	---	0.003 U	---	0.00008	---	0.0012	0.63	0.0005 U	0.19	---	---	---	0.08 J+	7	17.8
LOB-SW02	10/9/2008	---	0.005 U	0.874	0.1 U	0.163	0.01 U	0.04	29.6	0.07	5.64	0.001 U	0.03	0.005 U	17.7	---	---
LOB-SW03	10/9/2008	---	0.005 U	0.014	0.1 U	0.003	0.01 U	0.01 U	0.61	0.01 U	0.74	0.001 U	0.01 U	0.005 U	0.61	---	---
LOB-SW03	9/29/10	0.13	---	0.015	---	0.0018	---	0.0036	0.71 J+	0.0021	0.46	---	---	---	0.38	6.6	22.9
LOB-SW03	10/13/10	0.11 J-	---	0.024	---	0.0018	---	0.0033	1.3	0.0033	0.53	---	---	---	0.31	6.7	21.9
LOB-SW03	10/15/10	0.11	---	0.029	---	0.0033	---	0.0032	1.3	0.0028	0.68	---	---	---	0.52	6.5	33.5
LOB-SW03	10/17/10	0.16	---	0.015	---	0.003	---	0.0039	0.72	0.0026	0.55	---	---	---	0.44	6.5	23.4
LOB-SW03	10/18/10	0.17	---	0.019	---	0.0054 J+	---	0.006	1.1	0.004	0.66	---	---	---	0.6	6.3	26.1
LOB-SW03	10/19/10	0.056	---	0.026	---	0.0093	---	0.01	1.3	0.0065	1	---	---	---	1.3	6.2	35.5
LOB-SW03	10/20/10	0.067	---	0.027	---	0.0074	---	0.0075	1.1	0.005	0.82	---	---	---	0.9	6.4	31.3
LOB-SW03	10/21/10	0.054	---	0.032	---	0.011	---	0.012	1.3	0.0069	1.1	---	---	---	1.4	6.3	35.8
LOB-SW03	10/22/10	0.13	---	0.019	---	0.0063	---	0.0074	0.83	0.0038	0.67	---	---	---	0.72	6.3	28.9
LOB-SW03	12/6/10	0.054	---	0.026	---	0.00049	---	0.0015	1.7	0.0037	0.54	---	---	---	0.092 J+	7	18.1
LOB-SW04	10/9/2008	---	0.005 U	0.854	0.1 U	0.067	0.01 U	0.1	8.28	0.05	5.25	0.001 U	0.02	0.005 U	9.31	---	---
LOB-SW05	9/29/10	0.063	---	0.0035	---	0.00008 U	---	0.0012	0.19 J+	0.0005 U	0.085	---	---	---	0.016 J+	7.1	16.4
LOB-SW05	10/7/10	0.046 J-	---	0.0035	---	0.00008 U	---	0.001 U	0.2	0.0005 U	0.092	---	---	---	0.015 J+	6.9	17.6
LOB-SW05	12/6/10	0.046	---	0.0094	---	0.00028 U	---	0.0019	0.91	0.0011 U	0.15	---	---	---	0.083 J+	7.2	17.8
LOB-SW06	9/29/10	0.063	---	0.012	---	0.00041	---	0.0015	0.65 J+	0.00069	0.29	---	---	---	0.12	7	20.5
LOB-SW06	12/6/10	0.072	---	0.027	---	0.00046	---	0.0018	1.8	0.0056	0.59	---	---	---	0.084 J+	7.2	31.9
LOB-SW07	10/1/10	0.086	---	0.014	---	0.0025	---	0.0038	0.54 J+	0.0013	0.46	---	---	---	0.48	6.2	24.1
LOB-SW07	10/7/10	0.094	---	0.014	---	0.0031	---	0.0038	0.47	0.0013	0.52	---	---	---	0.56	6.6	28.6
LOB-SW07	10/13/10	0.11	---	0.015	---	0.0029	---	0.0042	0.68	0.0014	0.5	---	---	---	0.47	6.6	24.9
LOB-SW07	10/15/10	0.11	---	0.017	---	0.0042	---	0.0046	0.68	0.0015	0.58	---	---	---	0.63	6.6	34.7
LOB-SW07	10/17/10	0.14	---	0.012	---	0.0041	---	0.0051	0.47	0.0013	0.56	---	---	---	0.63	6.6	30.5
LOB-SW07	10/18/10	0.11	---	0.014	---	0.0057 J+	---	0.0061	0.69	0.0019	0.65	---	---	---	0.77	6.2	31.6
LOB-SW07	10/19/10	0.03 U	---	0.021	---	0.0082	---	0.0083	0.84	0.0029	0.85	---	---	---	1.2	6.4	37.6
LOB-SW07	10/21/10	0.03 U	---	0.018	---	0.0075	---	0.0073	0.75	0.0024	0.79	---	---	---	1.1	6.4	38.6
LOB-SW07	10/21/10	0.1	---	0.017	---	0.0062	---	0.0069	0.73	0.0027	0.63	---	---	---	0.88	6.5	33
LOB-SW07	10/22/10	0.11	---	0.013	---	0.0059	---	0.0063	0.51	0.0017	0.63	---	---	---	0.86	6.3	34.1
<b>Surface Water Standards and Guidelines</b>	<b>Acute*</b>	<b>0.75</b>	---	<b>0.34</b>	---	<b>0.00052<sup>a</sup></b>	<b>0.579<sup>a,b</sup></b>	<b>0.00379<sup>a</sup></b>	--	<b>0.014<sup>a</sup></b>	--	<b>0.0017</b>	<b>0.145<sup>a</sup></b>	<b>0.00037<sup>a</sup></b>	<b>0.037<sup>a</sup></b>	<b>6.5-8.5</b>	---
	<b>Chronic*</b>	0.087	---	0.15	---	0.000097 <sup>a</sup>	0.0277 <sup>a,b</sup>	0.00285 <sup>a</sup>	1.0	0.00055 <sup>a</sup>	--	0.00091	0.0161 <sup>a</sup>	---	0.037 <sup>a</sup>	6.5-8.5	---
	<b>Human Health*</b>	---	0.0056	0.01	1.0	0.005	0.1	1.3	0.3 (aesthetic)	0.015	0.05 (aesthetic)	0.00005	0.1	0.1	2.0	6.5-8.5	---
	<b>Recreational Cleanup Guideline**</b>	---	0.117	0.0876	204	0.146	438 <sup>b</sup>	10.8	---	0.127	40	0.0876	5.89	---	87.9	---	---

**Notes:**

- Exceeds DEQ-7 acute aquatic life numeric water quality standards (DEQ 2012).

\* DEQ-7 chronic aquatic life and human health standards are provided for reference (Circular DEQ-7, 2012).

\*\* Recreational Cleanup Guideline based on a 50-day gold panner/rock hound exposure scenario (Tetra Tech 2004).

<sup>a</sup> - Hardness dependent standard. Listed value based on hardness value of 25 mg/L.

<sup>b</sup> - Standard for Chromium (III).

U the constituent was analyzed for, but not detected.

J - estimate

J+ - high estimate

--- - Sample not analyzed, or Surface Water Standards/Guideline not available.

mg/L - Milligrams per Liter

1993 Data obtained from Pioneer (1994)

2008 data obtained from Tetra Tech (2009)

2010 data obtained from TerraGraphics (2011)

**TABLE 5**  
**Summary of Groundwater Results**  
**Lilly/Orphan Boy Mine Site**

Sample Location (Alias)	Sample Date	Aluminum mg/L	Arsenic mg/L	Cadmium mg/L	Copper mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Nickel mg/L	Zinc mg/L
LOB-GW-01 (MW-Shaft)	10/9/08	---	0.131	0.001	< 0.01	1.68	< 0.01	2.05	< 0.01	0.78
LOB-GW-02 (MW-Injection 2)	10/9/08	---	0.236	< 0.001	< 0.01	52.5	< 0.01	1.64	< 0.01	0.02
LOB-GW-03 (LOB-3 (MSE))	10/9/08	---	0.138	0.065	0.14	13.6	0.08	3.3	0.01	9.45
LOB-MW01	9/29/10	0.64	0.019	0.00064	0.012	2.3 J+	0.02	1.4	---	0.47
LOB-MW02	9/27/10	0.79	0.083	0.0074	0.0059	27 J+	0.056	12.5	---	11.7
LOB-MW03	9/29/10	0.61	0.069	0.11	0.011	0.76 J+	0.014	0.49	---	15.3
LOB-MW04	9/29/10	0.29	0.0032	0.016	0.0078	0.22 J+	0.0014	0.37	---	13.3
LOB-MW05	9/29/10	2.5	0.0064	0.00015	0.0057	2.4 J+	0.01	0.63	---	0.054
<b>DEQ-7 Human Health Standard for Groundwater</b>		---	<b>0.01</b>	<b>0.005</b>	<b>1</b>	<b>0.3<sup>a</sup></b>	<b>0.015</b>	<b>0.050<sup>a</sup></b>	<b>0.1</b>	<b>2</b>

**Notes:**

- Exceeds Circular DEQ-7 Human Health Standard for Groundwater (DEQ 2012).
- <sup>a</sup> - Secondary Maximum Contaminant Levels have been established by EPA for iron and manganese (0.3 and 0.05 mg/L, respectively) in public drinking water supplies, but are not listed in DEQ-7
- J+ - high estimate
- - Sample not analyzed, or DEQ-7 Human Health Standards not available.
- mg/L - Milligrams per Liter

2008 data obtained from Tetra Tech (2009)

2010 data obtained from TerraGraphics (2011)

**TABLE 6**  
**Human Health Reference Concentrations**  
**Lilly/Orphan Boy Mine Site**

Constituent	Mine Waste / Soil (mg/kg)	Surface Water (mg/L)
Antimony	586	0.117
Arsenic	323	0.01
Barium	103,000	1.0
Cadmium	1,750	0.005
Chromium	1,470,000	0.1
Copper	54,200	1.3
Lead	2,200	0.015
Manganese	7,330	---
Mercury	440	0.00005
Nickel	29,300	0.1
Silver		0.1
Zinc	440,000	2.0

**Notes:**

mg/kg - milligrams per kilogram

mg/L - milligrams per liter

**Reference:**

<sup>1</sup>Tetra Tech, Inc. 2004. User's Guide: Risk-Based Cleanup Guidelines for Abandoned Mine Sites. Prepared for the Montana Department of Environmental Quality, Mine Waste Cleanup Bureau/Abandoned Mines Section. July.



**TABLE 7**  
**Reference Concentrations for Aquatic Life**  
**Lilly/Orphan Boy Mine Site**

Constituent	Surface Water <sup>1</sup> (mg/L)		Sediment <sup>2</sup> (mg/kg)
	Acute	Chronic	
Aluminum	0.75	0.087	---
Antimony	---	---	35
Arsenic	0.34	0.15	19
Barium	---	---	---
Cadmium	0.00052 <sup>a</sup>	0.000097 <sup>a</sup>	7.6
Chromium	0.579 <sup>a,b</sup>	0.0277 <sup>a,b</sup>	70
Copper	0.00379 <sup>a</sup>	0.00285 <sup>a</sup>	340
Iron	--	1.0	---
Lead	0.014 <sup>a</sup>	0.00055 <sup>a</sup>	240
Manganese	--	--	1400
Mercury	0.0017	0.00091	0.22
Nickel	0.145 <sup>a</sup>	0.0161 <sup>a</sup>	39
Silver	0.00037 <sup>a</sup>	---	3.9
Zinc	0.037 <sup>a</sup>	0.037 <sup>a</sup>	500

**Notes:**

mg/L - milligrams per liter

mg/kg - milligrams per kilogram

**References**

<sup>1</sup> Montana Department of Environmental Quality, 2012. Circular DEQ-7 Montana Numeric Water Quality Standards. October.

<sup>2</sup> Washington State Department of Ecology (WDOE), 1997. Creation and Analysis of Freshwater Sediment Quality Values in Washington State. July.

**TABLE 8**  
**ARAR-BASED RECLAMATION GOALS FOR SURFACE WATER AND GROUNDWATER**  
**Lilly/Orphan Boy Mine Site**

Media	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
Surface Water	0.01 <sup>a</sup>	0.000097 <sup>b, c</sup>	0.00285 <sup>b, c</sup>	0.00055 <sup>b, c</sup>	0.037 <sup>b, c</sup>
Groundwater <sup>d</sup>	0.01	0.005	1	0.015	2

**Notes:**

- <sup>a</sup> DEQ-7 Human Health Standard for Surface Water (Circular DEQ-7, 2012).
- <sup>b</sup> DEQ-7 Chronic Aquatic Life Standard for Surface Water (Circular DEQ-7, 2012).
- <sup>c</sup> Hardness dependent standard. Listed value based on a hardness value of 25 mg/L.
- <sup>d</sup> Project does not address groundwater at the site. DEQ-7 Human Health Standard for Groundwater (Circular DEQ-7, 2012) provide for reference only.

**TABLE 9**  
**RISK-BASED RECLAMATION GOALS FOR SOIL AND SEDIMENT**  
**Lilly/Orphan Boy Mine Site**

Media	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
Soil <sup>a</sup>	323	1,750	54,200	2,200	440,000
Sediment <sup>b</sup>	19	7.6	340	240	500

**Notes:**

- <sup>a</sup> Recreational Cleanup Guideline based on a 50-day gold panner/rock hound exposure scenario (Tetra Tech 2004).
- <sup>b</sup> Probable Apparent Effects Thresholds (PAET; Washington State Department of Ecology, 1997).

**TABLE 10  
RECLAMATION TECHNOLOGY SCREENING SUMMARY  
LILLY/ORPHAN BOY MINE SITE**

General Reclamation Action	Reclamation Technology	Process Option	Description	Initial Screening Result
No Action	None	Not Applicable	No action taken to address site conditions.	Retained as a baseline for comparison to other reclamation actions.
Institutional Controls	Access Restrictions	Physical barriers / signs	Install fences around mine waste / impacted soil and warning signs to restrict access.	Not effective as a stand-alone response. Retained for consideration as a potential component of overall response action.
		Deed restrictions	Legal restriction to control current and future land use.	Not effective as a stand-alone response. Retained for consideration as a potential component of overall response action.
Engineering Controls	Containment	Simple Soil Cover	Mine waste covered by monolithic layer of growth media or a layer of coarse-grained material (as a capillary break) and then overlain with growth media; growth media revegetated to promote evapotranspiration and reduce both infiltration and erosion.	Prevents direct contact with waste materials. Would require mine waste in direct contact with Telegraph Creek to be excavated and placed on site. Cover materials would need to be imported to the site and extensive grading of mine waste would be required prior to cover placement. Would require maintenance and weed control until vegetation is established. Vegetated cover would not reduce infiltration during spring runoff when plants are dormant. Not retained because site slopes, aspects, and proximity to surface water make the LOB mine site unsuitable for on-site containment.
		Composite Cover	Mine waste covered by compacted clay layer or geomembrane liner overlain by a layer of growth media. Revegetate growth media to promote evapotranspiration and reduce both infiltration and erosion.	Prevents direct contact with waste materials and effectively controls infiltration. Would require mine waste in direct contact with Telegraph Creek to be excavated and placed on site. Growth media and other soil cover materials would need to be imported to the site and regrading of mine waste would be required prior to cover placement. Not retained because site slopes, aspects, and proximity to surface water make the LOB mine site unsuitable for on-site containment.
	Surface Controls	Grading	Reshape and reduce slopes of mine waste to control storm water run-on/runoff, prevent erosion, and reduce infiltration.	Readily implementable. Periodic maintenance may be necessary to repair erosion that occurs following remedial action. Retained for further evaluation through inclusion with other response action alternatives.
		Revegetation	Seeding of mine waste to reduce infiltration and control erosion.	Addition of soil amendments would be necessary to establish vegetation due to the absence of organic materials. Mulching, chemical stabilization, weed control and fertilization will likely be necessary. Periodic maintenance may be necessary until a self-sustaining plant community is established. Readily implementable. Effectively controls erosion of mine waste. Retained for further evaluation since revegetation would be required with other response actions.
		Erosion Controls	Construction of run-on/runoff diversion channels to direct storm water runoff away from mine waste. Placement of erosion resistant materials (e.g., mulch or fiber mats) to reduce erosion of mine waste.	Readily implementable. Effective at reducing infiltration and controlling erosion of mine waste. Retained for further evaluation since other response action alternatives would require erosion control.
	Excavation and Disposal	On-site Disposal	Repository with Composite or Simple Soil Cover	Excavate mine waste and impacted soil / sediment. Place in an on-site repository with either a composite or simple soil cover. Regrade and revegetate excavation areas to control erosion. Reconstruct portions of Telegraph Creek affected by excavation.
	Off-site Disposal	Off-site Repository	Excavate mine waste and impacted soil / sediment. Load, haul, and place material in an off-site repository constructed with either a composite or simple soil cover. Regrade and revegetate excavation areas to control erosion. Reconstruct portions of Telegraph Creek affected by excavation.	Implementable. Potential off-site repository locations identified in Telegraph Creek watershed during a preliminary siting evaluation. Prevents direct contact with mine waste and removes a source of impacts to Telegraph Creek. Retained for further evaluation.

**TABLE 10  
RECLAMATION TECHNOLOGY SCREENING SUMMARY  
LILLY/ORPHAN BOY MINE SITE**

General Reclamation Action	Reclamation Technology	Process Option	Description	Initial Screening Result
Excavation and Disposal, cont.	Off-site Disposal, cont.	Luttrell Repository	Excavate mine waste and impacted soil / sediment. Load and haul material for placement in the Luttrell Repository. Regrade and revegetate excavation areas to control erosion. Reconstruct portions of Telegraph Creek affected by excavation.	Implementable. DEQ/MWCB currently (January 2016) negotiating new operational agreement with USEPA and USDA-FS that would allow the repository to accept waste from the LOB mine site. Prevents direct contact with mine waste and removes a source of impacts to Telegraph Creek. Retained for further evaluation.
		RCRA Class C Landfill	Excavate mine waste and impacted soil /sediment for disposal in a hazardous waste landfill. Regrade and revegetate excavation areas to control erosion. Reconstruct portions of Telegraph Creek affected by excavation.	Readily implementable. Prevents direct contact with mine waste and removes one source of contaminants. Disposal fees and transportation costs would be cost prohibitive compared to other disposal options (e.g., off-site repository, Luttrell Repository, etc.). Not retained for further evaluation.
In-Situ Treatment	Fixation/Stabilization	Portland Cement / Pozzolans	Mine waste would be mixed in-situ with Portland cement or other pozzolan(s) to solidify the waste and prevent or reduce leaching of contaminants to surface water. Revegetate treated mine waste to control erosion.	Extensive treatability and leaching tests required. Potentially implementable but cost prohibitive. Not retained for further evaluation.
		Phosphate	In-situ mixing of mine waste with phosphate to reduce leachable concentrations of metals. Revegetate treated mine waste to control erosion.	Demonstrated technology at similar mine sites, although limited data is available regarding long-term effectiveness. Extensive treatability and leaching tests required. Reapplication and maintenance may be required. Not retained for further evaluation.
Ex-Situ Treatment	Reprocessing	Milling and Smelting	Excavate and transport mine waste to operating mill and/or smelter for minerals extraction. Regrade/revegetate excavation areas. Reconstruct sections of Telegraph Creek affected by excavation.	Not readily implementable because elevated (non-ore) metals concentration in mine waste make it unacceptable to the nearest mill (GSM), potentially low concentrations of recoverable metals, and high costs relative to other response actions. Not retained for further evaluation.
	Re-Use	Paving	Excavate and use mine waste as aggregate in asphalt or concrete pavement. Regrade and revegetate excavation areas to control erosion. Reconstruct portions of Telegraph Creek affected by excavation.	Not retained for further consideration due to potential liability concerns associated with using contaminated materials at off-site locations.
	Physical / Chemical Treatment	Soil Washing	Separate hazardous constituents from excavated mine waste through dissolution, physical separation, and precipitation. Regrade/revegetate excavation areas. Reconstruct sections of Telegraph Creek affected by excavation.	Testing required to verify effectiveness. Wastes generated would require additional treatment and/or disposal. Not retained for further evaluation due to high associated cost relative to other response actions.
		Acid Extraction	Application of acidic solution to excavated mine waste in mixing tank to extract metals from media. Regrade/revegetate excavation areas. Reconstruct sections of Telegraph Creek affected by excavation.	Testing required to verify effectiveness. Wastes generated would require additional treatment and/or disposal. Not retained for further evaluation due to high associated cost relative to other response actions.

**Notes:**

Shading indicates reclamation technology or process option retained for inclusion in reclamation alternatives.

LOB = Lilly/Orphan Boy Mine Site.

DEQ MWCB = Montana Department of Environmental Quality, Mine Waste Cleanup Bureau.

USEPA = U.S. Environmental Protection Agency.

USDA-FS = U.S. Department of Agriculture, Forest Service.

GSM = Golden Sunlight Mine, Whitehall, Montana vicinity.

**TABLE 11**  
**COMPARATIVE ANALYSIS OF RECLAMATION ALTERNATIVES**  
**LILLY/ORPHAN BOY MINE SITE**

Assessment Criteria	Alternative 1: No Action	Alternative 2: Excavation and Disposal in Off-site Repository	Alternative 3: Excavation and Disposal in Luttrell Repository
<b>Threshold Criteria</b>			
Overall Protection of Human Health and the Environment	Provides no protection of human health and the environment.	Significantly reduces risk to human health and the environment. Achieves cleanup goals and project reclamation goals.	Significantly reduces risk to human health and the environment. Achieves cleanup goals and project reclamation goals.
Compliance with ARARs			
<ul style="list-style-type: none"> <li>• Contaminant Specific</li> </ul>	<ul style="list-style-type: none"> <li>• Does not comply with ARARs.</li> </ul>	<ul style="list-style-type: none"> <li>• Action may not achieve surface water and groundwater quality ARARs because the discharge from the Lilly adit and groundwater are not included in the project scope.</li> </ul>	<ul style="list-style-type: none"> <li>• Action may not achieve surface water and groundwater quality ARARs because the discharge from the Lilly adit and groundwater are not included in the project scope.</li> </ul>
<ul style="list-style-type: none"> <li>• Location Specific</li> </ul>	<ul style="list-style-type: none"> <li>• Does not comply with ARARs.</li> </ul>	<ul style="list-style-type: none"> <li>• Complies with ARARs.</li> </ul>	<ul style="list-style-type: none"> <li>• Complies with ARARs</li> </ul>
<ul style="list-style-type: none"> <li>• Action Specific</li> </ul>	<ul style="list-style-type: none"> <li>• Does not comply with ARARs.</li> </ul>	<ul style="list-style-type: none"> <li>• Complies with ARARs.</li> </ul>	<ul style="list-style-type: none"> <li>• Complies with ARARs.</li> </ul>
<b>Primary Balancing Criteria</b>			
Long-term effectiveness and permanence	Not effective. No action would be taken to reduce risks to human health and the environment. No administrative or engineering controls would be implemented at the site.	Provides long-term effectiveness and permanence because mine waste would be permanently removed from the LOB mine site. The repository cover would isolate the waste from human and ecological receptors. No long-term monitoring or maintenance would be required once vegetation is fully established on the repository site. Ranks equally with Alternative 3.	Provides long-term effectiveness and permanence because mine waste be permanently removed from the LOB mine site. The temporary cover placed at the end of each operating season at the repository would limit infiltration until the final cover system is placed. A long-term monitoring and maintenance program is in place for the Luttrell Repository. Ranks equally with Alternative 2.
Reduction in toxicity, mobility, and volume through treatment	Provides no reduction in toxicity, mobility, and volume of mine waste and impacted soil / sediment.	Reduces contaminant mobility through placement of mine waste and impacted sediment / soil in an off-site repository. Provides no reduction in the toxicity or volume of contaminants. Ranks equally with Alternative 3.	Reduces contaminant mobility through placement of mine waste and impacted sediment / soil in the Luttrell Repository. Provides no reduction in the toxicity or volume of contaminants. Ranks equally with Alternative 2.
Short-term effectiveness	No short-term risks would be created because no actions would be implemented.	Limited short-term environmental risks. Potential risks associated with release/spills of materials during hauling would be mitigated through reduced speed and by covering trucks. Construction risks would be mitigated through administrative and engineering controls. Ranks equally with Alternative 2.	Limited short-term environmental risks. Potential risks associated with release/spills of materials during hauling would be mitigated through reduced speed and by covering trucks. Construction risks would be mitigated through administrative and engineering controls. Ranks equally with Alternative 2.
Implementability	No actions would be implemented.	Implementation is technically and administratively feasible. Limited availability of suitable repository sites and uncertainty regarding the ability to purchase or obtain long-term agreement for repository affect implementability of this alternative.	Assuming the interagency agreement is finalized for taking LOB mine waste to the Luttrell Repository, Alternative 3 ranks highest for implementability. Labor, equipment, and materials are locally available.
Cost	\$0	\$897,300	\$429,000

**Notes:**

ARARs = Applicable or Relevant and Appropriate Requirements

LOB = Lilly/Orphan Boy Mine Site

**TABLE 12**  
**Reclamation Alternative Cost Comparison**  
**Lilly/Orphan Boy Mine Site**

Item	Alternative 1: No action	Alternation 2: Off-Site Repository	Alternative 3: Luttrell Repository
Purchase repository site	\$ -	\$ 100,000	\$ -
Stream Diversion	\$ -	\$ 7,000	\$ 7,000
Mine Waste Removal	\$ -	\$ 216,700	\$ 216,700
Repository Construction	\$ -	\$ 190,200	\$ -
Lilly Adit Improvements	\$ -	\$ 20,000	\$ 20,000
<b>Subtotal</b>	<b>\$ -</b>	<b>\$ 533,900</b>	<b>\$ 243,700</b>
Mobilization & Site Prep	\$ -	\$ 83,100	\$ 48,800
Wetland Delineation/ Pre-Construction Notice	\$ -	\$ 4,500	\$ 4,500
Project Management/ Administrative Costs (6%)	\$ -	\$ 26,000	\$ 14,600
Engineering and Design (15%)	\$ -	\$ 65,100	\$ 36,600
Construction Management (10%)	\$ -	\$ 43,400	\$ 24,400
Contingency (25%)	\$ -	\$ 133,500	\$ 60,900
O&M <sup>1</sup> Net Present Value	\$ -	\$ 12,300	\$ -
<b>TOTAL</b>	<b>\$ -</b>	<b>\$ 901,800</b>	<b>\$ 433,500</b>

**Notes:**

<sup>1</sup> Operation and maintenance

Refer to Appendix C for a detailed breakdown of reclamation action alternative costs





# APPENDIX A

## Preliminary Repository Siting Evaluation





## MEMORANDUM

**DATE:** January 6, 2016 **PROJECT NO.** 350.0215

**TO:** Rob Roberts, Trout Unlimited

**FROM:** Shane Fox  
K. Bill Clark

**SUBJECT:** Preliminary Repository Siting Evaluation  
Lilly/Orphan Boy Mine, Telegraph Creek Watershed, Elliston, Montana Vicinity

NewFields Companies, LLC (NewFields) completed a preliminary repository siting evaluation for the Lilly/Orphan Boy mine site using ArcGIS. Work was completed to fulfill Task 2 of the Contract for Services between Trout Unlimited and NewFields, dated September 14, 2015. The study area generally consists of the Telegraph Creek watershed with a slight extension on the west side. Trout Unlimited requested that the area around the Tramway Creek Mining Complex in Section 6, Township 8 North, Range 6 West be evaluated for a potential repository during the GIS analysis.

### SITING CRITERIA

Specific repository siting criteria for the GIS analysis were established for key resources, as presented in the following chart.

RESOURCE	SITING CRITERIA
Surficial Geologic Materials	Repository cannot be located in mapped alluvial material
Mapped Faults	Greater than 500 feet from any mapped fault
Streams, Lakes and Ponds	Greater than 500 feet from flowing or ponded water
Wetlands	Greater than 500 feet from mapped wetlands
Depth to Groundwater	Greater than 20 feet
Existing Roads	Sites accessible by existing roads are preferred
Slope	Less than 20 percent
Aspect	Compass direction from 157 to 248 degrees, clockwise from north
Site size	Minimum of 5 acres
Land Ownership	USDA-Forest Service administered land preferred over private land

### DATA SOURCES

A variety of publically available data sources were accessed to obtain resource data layers. The following identifies data sources along with descriptions posted on their various websites.



### Geology/Faults

Surficial geology and information on faults was obtained from the following Montana Bureau of Mines and Geology publication accessed at <http://www.mbmgs.mtech.edu>:

Lewis, R.S., 1998, Geologic map of the Butte 1° x 2° quadrangle, southwestern Montana: Montana Bureau of Mines and Geology Open-File Report 363, 16 p., 1 sheet, scale 1:250,000.

### Rivers/Streams/Lakes

Surface water data was obtained from the Montana Hydrography Framework; data were accessed at [http://mslapps.mt.gov/Geographic\\_Information/Applications/DigitalAtlas/Default](http://mslapps.mt.gov/Geographic_Information/Applications/DigitalAtlas/Default). The data are described as follows:

“The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD data was originally developed at 1:100,000-scale and exists at that scale for the whole country. This high-resolution NHD, generally developed at 1:24,000/1:12,000 scale, adds detail to the original 1:100,000-scale NHD.”

### Wetlands

Wetland information was obtained from the Montana Wetland and Riparian Framework ([http://mslapps.mt.gov/Geographic\\_Information/Applications/DigitalAtlas/Default](http://mslapps.mt.gov/Geographic_Information/Applications/DigitalAtlas/Default)). The following is a description of the framework:

“The Montana Wetland and Riparian Framework represents the extent, type, and approximate location of wetlands, riparian areas, and deepwater habitats in Montana. The Montana Wetland and Riparian Framework consists of features that were manually digitized at a scale of 1:4,500 or 1:5,000 from orthorectified digital color-infrared aerial imagery collected during the summers of 2005, 2006, 2009, 2011, and 2013 by the National Agricultural Imagery Program (NAIP). These data are intended for use in publications at a scale of 1:12,000 or smaller. This layer consists of one feature dataset: NHP\_Layers. The NHP\_Layers feature dataset contains the digital wetland and riparian mapping and consists of the feature class WetRip. This feature class consists of data that have undergone three rounds of internal quality assurance/quality control procedures by the Montana Natural Heritage Program.”

### Depth to Groundwater

Information on depth to groundwater in the study area was found at the Montana Bureau of Mines and Geology (MBMG) and was accessed from the Montana Natural Resources Information System (NRIS) at [http://mslapps.mt.gov/Geographic\\_Information/Data/DataList/datalist\\_Details?did=%7BB40FCBD4-DA34-483A-A8C9-F9C1E95F7A21%7D](http://mslapps.mt.gov/Geographic_Information/Data/DataList/datalist_Details?did=%7BB40FCBD4-DA34-483A-A8C9-F9C1E95F7A21%7D) According to MBMG:



“The Ground Water Information Center (GWIC) at the Montana Bureau of Mines and Geology is the central repository for information on the ground-water resources of Montana. The data include well-completion reports from drillers, measurements of well performance and water quality based on site visits, water-level measurements at various wells for periods of up to 60 years, and water-quality reports for thousands of samples. The databases at GWIC are continually updated with new data from driller's logs, MBMG research projects, and research projects from other agencies.”

### Existing Roads

Information to locate existing roads was obtained from the US Department of Agriculture Forest Service, at <http://data.fs.usda.gov/geodata/>. Due to the limited road network in the study area, road information was not specifically included in the analysis; however, existing roads are identified on the map resulting from the GIS analysis (see below).

### Slope and Aspect

Digital elevation data from the US Geological Survey (USGS) used to evaluate slope and aspect, and were obtained at <http://viewer.nationalmap.gov/basic/>. The following description of the data source is provided:

“USGS National Elevation Dataset (NED) is 1/3 arc-second resolution. The National Elevation Dataset (NED) serves the elevation layer of The National Map, and provides basic elevation information for earth science studies and mapping applications in the United States. Scientists and resource managers use NED data for global change research, hydrologic modeling, resource monitoring, mapping and visualization, and many other applications. The NED is an elevation dataset that consists of seamless layers and a high resolution layer. Each of these layers are composed of the best available raster elevation data of the conterminous United States, Alaska, Hawaii, territorial islands, Mexico and Canada. The NED is updated continually as new data become available. All NED data are in the public domain. The NED are derived from diverse source data that are processed to a common coordinate system and unit of vertical measure. These data are distributed in geographic coordinates in units of decimal degrees, and in conformance with the North American Datum of 1983 (NAD 83). All elevation values are in meters and, over the continental United States, are referenced to the North American Vertical Datum of 1988 (NAVD 88). The vertical reference will vary in other areas.”

### Land Ownership

Land ownership information was obtained from the Montana Cadastral Framework ([http://mslapps.mt.gov/Geographic\\_Information/Applications/DigitalAtlas/Default](http://mslapps.mt.gov/Geographic_Information/Applications/DigitalAtlas/Default)). The database is described as follows:



“The Montana Cadastral Database is comprised of taxable parcels (fee land) and public land (exempt property). It is not broken down into individual lots, for instance lots 4 & 5, Forest Grove Subdivision may comprise one taxable parcel and the Lot line between lots 4 & 5 is not contained in this database. The database encompasses all the area within Montana. At this time, the Data is in an ArcSde/Oracle geodatabase. Each county is available for download as a single ArcGIS personal geodatabase or shapefile. The data is maintained by the Montana Department of Revenue (DOR) or in cases of Silver Bow, Cascade, Missoula, Lake, Flathead and Yellowstone counties that are maintained by the individual counties. The data is integrated by Montana State Library Geographic Information Services staff. Each parcel contains an attribute called ParcelID (geocode) that is the parcel identifier. It relates to the geocode in the DOR's Orion database (Computer Assisted Mass Appraisal data - CAMA). Most of the ancillary attribute information is held in this database. Information such as owner name, legal description, and appraised value as well as structural and agricultural data are available within CAMA. SQL Server Express 2000 R2 database files of individual county CAMA data are available for download at the project website listed above. In addition, a SQL Server Express database of selected attributes is available for the entire state. Parcel data is built upon the USDI Bureau of Land Management's (BLM) Geographic Coordinate Database (GCDB). The GCDB is a complex measurement management system that uses a least squares adjustment of existing survey data to come up with a digital representation of the Public Land Survey System (PLSS). For more information on GCDB you should proceed to the [Montana/North Dakota BLM website at http://www.blm.gov/mt/st/en/res/public\\_room/cadastral\\_survey/gcdb.html](http://www.blm.gov/mt/st/en/res/public_room/cadastral_survey/gcdb.html). Accuracy varies between townships and it is important to note that the accuracy of the parcel data can't be any more accurate than the GCDB.”

## RESULTS

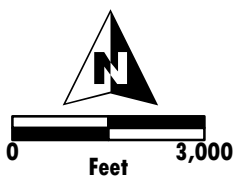
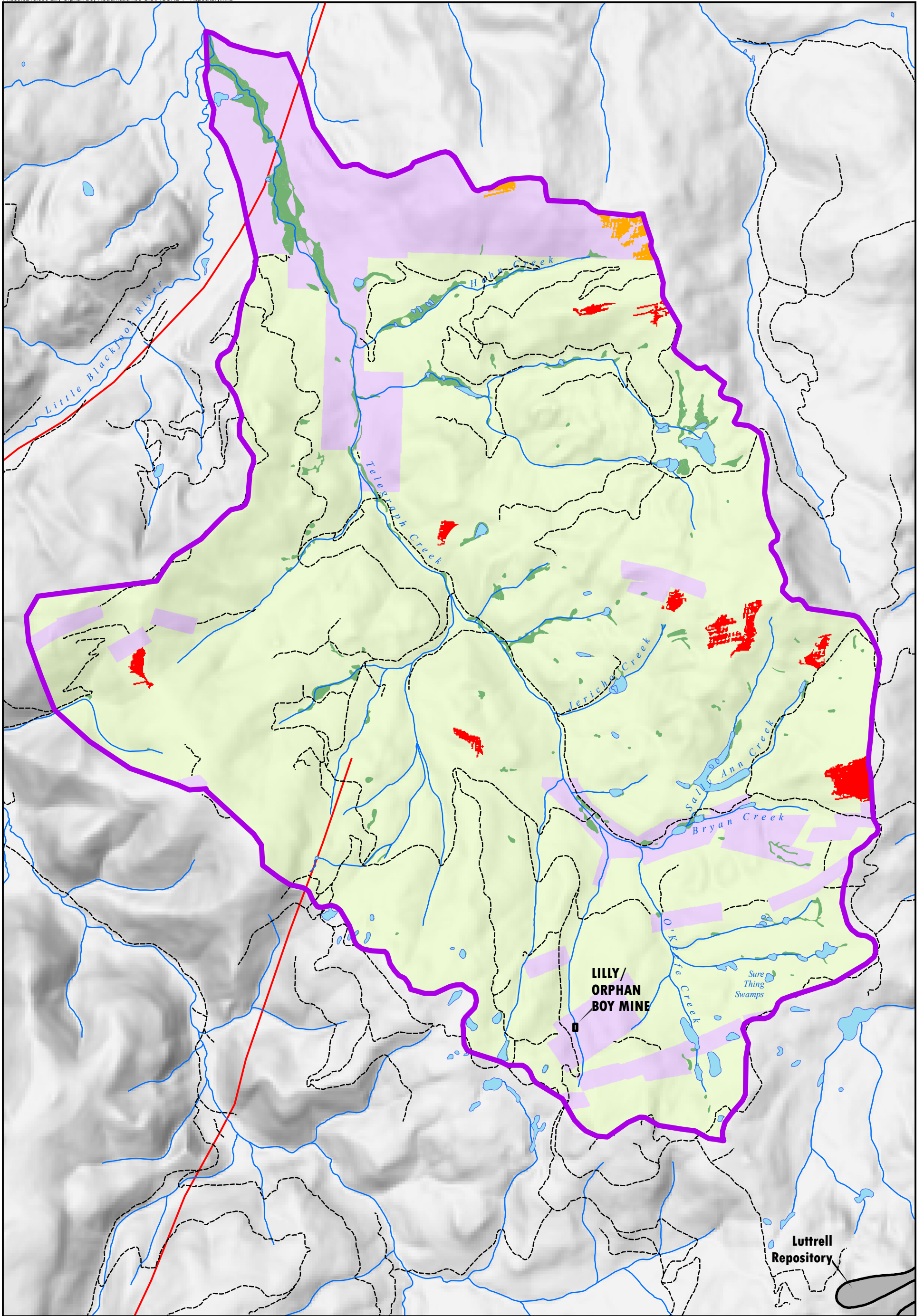
NewFields GIS analysts assembled the publically available data identified above to complete the analysis. Data layers for the resources identified in the chart above were simultaneously analyzed using ArcGIS to identify sites that met the criteria assigned to each resource. Because only a few of the potential repository locations were accessible by existing roads, the “existing roads” criteria was dropped from further consideration. Locations that met all criteria are shown on **Figure 1 (Attachment A)** and are differentiated between those located on USDA Forest Service lands (red) and those located on private land (orange).

With a few exceptions, most of the potential repository sites on USDA-Forest Service lands and all potential repository sites on private land are located near the Telegraph Creek watershed boundary. The potential repository site nearest the Lilly/Orphan Boy mine is located approximately 1.8 miles north of the mine. Only a few potential repository sites are adjacent to existing roads.

## ATTACHMENTS:

**Attachment A** Figure

Attachment A  
Figure



- |                                  |                          |                          |
|----------------------------------|--------------------------|--------------------------|
| --- National Forest System Roads | Study Area Boundary      | Private Land             |
| Steam/Creek                      | Wetland                  | USDA Forest Service Land |
| Fault                            | Private Land             |                          |
| Pond/Lake                        | USDA Forest Service Land |                          |

**Areas Passing All Criteria**

Repository Siting Evaluation  
Lilly/Orphan Boy Mine  
Powell County, Montana  
**FIGURE 1**





# APPENDIX B

Applicable or Relevant and  
Appropriate Requirements (ARARs)





**TABLE B-1**  
**Preliminary Identification of**  
**Applicable or Relevant and Appropriate Requirements (ARARs)**  
**Lilly/Orphan Boy Mine**

Standard, Requirement, Criteria or Limitation	Citation	Description	ARAR Status
<b>FEDERAL: CONTAMINANT-SPECIFIC</b>			
<u>Safe Drinking Water Act</u>	40 USC § 300		Relevant and appropriate. Although surface water and groundwater are not currently used for drinking water at the site, the potential for future use exists.
National Primary Drinking Water Regulation	40 CFR Part 141	Establishes health-based standards (MCLs) for public water systems	
National Secondary Drinking Water Regulation	40 CFR Part 143	Establishes welfare-based standards (secondary MCLs) for public water systems.	
<u>Clean Water Act</u>	33 USC § 1251-13871	Ch. 26 Water Pollution Prevention and Control	Relevant and appropriate
Water Quality Standards	40 CFR Part 131 Quality Criteria for Water	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	
<u>National Ambient Air Quality Standards</u>	40 CFR 50.16, 50.12	Establish standards for PM-10 and lead emissions to air.	Applicable
<b>STATE: CONTAMINANT SPECIFIC</b>			
<u>Groundwater Protection</u>	ARM 17.30.1005, 1006, 1011	Identifies groundwater classes, assigns beneficial uses, and establishes groundwater standards, including non-degradation requirements	Not applicable or relevant. Project does not address groundwater.
<u>Montana Water Quality</u>	ARM 17.30.637 75-5101, 303, 605, 705 MCA	Establishes water quality criteria for discharges to surface water Establishes requirements to protect, maintain and improve the quality of surface water and groundwater	Applicable
<u>Montana Ambient Air Quality</u>	ARM 17.8.206, -220, -221, -222, -223	Establishing monitoring requirements for ambient air quality standards, including limits for lead emissions, settled particulate matter, and PM-10 concentration in ambient air.	Applicable

**TABLE B-1**  
**Preliminary Identification of**  
**Applicable or Relevant and Appropriate Requirements (ARARs)**  
**Lilly/Orphan Boy Mine**

Standard, Requirement, Criteria or Limitation	Citation	Description	ARAR Status
<b>FEDERAL: LOCATION-SPECIFIC</b>			
<u>National Historic Preservation Act</u>	16 USC § 470; 36 CFR Part 800; 40 CFR part 6.310(b)	Requires Federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places and to minimize harm to any National Historic Landmark adversely or directly affected by an undertaking.	Applicable
<u>Archaeological and Historic Preservation Act</u>	16 USC § 469; 40 CFR 6.301 (c)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.	Applicable
<u>Historic Sites, Buildings, and Antiquities Act</u>	36 CFR § 62.6(d)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Applicable
<u>Protection of Wetlands Order</u>	40 CFR Part 6	Avoid adverse impacts to wetlands.	Applicable
<u>Migratory Bird Treaty Act</u>	16 USC § 703 <u>et seq.</u>	Establishes a Federal responsibility for the protection of international migratory bird resource.	Applicable
<u>Fish and Wildlife Coordination Act</u>	16 USC § 661 <u>et seq.</u> ; 40 CFR Part 6.302(g)	Requires consultation when Federal department or agency proposes or authorizes any modification or any stream or other water body and adequate provision for protection for protection of fish and wildlife resources.	Applicable
<u>Floodplain Management Order</u>	40 CFR Part 6	Requires Federal agencies to evaluate the potential effects of actions they may make in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain, to the extent possible.	Applicable
<u>Bald Eagle Protection Act</u>	16 USC § 668 <u>et seq.</u>	Establishes a federal responsibility for protection of bald and golden eagles. Requires consultations with the USFWS.	Applicable

**TABLE B-1**  
**Preliminary Identification of**  
**Applicable or Relevant and Appropriate Requirements (ARARs)**  
**Lilly/Orphan Boy Mine**

Standard, Requirement, Criteria or Limitation	Citation	Description	ARAR Status
<u>Endangered Species Act</u>	16 USC §§ 1531-1543; 40 CFR Part 6.302(h); 50 CFR Part 402	Requires action to conserve endangered species within critical habitat upon which species depend. Includes consultation with US Department of Interior.	Applicable
<u>Clean Water Act</u>	33 USC § 1251	Regulates discharge or dredged or fill materials into waters of the United States.	Applicable
<u>Resource Conservation and Recovery Act</u>	40 CFR Part 264.18(a) and (b)	Provides seismic and floodplain restrictions on location waste management units.	Applicable
<u>American Indian Religious Freedom Act</u>	42 USC § 1996	Requires reclamation activities to consider and protect Indian religious freedom.	Applicable
<u>Native American Graves Protection and Repatriation Act</u>	25 USC § 3001	Prioritizes ownership or control over Native American cultural items excavated or discovered on Federal or tribal lands.	Relevant and appropriate
<b>STATE: LOCATION-SPECIFIC</b>			
<u>Montana Antiquities Act</u>	22-3-421MCA	Address the responsibilities of State agencies regarding historic and prehistoric sites.	Relevant and appropriate
<u>Montana Human Skeletal Remains and Burial Site Protection Act</u>	22-3-801 MCA	Establishes requirements for the protection of human skeletal remains and burial requirements.	Applicable
<u>Montana Floodplain and Floodway Management Act</u>	76-5-401 et seq., MCA, ARM 36.15.601, et seq.	Specifies the types of uses/structures that are allowed or prohibited in designated 100-year floodway and floodplain. Solid and hazardous waste disposal are prohibited in the floodway or the floodplain.	Applicable
<u>Montana Stream Protection Requirements</u>	75-7-101 et seq., MCA, ARM 36.2.401, et seq.	Establishes requirements for actions that would alter or affect a streambed or its banks. Reclamation projects must be designed and constructed to minimize adverse impacts to the stream.	Applicable
<u>Montana Solid Waste Management Act</u>	75-10-201, et seq.,	Sets requirements for the location of solid waste management	Applicable

**TABLE B-1**  
**Preliminary Identification of**  
**Applicable or Relevant and Appropriate Requirements (ARARs)**  
**Lilly/Orphan Boy Mine**

Standard, Requirement, Criteria or Limitation	Citation	Description	ARAR Status
	MCA, ARM 17.50.505	facilities. Facilities must be located outside the 100-year floodplain and must be located to prevent impacts to groundwater, surface water, and private water supply systems.	
<u>Endangered Species and Wildlife act</u>	85-5-106, -107, and -111 MCA	Establishes protections for endangered species.	Applicable
<b>FEDERAL: ACTION-SPECIFIC</b>			
<u>Clean Water Act</u> National Pollutant Discharge Elimination System (NPDES)	33 USC § 1251-1387 40 CFR Parts 121, 122, 125	Requires permits for the discharge of pollutants from a point source into waters of the United States.	Relevant and appropriate
<u>Clean Air Act</u> National Primary and Secondary Ambient Air Quality Standards	42 USC § 7409; 40 CFR Part 50.12	Air quality levels that protect public health.	Applicable
<u>Surface Mining Control and Reclamation Act</u>	30 CFR parts 816, 784	Reclamation requirements for coal and certain non-coal mining.	Relevant and Appropriate
<u>Resources Conservation and Recovery Act</u>	42 USC § 6921	Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and parts 124, 270, and 271	Relevant and appropriate
	40 CFR Part 257.3	Governs waste handling and disposal	Relevant and appropriate
	40 CFR Part 264.310	Provisions regarding run-on and run-off controls.	Relevant and appropriate
<u>Occupational Safety and Health Act</u> Hazardous Waste Operations and Emergency Response	29 USC § 655 29 CFR 1910.120	Defines standards for employee protection during initial site characterization and analysis, monitoring activities, material handling activities, training, and emergency response.	Applicable
<b>STATE: ACTION-SPECIFIC</b>			

**TABLE B-1**  
**Preliminary Identification of**  
**Applicable or Relevant and Appropriate Requirements (ARARs)**  
**Lilly/Orphan Boy Mine**

Standard, Requirement, Criteria or Limitation	Citation	Description	ARAR Status
<u>Montana Pollutant Discharge Elimination System (MPDES)</u>	ARM 17.30.1342-1344, and .1203	Establishes requirements for MPDES and NPDES permits, including technology-based treatment requirements	Applicable
<u>Montana Water Quality Act and Regulations</u>	75-5-303, and -605 MCA; ARM 17.303.637, .705, and 1011	Prohibits the pollution of state waters and establishes provisions that existing uses and levels of water quality of state water must be protected and maintained.	Applicable
<u>Storm Water Runoff Control Requirements</u>	ARM 17.24.633 and 17.30.1341	Surface drainage from disturbed areas must be treated by the best technology currently available and requires compliance with the MPDES General Permit for Construction Activities.	Applicable
<u>Montana Solid Waste Requirements</u>	75-10-201 et seq., MCA	Establishes requirements for management and disposal of solid wastes, including mine wastes that at sites not currently subject to operating permit requirements	Applicable
<u>Montana Strip and Underground Mine Reclamation Act and Montana Metal Mining Act</u>	82-4-201 et seq., and 82-4-301 et seq., MCA	Establishes grading, drainage, erosion control, groundwater protection, revegetation, and fish and wildlife protection requirements.	Relevant and appropriate
<u>Montana Ambient Air Quality Regulations</u>	ARM 17.8.304, .308, and .604;	Establishes requirements to ensure existing air quality will not be adversely affected	Applicable
	ARM 17.24.761	Specifies measures for controlling fugitive dust	Relevant and appropriate



**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
(ARARS)  
FOR  
RECLAMATION PROJECTS**

**NOVEMBER, 2008**

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## **ARARS FOR RECLAMATION PROJECTS**

### **1.0 INTRODUCTON - HISTORY OF ARARS AT ABANDONED MINED LAND RECLAMATION SITES**

After the enactment of the Federal Surface Mining Control and Reclamation Act in 1977 (“SMCRA”, 30 USC §§ 1201-1238), the State of Montana could be delegated the authority to implement the Abandoned Mined Lands Reclamation (“AMLR”) program authorized by that Act, as well as funding for implementation of that program, by the Federal Office of Surface Mining, Reclamation, and Enforcement (“OSM”). The State enacted necessary legislation to implement the AMLR program according to State law and had a plan (“Reclamation Plan”) to do so, which was approved by OSM. Delegation of exclusive authority for the program would follow. Montana passed necessary legislation for reclamation of coal mines (Title 82, Chapter 4, Part 2, MCA), as well as legislation for reclamation of other types of mines (Title 82, Chapter 4, Part 3, MCA – Metal Mine Reclamation, and Title 82, Chapter 4, Part 4, Part 4, MCA – Open Cut Mining Reclamation).

Satisfaction of the requirements of SMCRA by the State of Montana resulted in the delegation by OSM to the State of Montana of the exclusive authority to implement the Reclamation Plan in the State of Montana on November 24, 1980. While the delegation of the program in 1980 was limited to abandoned coal mine reclamation, it was expanded by Montana’s showing it had reclaimed all eligible abandoned coal mines, whereupon OSM approved the 1995 amendments to the State’s Reclamation Plan to include non-coal abandoned mines. This approval resulted in additional delegation of authority to the State of Montana to implement reclamation of abandoned hardrock mines as well as quarries.

In the 1995 Amendments to its Reclamation Plan, the State of Montana stated that the AMLR program would comply with the National Contingency Plan (“NCP”). Among other things, the NCP provides a procedure for evaluating alternative cleanup methods for hazardous wastes. The NCP also establishes cleanup standards for hazardous wastes, which standards are referred to in the NCP as “ARARs.” By requiring compliance with the NCP, the State adopted the NCP procedures for evaluation of alternatives in addressing AMLR Reclamation Projects, as well as ARARS. At the same time, utilization of the evaluation of alternatives procedures found in the NCP satisfied the evaluation of alternatives required for major Federal actions undertaken by the Federal government which could have a significant effect on the environment as required by the Federal National Environmental Policy Act (“NEPA”, 42 USC 4321 – 4370).

AMLR, which is based upon SMCRA, is one of several legal authorities available in the State of Montana for cleanup of mine wastes, the others being the Federal Comprehensive Environmental Response, Compensation, and Liability Act (“CERCLA” or “Superfund”, 42 USC 9601 – 9675) and the State’s counterpart to the Federal

Superfund law, the Comprehensive Environmental Cleanup and Responsibility Act (“CECRA,” §§ 75-10-701 - 752 MCA).

To paraphrase the Federal Superfund statute, at 42 USC 121(d)(E)(4), in remedy selection for cleanup of an hazardous waste site, if a State ARAR is not consistently applied, a remedy may be selected by the Federal government which does attain that ARAR. Such a decision could result in State standards not being applied to Federal mine waste cleanups in the State of Montana. Consequently, to avoid the risk that State standards would not be applied within the State of Montana, ARARs should be consistently applied in the State’s three mine waste cleanup programs (Superfund, CECRA, and AMLR).

The interaction of SMCRA and CERCLA requirements, particularly the interaction of the consistency requirement of CERCLA and the adoption of the NCP in Montana’s 1995 Reclamation Plan, resulted in procedures and standards for the Montana AMLR program which address NEPA alternatives analysis and incorporate CERCLA standards (i.e., ARARs).

The ARARs described below are, by necessity, generic because they are to be used as part of the evaluation process developed by the AMLR program for analysis of alternatives for AMLR Projects. This evaluation results in the Expanded Engineering Evaluation/Cost Analysis (“EEE/CA”) which precedes selection of a Reclamation alternative.

The ARARs listed below are based upon those identified for the Neihart Operable Unit 1, Carpenter-Snow Creek Mining District NPL Site (June, 2007). The wastes include both mining and milling wastes, which exist at a typical AMLR site. The text of the ARARs analysis used has been updated and adapted to allow its application to AMLR sites in general.

## **2.0 TYPES OF ARARS**

ARARs are either applicable or relevant and appropriate. Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location or other circumstances found at a CERCLA site. 40 CFR Section 300.5 Relevant and appropriate requirements are those “Standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable” to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site.” *Id.* Factors which may be considered in making this determination are presented in 40 CFR 300.400 (g)(2).

Each ARAR or group of related ARARs identified herein is followed by a specific statutory or regulatory citation, a classification describing whether the ARAR is



applicable or relevant and appropriate, and a description which summarizes the requirements.

ARARs are divided into contaminant specific, location specific, or action specific requirements, as described in the NCP and EPA Guidance.

Contaminant specific ARARs include those laws and regulations governing the release to the environment of materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Contaminant specific ARARs generally set health or risk based numerical values or methodologies which, when applied to site specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location specific ARARs relate to the geographic or physical position of the site, rather than to the nature of the contaminants. Action specific ARARs are usually technology or activity based requirements or limitations on actions taken with respect to hazardous substances.

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by both EPA and the states, such as many of the requirements of the federal Clean Water Act and the Montana Water Quality Act. The Preamble to the final NCP states that such a situation results in citation to the state provision as the appropriate standard, but treatment of the provisions is a federal requirement. ARARs and other laws which are unique to state law are identified as state ARARs.

As noted previously, the 1995 Reclamation Plan provides that the NCP was adopted for Reclamation activities. Those activities are directly analogous to "removal actions" under CERCLA. As stated in the NCP at 55 FR 8695 (March 8, 1990):

The purpose of removal actions generally is to respond to a release...so as to prevent, minimize, or mitigate harm to human health and the environment. Although all removals must be protective...removals are distinct from remedial actions in that they may mitigate or stabilize the threat rather than comprehensively address all the threats at a site. Consequently, removal actions cannot be expected to attain all ARARs. Remedial actions, in contrast, must comply with all ARARs or obtain a waiver. (emphasis supplied).

Consequently, the NCP, at 40 CFR 300.410 provides that ARARS at removal actions:

...shall, to the extent practicable, considering the exigencies of the situation, attain...[ARARs]. In determining whether compliance with ARARs is

practicable, the lead agency may consider appropriate factors, including:

- a) the urgency of the situation; and
- b) the scope of the removal action to be conducted.

Therefore, based upon the NCP, after an ARAR has been identified for a Reclamation project, the EEE/CA should evaluate how the alternatives will attain ARARs and select an alternative that complies with ARARs to the extent practicable. If an ARAR cannot be complied with, the EEE/CA should indicate why, utilizing the two part test set out above, attainment is not practicable.

### 3.0 CONTAMINANT-SPECIFIC ARARs

#### 3.1 Federal

##### 3.1.1 Safe Drinking Water Act

**Safe Drinking Water Act, 42 U.S.C. ' 300f, et seq., National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141 and 142 (relevant and appropriate).** The National Primary and Secondary Drinking Water Regulations (40 CFR Parts 141 and 143) establish maximum contaminant levels (MCL) for chemicals in drinking water distributed in public water systems. These are enforceable in Montana under the Public Water Supplies, Distribution, and Treatment Act and corresponding regulations, MCA ' 75-6-101, et seq., and ARM ' 17.38.203. Safe Drinking Water Act MCLs are relevant and appropriate to for reclamation projects because the groundwater in a reclamation project area is a potential source of drinking water.

The determination that the drinking water standards are relevant and appropriate for reclamation projects is supported by the regulations and guidance. The Preamble to the NCP clearly states that the MCLs are relevant and appropriate for ground or surface water that is a current or potential source of drinking water. See 55 Fed. Reg. 8750, March 8, 1990, and 40 CFR ' 300.430(e)(2)(I)(B). MCLs developed under the Safe Drinking Water Act generally are ARARs for current or potential drinking water sources. See, EPA Guidance On Remedial Action For Contaminated Groundwater at Superfund Sites, OSWER Dir. #9283.1-2, December 1988.

In addition, maximum contaminant level goals (MCLG) may also be relevant and appropriate . See 55 Fed. Reg. 8750-8752. MCLGs are health-based goals which are established at levels at which no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety. According to the NCP, MCLGs that are set at levels above zero must be attained for ground or surface waters that are current or potential sources of drinking water. Where the MCLG for a contaminant has been set at a level of zero, the MCL promulgated for that contaminant must be attained.

The MCLs and MCLGs for contaminants of concern are:

<b><u>Contaminant</u></b>	<b><u>MCL (mg/L)</u></b>	<b><u>MCLG<sup>a</sup> (mg/L)</u></b>
Antimony	0.006	0.006
Arsenic	0.01	NE
Cadmium	0.005 <sup>b</sup>	0.005 <sup>b</sup>

Copper	1.3 <sup>c</sup>	1.3 <sup>c</sup>
Iron	0.3 <sup>d</sup>	NE
Lead	0.015 <sup>c</sup>	0
Manganese	0.05 <sup>d</sup>	NE
Mercury	0.002 <sup>b</sup>	0.002 <sup>b</sup>
Silver	NE	NE
Thallium	0.002 <sup>b</sup>	0.0005
Zinc	5.0 <sup>d</sup>	NE

NE - Not Established

<sup>a</sup> 40 CFR ' 141.51(b)

<sup>b</sup> 40 CFR ' 141.62(c)

<sup>c</sup> 40 CFR ' 141.80(c) B No MCL, but specifies BAT to be applied.

<sup>d</sup> 40 CFR ' 143.3 B Secondary MCL

ARM 17.38.203 incorporates by reference into State law the MCLs for inorganic substances set forth in 40 CFR Part 141 (Primary Drinking Water Standards).

### 3.1.2 Clean Water Act

**Federal Surface Water Quality Requirements, Clean Water Act, 33 USC ' 1251, et seq. (applicable).** As provided under Section 303 of the Clean Water Act, 33 U.S.C. ' 1313, the State of Montana has promulgated water quality standards. See the discussion concerning State surface water quality requirements.

### 3.1.3 National Ambient Air Quality Standards

**National Ambient Air Quality Standards, 40 CFR ' 50.6 (PM-10); 40 CFR ' 50.12 (lead) (applicable).** These provisions establish standards for PM-10 and lead emissions to air. (Corresponding state standards are found at ARM ' 17.8.222 [lead] and ARM ' 17.8.223 [PM-10].) The PM-10 standard is 150 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), 24-hour average concentration, and the lead standard is 1.5  $\mu\text{g}/\text{m}^3$ , maximum arithmetic mean averaged over a calendar quarter.

## 3.2 State

### 3.2.1 Groundwater Protection

**ARM 17.30.1005 (applicable)** explains the applicability and basis for the groundwater standards in ARM ' 17.30.1006, which establish the maximum allowable changes in groundwater quality and may limit discharges to groundwater.

**ARM 17.30.1006 (applicable)** provides that groundwater is classified into Classes I through IV based on its specific conductance and establishes the applicable ground water quality standards with respect to each groundwater classification.

Concentrations of dissolved substances in Class I or II groundwater may not exceed the human health standards listed in department Circular DEQ-7.<sup>1</sup> These levels are listed below for the primary contaminants of concern.

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<sup>1</sup>

Montana Department of Environmental Quality, Water Quality Division, Circular DEQ-7, Montana Numeric Water Quality Standards (February 2008).

<u>Contaminant</u>	<u>DEQ-7 Standard (mg/L)<sup>a</sup></u>
Antimony	0.006
Arsenic	0.01
Cadmium	0.005
Copper	1.3
Iron	NE <sup>b</sup>
Lead	0.015
Manganese	NE <sup>b</sup>
Mercury	0.002
Silver	0.1
Thallium	0.002
Zinc	2.0

NE- Not Established

<sup>a</sup> DEQ-7 standards for metals and arsenic in ground water are based on the dissolved portion of the sample (after filtration through a 0.45  $\Phi$ m membrane filter).

<sup>b</sup> Concentrations of iron and manganese must not reach values that interfere with the uses specified in the surface and groundwater standards (ARM 17.30.601 et seq. and ARM 17.30.1001 et seq.). The secondary maximum contaminant levels of 300  $\Phi$ g/L and 50  $\Phi$ g/L, respectively, may be considered guidance to determine levels that will interfere with the specified uses.

Reclamation projects must meet the DEQ-7 standards for all contaminants at a Reclamation site. In addition, for Class I and Class II ground water, no increase of a parameter may cause a violation of Section 75-5-303, MCA (nondegradation).

ARM 17.30.1006 requires that concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to public health. Maximum allowable concentrations of these substances also must not exceed acute or chronic problem levels that would adversely affect existing or designated beneficial uses of groundwater of that classification.

### **ARM 17.30.1011 (applicable)**

This section provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality in accordance with Section 75-5-303, MCA, and ARM Title 17, Chapter 30, Subchapter 7.

An additional concern with respect to ARARs for groundwater is the impact of groundwater upon surface water. If significant loadings of contaminants from groundwater sources to any surface water within a Reclamation Project contribute to the inability of the stream to meet classification standards, then alternatives to alleviate such groundwater loading must be evaluated and, if appropriate, implemented. Groundwater in certain areas may have to be remediated to levels more stringent than the groundwater classification standards in order to achieve the standards for affected surface water. See Compliance with Federal Water Quality Criteria, OSWER Publication 9234.2-09/FS (June 1990) (AWhere the ground water flows naturally into the surface water, the ground-water remediation should be designed so that the receiving surface-water body will be able to meet any ambient water-quality standards [such as State WQSs or FWQC] that may be ARARs for the surface water.@)



### 3.2.2 Montana Water Quality Act

**State of Montana Surface Water Quality Requirements, Montana Water Quality Act, Section 75-5-101, et seq., MCA, and implementing regulations (applicable).** General. The Clean Water Act, 33 U.S.C. § 1251, et seq., provides the authority for each state to adopt water quality standards (40 CFR Part 131) designed to protect beneficial uses of each water body and requires each state to designate uses for each water body. The Montana Water Quality Act, Section 75-5-101, et seq., MCA, establishes requirements to protect, maintain and improve the quality of surface and groundwater. Montana's regulations classify State waters according to quality, place restrictions on the discharge of pollutants to State waters, and prohibit degradation of State waters. Pursuant to this authority and the criteria established by Montana surface water quality regulations, ARM § 17.30.601, et seq., Montana has established the Water-Use Classification system. The classification for specific surface water bodies within the State are set for in ARM 17.30.607 et. seq. The applicable standards for each classification are set forth in ARM 17.30.621 through ARM 17.30.629, inclusive.

**ARM 17.30.637 (applicable).** Provides that surface waters must be free of substances attributable to industrial practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; (e) create conditions which produce undesirable aquatic life.

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

In addition, ARM 17.30.637 provides that leaching pads, tailings ponds, or water or waste or product holding facilities must be located, constructed, operated and maintained in such a manner and of such materials to prevent any discharge, seepage, drainage, infiltration, or flow which may result in pollution of state waters, and a monitoring system may be required to ensure such compliance.

Section 75-5-605, MCA (applicable) provides that it is unlawful to cause pollution of any state waters or to place or cause to be placed, any wastes where they will cause pollution of any state waters.

Section 75-5-303, MCA (applicable) states that existing uses of state waters and the level of quality of state waters necessary to protect those uses must be maintained and protected.

**ARM 17.30.705 (applicable).** For all state waters, existing and anticipated uses and water quality necessary to support those uses must be maintained and protected.

### 3.2.3 Montana Ambient Air Quality Regulations

**Montana Ambient Air Quality Regulations, ARM 17.8.206, -.222, -.220, and -.223 (applicable).** The following provisions establish air quality standards.

**ARM 17.8.206.** This provision establishes sampling, data collection, and analytical requirements to ensure compliance with ambient air quality standards.

**ARM 17.8.222.** Lead emissions to ambient air shall not exceed a ninety (90) day average of 1.5 micrograms per cubic liter of air.

**ARM 17.8.220.** Settled particulate matter shall not exceed a thirty (30) day average of 10 grams per square meter.

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

#### 4.0 LOCATION-SPECIFIC ARARS

The statutes and regulations set forth below relate to solid waste, floodplains, floodways, streambeds, and the preservation of certain cultural, historic, natural or other national resources located in certain areas that may be adversely affected by Reclamation.

##### 4.1 Federal

###### 4.1.1 National Historic Preservation Act

**National Historic Preservation Act, 16 USC ' 470, 40 CFR ' 6.301(b), 36 CFR Part 63, Part 65, and Part 800 (NHPA) (applicable).** This statute and implementing regulations require Federal agencies to take into account the effect of Reclamation upon any district, site, building, structure, or object that is included in or eligible for the Register of Historic Places. If the effect of Reclamation cannot be reasonably avoided, Measures will be implemented to minimize or mitigate the potential effects of the activity. In addition, Indian cultural and historical resources must be evaluated and effects avoided, minimized or mitigated.

###### 4.1.2 Archaeological and Historic Preservation Act

**Archaeological and Historic Preservation Act, 16 USC ' 469, 40 CFR 6.301(c) (applicable).** This statute and implementing regulations establish requirements for the evaluation and preservation of historical and archaeological data, including Indian cultural and historic data, which may be destroyed through alteration of terrain as a result of a Federal program (such as AMLR). This requires the AMLR Program to survey the site for covered scientific, prehistorical or archaeological artifacts. If eligible scientific, prehistoric, or archeological data are developed during reclamation, they shall be preserved in accordance with these requirements.

###### 4.1.3 Historic Sites Act of 1935

**Historic Sites Act of 1935, 16 USC ' 461, et seq., 40 CFR 6.310(a) (applicable).** This statute and implementing regulations require federal agencies to consider the existence and location of land marks on the National Registry of National Landmarks and to avoid undesirable impacts on such landmarks.

###### 4.1.4 Protection and Enhancement of the Cultural Environment

**Executive Order 11593 Protection and Enhancement of the Cultural Environment, 16 USC ' 470 (applicable).** Directs federal agencies to institute procedures to ensure programs

contribute to the preservation and enhancement of non-federally owned historic resources. Consultation with the Advisory Council on Historic Preservation is required if Reclamation activities should threaten cultural resources.

#### **4.1.5 The Archaeological Resources Protection Act of 1979**

**The Archaeological Resources Protection Act of 1979, 16 USC ' 470aa-47011 (relevant and appropriate).** Requires a permit for any excavation or removal of archeological resources from public lands or Indian lands. Substantive portions of this act may be relevant and appropriate if archeological resources are encountered during Reclamation activities.

#### **4.1.6 American Indian Religious Freedom Act**

**American Indian Religious Freedom Act, 42 U.S.C. ' 1996. (applicable).** This Act establishes a federal responsibility to protect and preserve the inherent right of American Indians to believe, express and exercise the traditional religions of American Indians. This right includes, but is not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. The Act requires Federal agencies to protect Indian religious freedom by refraining from interfering with access, possession and use of religious objects, and by consulting with Indian organizations regarding proposed actions affecting their religious freedom.

#### **4.1.7 Native American Graves Protection and Repatriation Act**

**Native American Graves Protection and Repatriation Act, 25 U.S.C. ' 3001, et seq. (applicable).** The Act prioritizes ownership or control over Native American cultural items, including human remains, funerary objects and sacred objects, excavated or discovered on Federal or tribal lands. Federal agencies and museums that have possession or control over Native American human remains and associated funerary objects are required under the Act to compile an inventory of such items and, to the extent possible, identify their geographical and cultural affiliation. Once the cultural affiliation of such objects is established, the Federal agency or museum must expeditiously return such items, upon request by a lineal descendent of the individual Native American or tribe identified.

#### **4.1.8 Fish and Wildlife Coordination Act**

**Fish and Wildlife Coordination Act, 16 USC ' 661, 40 CFR 6.302 (applicable).** This statute and implementing regulations require that Federal agencies or federally funded projects ensure that any modification of any stream or other water body affected by any action authorized or funded by the Federal agency provide for adequate protection of fish and wildlife resources. This ARAR requires consultation with the U.S. Fish and Wildlife Service and the Montana Department of Fish, Wildlife, and Parks. Further consultation will occur during Reclamation design and construction.

#### **4.1.9 Endangered Species Act**

**Endangered Species Act, 16 USC ' 1531, 50 CFR Parts 17 and 402 (applicable).** This statute and implementing regulations provide that federal activities not jeopardize the continued existence of any threatened or endangered species. This ARAR will be achieved through consultation with the U.S. Fish and Wildlife Service and the Montana Department of Fish, Wildlife and Parks during Reclamation design and construction action. Specific avoidance or

other mitigation measures identified shall be incorporated into the Reclamation design and implemented as part of construction.

#### **4.1.10 Floodplain Management Regulations**

**Floodplain Management Regulations, Executive Order No. 11988 and 40 CFR ' 6.302(b) (applicable)**. These require that actions be taken to avoid, to the extent possible, adverse effects associated with direct or indirect development of a floodplain, or to minimize adverse impacts if no practicable alternative exists.

#### **4.1.11 Protection of Wetlands Regulations**

**Protection of Wetlands Regulations, 40 CFR Part 6, Appendix A, and Executive Order No. 11990 (applicable)**. Steps will be taken to avoid or mitigate the adverse impacts associated with the destruction or loss of wetlands to the extent possible and avoidance of new construction in wetlands if a practicable alternative exists. Wetlands are defined as those areas that are inundated or saturated by groundwater or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Compliance with this ARAR will be achieved through consultation with the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, to determine the existence and category of wetlands present at the site, and any avoidance or mitigation and replacement which may be necessary.

#### **4.1.12 Clean Water Act**

**Section 404, Clean Water Act, 33 USC ' ' 1251 et seq., 33 CFR Part 330 (applicable)**. Regulates discharge of dredged or fill materials into waters of the United States. Substantive requirements of portions of Nationwide Permit No. 38 (General and Specific Conditions) are applicable to Reclamation activities conducted within waters of the United States within the Reclamation Project area.

#### **4.1.13 Migratory Bird Treaty Act**

**Migratory Bird Treaty Act, 16 USC ' 703, et seq. (applicable)**. This requirement establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during Reclamation design and construction to ensure that Reclamation of the site does not unnecessarily impact migratory birds.

#### **4.1.14 Bald Eagle Protection Act**

**Bald Eagle Protection Act, 16 USC ' 668, et seq. (applicable)**. This requirement establishes a federal responsibility for protection of bald and golden eagles, and requires continued consultation with the U.S. Fish and Wildlife Service during Reclamation design and construction to ensure that Reclamation of the site does not unnecessarily adversely affect bald and golden eagles.

#### **4.1.15 Resource Conservation and Recovery Act**

**Resource Conservation and Recovery Act and regulations, 40 CFR ' 264.18 (a) and (b) (relevant and appropriate)**. These regulations provide seismic and floodplain restrictions on the location of a waste management unit.

## 4.2 State

### 4.2.1 Montana Antiquities Act

**Montana Antiquities Act, Section 22-3-421, et seq., MCA (relevant and appropriate).** The Montana Antiquities Act addresses the responsibilities of State agencies regarding historic and prehistoric sites including buildings, structures, paleontological sites, archaeological sites on state owned lands. Each State agency is responsible for establishing rules regarding historic resources under their jurisdiction which address National Register eligibility, appropriate permitting procedures and other historic preservation goals. The State Historic Preservation Office maintains information related to the responsibilities of State Agencies under the Antiquities Act.

### 4.2.2 Montana Human Skeletal Remains and Burial Site Protection Act

**Montana Human Skeletal Remains and Burial Site Protection Act (1991), Section 22-3-801, MCA (applicable).** The Human Skeletal Remains and Burial Site Protection Act is the result of years of work by Montana Tribes, State agencies and organizations interested in ensuring that all graves within the State of Montana are adequately protected. If human skeletal remains or burial sites are encountered during Reclamation, then requirements will be applicable.

### 4.2.3 Montana Floodplain and Floodway Management Act

**Montana Floodplain and Floodway Management Act and Regulations, Section 76-5-401, et seq., MCA, ARM 36.15.601, et seq. (applicable).** The Floodplain and Floodway Management Act and regulations specify types of uses and structures that are allowed or prohibited in the designated 100-year floodway<sup>2</sup> and floodplain.<sup>3</sup> If a Reclamation Project contains streams or creeks that run through areas that can flood, these standards are applicable to Reclamation Projects within these floodplain areas.

**A. Prohibited uses.** Uses prohibited anywhere in either the floodway or the floodplain are:

- Ⓐ solid and hazardous waste disposal; and
- Ⓐ storage of toxic, flammable, hazardous, or explosive materials.

ARM 36.15.605(2) and 36.15.703 (Applicable); see also ARM 36.15.602(5)(b) (Applicable). These provisions effectively prohibit the placement of mine waste repositories within the 100-year floodplain and require mine wastes addressed by Reclamation to be removed from the floodplain.

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<sup>2</sup> The "floodway" is the channel of a watercourse or drainway and those portions of the floodplain adjoining the channel that are reasonably required to carry and discharge the floodwater of the watercourse or drainway. ARM 36.15.101(13).

<sup>3</sup> The "floodplain" is the area adjoining the watercourse or drainway which would be covered by the floodwater of a base (100-year) flood except for sheetflood areas that receive less than one foot of water per occurrence. The floodplain consists of the floodway and flood fringe. ARM 36.15.101(11).



In the floodway, additional prohibitions apply, including prohibition of:

- Ⓐ a building for living purposes or place of assembly or permanent use by human beings;
- Ⓐ any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; and
- Ⓐ the construction or permanent storage of an object subject to flotation or movement during flood level periods.

Section 76-5-403, MCA (Applicable).

**B. Applicable considerations in use of floodplain or floodway.** Applicable regulations also specify factors that must be considered in allowing diversions of the stream, changes in place of diversion of the stream, flood control works, new construction or alteration of artificial obstructions, or any other nonconforming use within the floodplain or floodway. Many of these requirements are set forth as factors that must be considered in determining whether a permit can be issued for certain obstructions or uses. While permit requirements are not directly applicable to Reclamation construction conducted entirely on site, the substantive criteria used to determine whether a proposed obstruction or use is permissible within the floodway or floodplain are applicable standards. Factors which must be considered in addressing any obstruction or use within the floodway or floodplain include:

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

See Section 76-5-406, MCA; ARM 36.15.216 (Applicable, substantive provisions only). Conditions or restrictions that generally apply to specific activities within the floodway or floodplain are:

- Ⓐ the proposed activity, construction, or use cannot increase the upstream elevation of the 100-year flood a significant amount (2 foot or as otherwise determined by the permit issuing authority) or significantly increase flood velocities, ARM 36.15.604 (Applicable, substantive provisions only); and
- Ⓐ the proposed activity, construction, or use must be designed and constructed to minimize potential erosion. See ARM 36.15.605.

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

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

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

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

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

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

Residential structures - ARM 36.15.702(1).

Commercial or industrial structures - ARM 36.15.702(2).

#### **4.2.4 Montana Stream Protection Requirements**

**Montana Natural Streambed and Land Preservation Act and Regulations, Section 75-7-101, et seq., MCA, and ARM 36.2.401, et seq., (applicable).** Applicable if Reclamation alters or affects a streambed or its banks. The adverse effects of any such action must be minimized.

**ARM 36.2.410 (applicable)** establishes minimum standards which would be applicable if Reclamation alters or affects a streambed, including any channel change, new diversion, riprap or other streambank protection project, jetty, new dam or reservoir or other commercial, industrial or residential development. Reclamation Projects must be designed and constructed using methods that minimize adverse impacts to the stream (both upstream and downstream) and future disturbances to the stream. All disturbed areas must be managed during construction and reclaimed after construction to minimize erosion. Temporary structures used during construction must be designed to handle high flows reasonably anticipated during the construction period. Temporary structures must be completely removed from the stream channel at the conclusion of construction, and the area must be restored to a natural or stable condition. Channel alterations must be designed to retain original stream length or otherwise provide hydrologic stability. Streambank vegetation must be protected except where removal of such vegetation is necessary for the completion of the Reclamation project. When removal of vegetation is necessary, it must be kept to a minimum. Riprap, rock, and other material used in a project must be of adequate size, shape, and density and must be properly placed to protect the streambank from erosion. The placement of road fill material in a stream, the placement of debris or other materials in a stream where it can erode or float into the stream, Reclamation projects that permanently prevent fish migration, operation of construction equipment in a stream, and excavation of streambed gravels are prohibited unless specifically authorized by the district. Such projects must also protect the use of water for any useful or beneficial purpose. See Section 75-7-102, MCA.

**Sections 87-5-502 and 504, MCA (applicable -- substantive provisions only)**, provide that a state agency or subdivision shall not construct, modify, operate, maintain or fail to maintain any construction project or hydraulic project which may or will obstruct, damage, diminish, destroy, change, modify, or vary the natural existing shape and form of any stream or its banks or tributaries in a manner that will adversely affect any fish or game habitat.

While the administrative / procedural requirements, including the consent and approval requirements set forth in these statutes and regulations are not ARARs, consultation with the Montana Department of Fish, Wildlife and Parks, and any conservation district or board of county commissioners (or consolidated city/county government) is encouraged during the design and implementation of Reclamation to assist in the evaluation of the factors discussed above.

#### **4.2.5 Montana Solid Waste Management Act**

**Montana Solid Waste Management Act and regulations, Section 75-10-201, et seq., MCA, ARM 17.50.505 (applicable)**. Sets forth requirements applying to the location of any solid waste management facility. Among other things, the location must have sufficient acreage, must not be within a 100-year floodplain, must be located so as to prevent pollution of ground, surface, and private and public water supply systems, and must allow for reclamation of the land.

Under ARM 17.50.505, a facility for the treatment, storage or disposal of solid wastes:

1. must be located where a sufficient acreage of suitable land is available for solid waste management;
2. may not be located in a 100-year floodplain;
3. may be located only in areas which will prevent the pollution of ground and surface waters and public and private water supply systems;
4. must be located to allow for reclamation and reuse of the land;
5. drainage structures must be installed where necessary to prevent surface runoff from entering waste management areas; and
6. where underlying geological formations contain rock fractures or fissures which may lead to pollution of the ground water or areas in which springs exist that are hydraulically connected to a proposed disposal facility, only Class III disposal facilities may be approved<sup>4</sup>.

Even Class III landfills may not be located on the banks of or in a live or intermittent stream or water saturated areas, such as marshes or deep gravel pits which contain exposed ground water. ARM 17.54.505(2)(j).

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<sup>4</sup> Group III consist of primarily inert wastes, including industrial mineral wastes which are essentially inert and non-water soluble and do not contain hazardous waste constituents. ARM 17.50.503(1)(b).

These standards apply to any facility for the treatment, storage, or disposal of mine wastes, including, for example, any mine waste repository, tailings deposit, or waste rock pile that is actively managed as part of a Reclamation Project.

**Section 75-10-212, MCA.** For solid wastes, Section 75-10-212, MCA, prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted.

#### **4.2.6 Endangered Species and Wildlife**

Sections 87-5-106, 107 and 111, MCA (applicable). Endangered species should also be protected in order to maintain and to the extent possible, enhance their numbers. These Sections list endangered species, prohibited acts, and penalties. Section 87-5-201, MCA (applicable) concerns protection of wild birds, nests and eggs and under ARM 12.5.201 certain activities are prohibited with respect to specified endangered species.

## 5.0 ACTION-SPECIFIC ARARS

### 5.1 Federal and State Water Protection Requirements

#### 5.1.1 Clean Water Act

**Clean Water Act, Point Source Discharges requirements, 33 USC ' 1342 (applicable, substantive provisions only).** Section 402 of the Clean Water Act, 33 USC ' 1342, *et seq.*, authorizes the issuance of permits for the discharge of any pollutant. This includes storm water discharges associated with industrial activity. See, 40 CFR ' 122.1(b)(2)(iv). Industrial activity includes inactive mining operations that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations, see, 40 CFR ' 122.26(b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA subtitle D, see, 40 CFR ' 122.26(b)(14)(v); and construction activity including clearing, grading, and excavation activities, see, 40 CFR ' 122.26(b)(14)(x). Because the State of Montana has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Montana through the Montana Pollutant Discharge Elimination System (MPDES). The MPDES requirements are set forth below.

#### 5.1.2 Montana Pollutant Discharge Elimination System Requirements

**Substantive MPDES Permit Requirements, ARM 17.30.1342-1344 (applicable).** These set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System (NPDES) permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control are applicable requirements for a repository containing mine waste.

**Technology-Based Treatment, ARM 17.30.1203 and 1344 (applicable).** Provisions of 40 CFR Part 125 for criteria and standards for the imposition of technology-based treatment requirements are adopted and incorporated in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125 are applicable, i.e., for toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case by case basis using best professional judgment (BPJ). See CERCLA Compliance with Other Laws Manual, Vol. I, August 1988, p. 3-4 and 3-7.

#### 5.1.3 Water Quality Statutes and Regulations

**Causing of Pollution, Section 75-5-605, MCA (applicable).** This section of the Montana Water Quality Act prohibits the causing of pollution of any state waters. Pollution is defined as contamination or other alteration of physical, chemical, or biological properties of state waters which exceeds that permitted by the water quality standards. Also, it is unlawful to place or caused to be placed any wastes where they will cause pollution of any state waters.

**Nondegradation, Section 75-5-303, MCA (applicable).** This provision states that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected. Section 75-5-317, MCA, provides an exemption from nondegradation requirements which allows changes of existing water quality resulting from an emergency or Reclamation that is designed to protect the public health or the environment and that is approved, authorized, or required by the department. Degradation meeting these requirements may be considered nonsignificant.

**Surface Water, ARM 17.30.637 (applicable).** Prohibits discharges containing substances that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; or (e) create conditions which produce undesirable aquatic life.

**ARM 17.30.705 (applicable).** This provides that for all state waters, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

#### **5.1.4 Stormwater Runoff Control Requirements**

**ARM 17.24.633 (applicable).** All surface drainage from a disturbed area must be treated by the best technology currently available.

**General Permits (applicable).** Pursuant to ARM 17.30.1341, DEQ has issued general storm water permits for certain activities. The substantive requirements of the following permits are applicable for the following activities: for construction activities B General Permit for Storm Water Discharge Associated with Construction Activity, Permit No. MTR100000 (April 16, 2007); for mining activities B General Discharge Permit for Storm Water Associated with Mining and with Oil and Gas Activities, Permit No. MTR300000 (November 17, 2002);<sup>5</sup> and for industrial activities B General Permit for Storm Water Discharge Associated with Industrial Activity, Permit No. MTR000000 (October 1, 2006).<sup>6</sup>

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<sup>5</sup> This permit covers point source discharges of storm water from mining and milling activities (including active, inactive, and abandoned mine and mill sites) including activities with Standard Industrial Code 14 (metal mining).

<sup>6</sup> Industrial activities are defined as all industries defined in 40 CFR 122, 123, and 124, excluding construction, mining, oil & gas extraction activities and storm water discharges subject to effluent limitations guidelines. This includes wood treatment operations, as well as the production of slag.



Generally, the permits require the permittee to implement best management practice (BMP) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, an individual MPDES permit or alternative general permit may be required.

A related mine reclamation requirement is set out in ARM 17.24.633 (relevant and appropriate), which requires that all surface drainage from disturbed areas that have been graded, seeded or planted must be treated by the best technology currently available (BTCA) before discharge. Sediment control through BTCA practices must be maintained until the disturbed area has been reclaimed, the revegetation requirements have been met, and the area meets state and federal requirements for the receiving stream.

## **5.2 Federal and State RCRA Subtitle C Requirements**

**Federal and State RCRA Subtitle C Requirements, 42 U.S.C. Section 6921, et seq. (relevant and appropriate for solid wastes, applicable for hazardous wastes).** The presentation of RCRA Subtitle C requirements in this section assumes that there will be solid wastes left in place in a waste management area (i.e., a repository) as a result of Reclamation. Because of the similarity of this waste management area to the RCRA waste management unit, certain discrete portions of the RCRA Subtitle C implementing regulations will be relevant and appropriate for Reclamation. RCRA Subtitle C and implementing regulations are designated as applicable for any hazardous wastes that are actively generated as part of this remedial action or that were placed or disposed after 1980. Also, should hazardous wastes be discovered as part of any Reclamation, EPA reserves the right to identify RCRA Subtitle C requirements in more detail at a later date. All federal RCRA Subtitle C requirements set forth below are incorporated by reference as State of Montana requirements as provided for under ARM 17.53.105(2) unless mentioned otherwise below.

### **40 CFR Part 264 Subpart F.**

**General Facility Standards.** These are potentially relevant and appropriate for solid wastes at Reclamation sites. Any waste management unit or similar area would be required to comply with the following requirements.

**40 CFR † 264.92, .93. and .94.** Prescribes groundwater protection standards.

**40 CFR † 264.97.** Prescribes general groundwater monitoring requirements.

**40 CFR † 264.98.** Prescribes requirements for monitoring and detecting indicator parameters.

### **Closure requirements.**

**40 CFR † 264.111.** Provides that the owner or operator of a hazardous waste management facility must close the facility in a way that minimizes the need for further maintenance, and controls or eliminates the leaching or escape of hazardous waste or its constituents, leachate, or runoff to the extent necessary to protect human health and the environment.

**40 CFR ' 264.117.** Incorporates monitoring requirements in Part 264, including those mentioned at Part 264.97 and Part 264.303. It governs the length of the post-closure care period, permits a lengthened security period, and prohibits any use of the property which would disturb the integrity of the management facility.

**40 CFR ' 264.310.** Specifies requirements for caps, maintenance, and monitoring after closure.

**40 CFR ' 264.301.** Prescribes design and operating requirements for landfills.

**40 CFR ' 264.301(a).** Provides for a single liner and leachate collection and removal system.

**40 CFR ' 264.301(f).** Requires a run-on control system.

**40 CFR ' 264.301(g).** Requires a run-off management system.

**40 CFR ' 264.301(h).** Requires prudent management of facilities for collection and holding of run-on and run-off.

**40 CFR ' 264.301(i).** Requires that wind dispersal of particulate matter be controlled.

### **5.3 Federal and State RCRA Subtitle D and Solid Waste Management Requirements**

40 CFR Part 257 establishes criteria under Subtitle D of the Resource Conservation and Recovery Act for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. See 40 CFR ' 257.1(a). This part comes into play whenever there is a disposal of any solid or hazardous waste from a facility. Disposal is defined as the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters. See 40 CFR ' 257.2. Facility means any land and appurtenances thereto used for the disposal of solid wastes. Solid waste requirements are either applicable to mine wastes as solid waste or are relevant and appropriate for the management, handling, storage, monitoring and disposal of the mine wastes to be addressed in a Reclamation Project.

#### **5.3.1. Federal Requirements**

**40 CFR ' 257 (applicable).** Establishes Criteria for Classification of Solid Waste Disposal Facilities and Practices. Reclamation will comply with the following requirements.

**40 CFR ' 257.3-1.** Washout of solid waste in facilities in a floodplain posing a hazard to human life, wildlife, or land or water resources shall not occur.

**40 CFR ' 257.3-2.** Facilities shall not contribute to the taking of endangered species or the endangering of critical habitat of endangered species.

**40 CFR ' 257.3-3.** A facility shall not cause a discharge of pollutants, dredged or fill material, into waters of the United States in violation of Sections 402 and 404 of the

Clean Water Act, as amended, and shall not cause non-point source pollution, in violation of applicable legal requirements implementing an area wide or statewide water quality management plan that has been approved by the Administrator under Section 208 of the Clean Water Act, as amended.

**40 CFR • 257.3-4.** A facility shall not contaminate an underground source of drinking water beyond the solid waste boundary or beyond an alternative boundary specified in accordance with this section.

**40 CFR • 257.3-8(d).** Access to a facility shall be controlled so as to prevent exposure of the public to potential health and safety hazards at the site.

### **5.3.2. State of Montana Solid Waste Requirements.**

The Montana Solid Waste Management Act, Section 75-10-201 et seq., MCA, and regulations are applicable to the management and disposal of all solid wastes, including mine wastes at sites that are not currently subject to operating permit requirements.

**ARM • 17.50.505(1) and (2) (applicable).** Sets forth standards that all solid waste disposal sites must meet, including the requirements that (1) Class II landfills must confine solid waste and leachate to the disposal facility. If there is the potential for leachate migration, it must be demonstrated that leachate will only migrate to underlying formations which have no hydraulic continuity with any state waters; (2) adequate separation of group II wastes from underlying or adjacent water must be provided<sup>7</sup>; and (3) no new disposal units or lateral expansions may be located in wetlands. ARM 17.50.505 also specifies general soil and hydrogeological requirements pertaining to the location of any solid waste management facility.

**ARM 17.50.506 (applicable).** Specifies design requirements for landfills. Landfills must either be designed to ensure that MCLs are not exceeded or the landfill must contain a composite liner and leachate collection system which comply with specified criteria.

**ARM 17.50.511 (applicable).** Sets forth operational and maintenance and design requirements for solid waste management facilities using land filling methods. Specific requirements specified in ARM 17.50.511 that are applicable are run-on and run-off control systems requirements, requirements that sites be fenced to prevent unauthorized access, and prohibitions of point source and nonpoint source discharges which would violate Clean Water Act requirements.

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<sup>7</sup> The extent of separation shall be established on a case-by-case basis, considering terrain and the type of underlying soil formations, and facility design.

**ARM 17.50.523 (applicable)**. Specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.

**ARM 17.50.530 (applicable)**. Sets forth the closure requirements for landfills. Class II landfills must meet the following criteria: (1) install a final cover that is designed to minimize infiltration and erosion; (2) design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than  $1 \times 10^{-5}$  cm/sec, whichever is less; (3) minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth and protecting the infiltration layer from frost effects and rooting damage; (4) revegetate the final cover with native plant growth within one year of placement of the final cover.

**ARM17.50.531 (applicable)**. Sets forth post closure care requirements for Class II landfills. Post closure care must be conducted for a period sufficient to protect human health and the environment. Post closure care requires maintenance of the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cover and comply with the groundwater monitoring requirements found at ARM Title 17, chapter 50, subchapter 7.

**Section 75-10-206, MCA**, allows variances to be granted from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship.

## **5.4 Federal and State Mine Reclamation Requirements**

### **5.4.1 Surface Mining Control and Reclamation Act**

**Surface Mining Control and Reclamation Act, 30 USC ' ' 1201-1326 (relevant and appropriate)**. This Act and implementing regulations found at 30 CFR Parts 784 and 816 establish provisions designed to protect the environment from the effects of surface coal mining operations, and to a lesser extent non-coal mining. These requirements are relevant and appropriate to the covering of discrete areas of contamination. The regulations require that revegetation be used to stabilize soil covers over reclaimed areas. They also require that revegetation be done according to a plan which specifies schedules, species which are diverse and effective, planting methods, mulching techniques, irrigation if appropriate, and appropriate soil testing. Reclamation performance standards are currently relevant and appropriate to mining waste sites.

### **5.4.2 Montana Statutory and Regulatory Requirements**

**Montana Strip and Underground Mine Reclamation Act, Section 82-4-201, et seq., MCA (relevant and appropriate) and Montana Metal Mining Act, Section 82-4-301, et seq., MCA (relevant and appropriate)**. The specified portions of the following statutory or regulatory provisions, as identified below, are relevant and appropriate requirements.

**Section 82-4-231, MCA**. Requires operators to reclaim and revegetate affected lands using most modern technology available. Operators must grade, backfill, topsoil, reduce high walls,

stabilize subsidence, control water, minimize erosion, subsidence, land slides, and water pollution.

**Section 82-4-233, MCA.** Operators must plant vegetation that will yield a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area and capable of self-regeneration.

**Section 82-4-336, MCA.** Disturbed areas must be reclaimed to utility and stability comparable to adjacent areas.

**ARM 17.24.501.** Provides general backfilling and grading requirements. Backfill must be placed so as to minimize sedimentation, erosion, and leaching of acid or toxic materials into waters, unless otherwise approved. Final grading must be to the approximate original contour of the land and final slopes must be graded to prevent slope failure, may not exceed the angle of repose, and must achieve a minimum long term static safety factor of 1:3. The disturbed area must be blended with surrounding and undisturbed ground to provide a smooth transition in topography.

**ARM 17.24.519.** Requires monitoring of settling of regraded areas.

**ARM 17.24.631(1), (2), (3)(a) and (b).** Requires minimization of disturbances to the prevailing hydrologic balance. Changes in water quality and quantity, in the depth to groundwater and in the location of surface water drainage channels will be minimized. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

**ARM 17.24.633.** Surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

**ARM 17.24.634.** Requires disturbed drainages be restored to the approximate pre-disturbance configuration. Drainage design must emphasize channel and floodplain dimensions that approximate the pre-mining configuration and that will blend with the undisturbed drainage above and below the area to be reclaimed. The average stream gradient must be maintained with a concave longitudinal profile. This regulation provides specific requirements for designing the reclaimed drainage to: (1) approximate an appropriate geomorphic habit or characteristic pattern; (2) remain in dynamic equilibrium with the system without the use of artificial structural controls; (3) improve unstable premining conditions; (4) provide for floods and for the long-term stability of the landscape; and (5) establish a premining diversity of aquatic habitats and riparian vegetation.

**ARM 17.24.635 through 17.24.637** set forth requirements for temporary and permanent diversions.

**ARM 17.24.638.** Sediment control measures must be implemented during operations.

**ARM 17.24.639.** Sets forth requirements for construction and maintenance of sedimentation ponds.

**ARM 17.24.640.** Discharges from sedimentation ponds, permanent and temporary impoundments, must be controlled to reduce erosion and enlargement of stream channels, and to minimize disturbance of the hydrologic balance.

**ARM 17.24.641.** Establishes practices to avoid drainage from acid or toxic forming spoil material into ground and surface water.

**ARM 17.24.643 through 17.24.646.** Provisions for groundwater protection, groundwater recharge protection, and groundwater and surface water monitoring.

**ARM 17.24.701 and 702.** Requirements for redistributing and stockpiling of soil for reclamation. Also, outlines practices to prevent compaction, slippage, erosion, and deterioration of biological properties of soil.

**ARM 17.24.703.** When using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

**ARM 17.24.711.** Requires that a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected shall be established except on road surfaces and below the low-water line of permanent impoundments. See also Section 82-4-233, MCA (Relevant and Appropriate). Vegetative cover is considered of the same seasonal variety if it consists of a mixture of species of equal or superior utility when compared with the natural vegetation during each season of the year. This requirement may not be appropriate where other cover is more suitable for the particular land use or another cover is requested by the landowner.

**ARM 17.24.713.** Seeding and planting of disturbed areas must be conducted during the first appropriate period favorable for planting after final seedbed preparation.

**ARM 17.24.714.** Mulch or cover crop or both must be used until adequate permanent cover can be established.

**ARM 17.24.716.** Establishes method of revegetation.

**ARM 17.24.717.** Relates to the planting of trees and other woody species if necessary, as provided in Section 82-4-233, MCA, to establish a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the affected area and capable of self-regeneration and plant succession at least equal to the natural vegetation of the area, except that introduced species may be used in the revegetation process where desirable and necessary to achieve the approved land use plan.

**ARM 17.24.718.** Requires soil amendments, irrigation, management, fencing, or other measures, if necessary to establish a diverse and permanent vegetative cover.

**ARM 17.24.721.** Specifies that rills or gullies in reclaimed areas must be filled, graded or otherwise stabilized and the area reseeded or replanted if the rills and gullies are disrupting the reestablishment of the vegetative cover or causing or contributing to a violation of water quality standards for a receiving stream.



**ARM 17.24.723.** States that operators shall conduct approved periodic measurements of vegetation, soils, water, and wildlife, and if data indicate that corrective measures are necessary, shall propose such measures.

**ARM 17.24.724.** Specifies that revegetation success must be measured against approved technical standards or unmined reference areas. Reference areas and standards must be representative of vegetation and related site characteristics occurring on lands exhibiting good ecological integrity. Required management for these reference areas is set forth.

**ARM 17.24.726.** Requires standard and consistent field and laboratory methods to obtain and evaluate revegetated area data with reference area data and/or technical standards, and sets out the required methods for measuring productivity.

**ARM 17.24.731.** If toxicity to plants or animals on the revegetated area or the reference area is suspected due to the effects of the disturbance, comparative chemical analyses may be required.

**ARM 17.24.751.** Sets forth requirements to protect and enhance fish and wildlife habitat.

**ARM 17.24.824.** If land use is to be other than grazing land or fish and wildlife habitat, areas of land affected by mining must be restored in a timely manner to higher or better uses achievable under criteria and procedures set forth.

## **5.5 Air Requirements**

Remedial activities will comply with the Montana Ambient Air Quality Regulations (above) and with the following requirements to ensure that existing air quality will not be adversely affected by Reclamation.

**ARM 17.8.308(1), (2) and (3) (applicable).** Airborne particulate matter. There shall be no production, handling, transportation, or storage of any material, use of any street, road, or parking lot, or operation of a construction site or demolition project unless reasonable precautions are taken to control emissions of airborne particles. Emissions shall not exhibit an opacity exceeding 20% or greater averaged over 6 consecutive minutes.

**ARM 17.8.304(2) (applicable).** Visible Air Contaminants. Emissions into the outdoor atmosphere shall not exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

**ARM 17.8.604 (applicable).** Lists certain wastes that may not be disposed of by open burning, including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers. Any waste which is moved from the site where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry, or demolition project) may be open burned only in accordance with the substantive requirements of ARM 17.8.611 or 612.

**ARM 17.24.761 (relevant and appropriate).** Specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of these measures could be considered relevant and appropriate to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of Reclamation at the site. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of

areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

## **5.6 Noxious Weeds**

**Noxious Weeds, Section 7-22-2101(8)(a), MCA.** Defines "noxious weeds" as any exotic plant species established or that may be introduced in the state which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities and that is designated: (i) as a statewide noxious weed by rule of the department; or (ii) as a district noxious weed by a board, following public notice of intent and a public hearing. Designated noxious weeds are listed in ARM 4.5.201 through 4.5.204 and must be managed consistent with weed management criteria developed under Section 7-22-2109(2)(b), MCA.

## **6.0 TO BE CONSIDERED (TBC) DOCUMENTS**

A list of TBC documents is included in the Preamble to the NCP, 55 Fed. Reg. 8765 (March 8, 1990). Those documents, plus any additional similar or related documents issued since that time, should be considered during the conduct of the Reclamation design and construction.

## 7.0 OTHER LAWS (NON-EXCLUSIVE LIST)

CERCLA defines as ARARs only federal environmental and state environmental and siting laws. Reclamation design, implementation, and operation and maintenance must comply with other applicable laws, except as may be provided in SMCRA.

The following other laws are included here to provide a reminder of other legal requirements Reclamation activity. They are not an exhaustive list of such requirements, but are included because they set out matters that must be addressed and, in some cases, may require advance planning. They are not included as ARARs because they are not environmental or facility siting laws. Because they are not ARARs, they are not subject to ARAR waiver provisions.

### 7.1 Other Federal Laws

**Occupational Safety and Health Regulations.** The federal Occupational Safety and Health Act regulations found at 29 CFR Part 1910 and Part 1926 are applicable to worker protection during the conduct of Reclamation .

### 7.2 Other State Laws

#### A. Groundwater Act

The Groundwater Act, ' 85-2-501, et seq., MCA, and implementing regulations, ARM 17.30.601, et seq. govern uses of groundwater and provide measures to protect groundwater from depletion or contamination. The regulations also set requirements for water wells.

Section 85-2-505, MCA, precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

Section 85-2-516, MCA, states that within 60 days after any well is completed a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

#### B. Public Water Supply Regulations

If remedial action at the site requires any reconstruction or modification of any public water supply line or sewer line, the construction standards specified in ARM 17.38.101(4) (Applicable) must be observed.

#### C. Water Rights

Section 85-2-101, MCA, declares that all waters within the state are the state's property, and may be appropriated for beneficial uses. The wise use of water resources is encouraged for the maximum benefit to the people and with minimum degradation of natural aquatic ecosystems.

Parts 3 and 4 of Title 85, Chapter 2, MCA, set out requirements for obtaining water rights and appropriating and utilizing water. All requirements of these parts are laws which must be complied with in any action using or affecting waters of the state. Some of the specific requirements are set forth below.

Section 85-2-301, MCA, of Montana law provides that a person may only appropriate water for a beneficial use.

Section 85-2-302, MCA, specifies that a person may not appropriate water or commence construction of diversion, impoundment, withdrawal or distribution works therefor except by applying for and receiving a permit from the Montana Department of Natural Resources and Conservation. While the permit itself may not be required under federal law, appropriate notification and submission of an application should be performed and a permit should be applied for in order to establish a priority date in the prior appropriation system.

Section 85-2-306, MCA, specifies the conditions on which groundwater may be appropriated, and, at a minimum, requires notice of completion and appropriation within 60 days of well completion.

Section 85-2-311, MCA, specifies the criteria which must be met in order to appropriate water and includes requirements that:

1. there are unappropriated waters in the source of supply;
2. the proposed use of water is a beneficial use; and
3. the proposed use will not interfere unreasonably with other planned uses or developments.

Section 85-2-402, MCA, specifies that an appropriator may not change an appropriated right except as provided in this section with the approval of the DNRC.

Section 85-2-412, MCA, provides that, where a person has diverted all of the water of a stream by virtue of prior appropriation and there is a surplus of water over and above what is actually and necessarily used, such surplus must be returned to the stream.

#### **D. Controlled Ground Water Areas**

Pursuant to Section 85-2-507, MCA, the Montana Department of Natural Resources and Conservation may grant either a permanent or a temporary controlled ground water area. The maximum allowable time for a temporary area is two years, with a possible two-year extension.

Pursuant to Section 85-2-506, MCA, designation of a controlled ground water area may be proposed if: (i) excessive ground water withdrawals would cause contaminant migration; (ii) ground water withdrawals adversely affecting ground water quality within the ground water area are occurring or are likely to occur; or (iii) ground water quality within the ground water area is not suited for a specific beneficial use.

#### **E. Occupational Health Act, Section 50-70-101, et seq., MCA.**

ARM 17.74.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This rule is

applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.95 applies.

ARM 17.74.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the rule. This rule is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.

#### **F. Montana Safety Act**

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

#### **G. Employee and Community Hazardous Chemical Information**

Sections 50-78-201, 202, and 204, MCA, state that each employer must post notice of employee rights, maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used. Employees must be informed of the chemicals at the work place and trained in the proper handling of the chemicals.





# APPENDIX C

Estimated Reclamation Action Costs





**Engineer's Estimate**  
**Alternative 2: Mine Waste Removal & Disposal at Off-Site Repository**  
**Expanded Engineering Evaluation and Cost Analysis**  
**Lilly/Orphan Boy Mine**

Item	Description	Units	Unit Cost	Quantity	Est. Subtotal	Comments
<b>1.0 Property Purchase</b>						
1.1	5-acre parcel (no improvements)	LS	\$ 100,000	1	\$ 100,000	Based on real estate listings in Elliston area
<b>2.0 Stream Diversion</b>						
2.1	Diversion berm	EA	\$ 2,500	1	\$ 2,500	
2.2	Diversion piping, installed	LF	\$ 12.50	160	\$ 2,000	Diversion piping to begin above area of ponding and continue downstream of Waste Rock Pile 3
2.3	Sedimentation basin	EA	\$ 2,500	1	\$ 2,500	At discharge of diversion pipe to prevent scouring
				<i>Subtotal</i>	<b>\$ 7,000</b>	
<b>3.0 Mine Waste Removal</b>						
3.1	Access improvement	LS	\$ 5,000	1	\$ 5,000	Access to Waste Rock Pile 3
3.2	Excavate, load, haul mine waste	CY	29.50	4415	\$ 130,243	Waste Rock Pile 1 - 3 and incidental soil
3.3	Rough grading	CY	\$4.80	2100	\$ 10,080	Post removal of mine waste
3.4	Run-on Diversion	LF	\$15.50	600	\$ 9,300	Uphill swale / berm to divert run-on away from mine
3.5	Fine grading	SY	\$ 2.50	6200	\$ 15,500	
3.6	Stream reconstruction	LF	\$ 40	160	\$ 6,400	Rough grading only. Final reconstruction by others.
3.7	Import / spread topsoil	CY	\$ 35	1050	\$ 36,750	Assume 6 inches topsoil spread over disturbed area
3.8	Revegetation	SY	\$ 0.55	6200	\$ 3,410	Broadcast seeding with hydromulch
				<i>Subtotal</i>	<b>\$ 216,700</b>	
<b>4.0 Repository Construction</b>						
4.1	Survey / construction staking	LS	\$ 4,500	1	\$ 4,500	
4.2	Access improvements	LS	\$ 2,500	1	\$ 2,500	
4.3	Cut & chip trees	AC	\$ 3,500	1.5	\$ 5,250	Assumes thin tree cover in repository area
4.4	Clearing & grubbing	AC	\$ 7,000	1.5	\$ 10,500	
4.5	Strip /stockpile topsoil	BCY	\$ 2.25	540	\$ 1,215	assumes 4 inches of topsoil present
4.6	Excavate / stockpile subsoil in footprint	BCY	\$ 2.50	4840	\$ 12,100	assume 3 ft. of subsoil excavated (Means)
4.7	Rough grade subgrade	HR	\$ 170	6	\$ 1,020	
4.8	Compact subgrade	LS	\$ 500	1	\$ 500	
4.9	Place and compact mine waste	LCY	\$ 5.78	5520	\$ 31,906	assumes 25% bulking factor for loose (excavated) waste rock
4.10	Rough grading	LCY	\$ 2.62	1600	\$ 4,192	top 1-ft interval of mine waste
4.11	Compost, delivered	CY	\$ 35.00	1080	\$ 37,800	
4.12	Gravel, delivered	CY	\$ 32.00	810	\$ 25,920	drainage layer
4.13	GCL, installed	SF	\$ 0.70	43600	\$ 30,520	
4.14	Drainage layer, installed	LCY	\$ 2.75	810	\$ 2,228	
4.15	Repository cover - soil placement	LCY	\$ 2.62	4840	\$ 12,681	
4.16	Revegetation	SY	\$ 0.53	7260	\$ 3,848	
4.17	Runoff / run-on control ditches	LS	\$ 3,500	1	\$ 3,500	
				<i>Subtotal</i>	<b>\$ 190,200</b>	

**Engineer's Estimate**  
**Alternative 2: Mine Waste Removal & Disposal at Off-Site Repository**  
**Expanded Engineering Evaluation and Cost Analysis**  
**Lilly/Orphan Boy Mine**

Item	Description	Units	Unit Cost	Quantity	Est. Subtotal	Comments
<b>5.0</b>	<b><u>Adit Discharge</u></b>					
5.1	Lilly Adit access improvements / barrier	LS	\$ 20,000	1	\$ 20,000	
<b>SUBTOTAL DIRECT CAPITAL COSTS</b>					<b>\$ 533,900</b>	
<b>6.0</b>	<b><u>Mobilization and Site Prep</u></b>					
6.1	Mobilization	%	\$ 433,900	12%	\$ 52,100	
6.2	Construction BMPs	%	\$ 433,900	6%	\$ 26,000	
6.2	Demobilization and Cleanup	LS	\$ 5,000	1	\$ 5,000	
				<i>Subtotal</i>	<b>\$ 83,100</b>	
<b>7.0</b>	<b><u>Engineering / Support Costs</u></b>					
7.1	Wetland Delineation / Pre-Construction Notice	LS	\$ 4,500	1	\$ 4,500	
7.2	Project Management/ Administrative Costs	%	\$ 433,900	6%	\$ 26,000	
7.3	Engineering and Design	%	\$ 433,900	15%	\$ 65,100	
7.4	Construction Management	%	\$ 433,900	10%	\$ 43,400	
				<i>Subtotal</i>	<b>\$ 139,000</b>	
8.0	Contingency	%	\$ 533,900	25%	\$ 133,500	
<b>TOTAL DESIGN AND CONSTRUCTION COSTS</b>					<b>\$ 889,500</b>	

**Assumptions**

1. Approximately 4,515 cubic yards of mine waste and impacted soil/sediment will be removed.
2. Excavated waste rock will be hauled to an off-site repository (approx. 7.6 miles from the site) constructed on private land.
3. No improvements will be required to the haul route between the site and the off-site repository. Standard (highway) 10 yard dump trucks would be used to haul the waste.
4. It will be necessary to construct an access road on the repository parcel from an existing public road.
5. During removal of Waste Rock Pile 3, access to the Lilly Adit will be improved to facilitate future remediation efforts. A physical barrier will be installed over the adit opening to prevent unauthorized access to the adit.
6. A diversion berm would be installed uphill of the Lilly shaft and above the upper-most adit to direct storm water / snow melt away from the mine workings.

**Engineer's Estimate**  
**Annual Maintenance and Operation Costs**  
**Alternative 2: Excavation & Off-Site Disposal**  
**Expanded Engineering Evaluation and Cost Analysis**  
**Lilly/Orphan Boy Mine Site**

<b>Year</b>	<b>Annual Monitoring Costs</b>	<b>Annual Maintenance Costs</b>	<b>Total Annual Costs</b>
1	\$ 1,000	\$ 3,500	\$ 4,500
2	\$ 1,022	\$ -	\$ 1,022
3	\$ 1,044	\$ 1,000	\$ 2,044
4	\$ 1,067	\$ -	\$ 1,067
5	\$ 1,091	\$ 3,500	\$ 4,591
<b>Net Present Value of Annual Costs</b>			<b>\$12,300</b>

**5-year nominal discount rate<sup>1</sup>** 2.40%  
**Annual Escalation Rate** 2.20%

**Source:**

<sup>1</sup> U.S. Office of Management and Budget, 2014. Circular A-94 Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses. Rev. Dec. 2014.

**Assumptions:**

1. Annual repository inspections conducted for 5 years following completion.
2. Repairs required on years 1, 3, and 5 following completion.
3. Repairs include minor erosion repairs (years 1 and 5) and control of invasive weeds (year 3).

**Engineer's Estimate**

**Alternative 3: Mine Waste Removal & Disposal at Luttrell Pit**

**Expanded Engineering Evaluation and Cost Analysis**

**Lilly/Orphan Boy Mine**

Item	Description	Units	Unit Cost	Quantity	Est. Subtotal	Comments
<b>1.0 Stream Diversion</b>						
1.1	Diversion berm	EA	\$ 2,500	1	\$ 2,500	
1.2	Diversion piping, installed	LF	\$ 12.50	160	\$ 2,000	Diversion piping to begin above area of ponding and continue downstream of Waste Rock Pile 3
1.3	Sedimentation basin	EA	\$ 2,500	1	\$ 2,500	At discharge of diversion pipe to prevent scouring
				<i>Subtotal</i>	<b>\$ 7,000</b>	
<b>2.0 Mine Waste Removal</b>						
2.1	Access improvement	LS	\$ 5,000	1	\$ 5,000	Access to Waste Rock Pile 3
2.2	Excavate, load, haul mine waste	CY	29.50	4415	\$ 130,243	Waste Rock Pile 1 - 3 and impacted soil/sediment
2.3	Rough grading	CY	\$4.80	2100	\$ 10,080	Post removal of mine waste
2.4	Run-on Diversion	LF	\$15.50	600	\$ 9,300	Uphill swale / berm to divert run-on away from mine
2.5	Fine grading	SY	\$ 2.50	6200	\$ 15,500	
2.6	Stream reconstruction	LF	\$ 40	160	\$ 6,400	Rough grading only. Final reconstruction by others.
2.7	Import / spread topsoil	CY	\$ 35	1050	\$ 36,750	Assume 6 inches topsoil spread over disturbed area
2.8	Revegetation	SY	\$ 0.55	6200	\$ 3,410	Broadcast seeding with hydromulch
				<i>Subtotal</i>	<b>\$ 216,700</b>	
<b>3.0 Adit Discharge</b>						
3.1	Lilly Adit access improvements / barrier	LS	\$ 20,000	1	\$ 20,000	
<b>SUBTOTAL DIRECT CAPITAL COSTS</b>					<b>\$ 243,700</b>	
<b>4.0 Mobilization and Site Prep</b>						
4.1	Mobilization	%	\$ 243,700	12%	\$ 29,200	
4.2	Construction BMPs	%	\$ 243,700	6%	\$ 14,600	
4.3	Demobilization and Cleanup	LS	\$ 5,000	1	\$ 5,000	
				<i>Subtotal</i>	<b>\$ 48,800</b>	
<b>5.0 Engineering / Support Costs</b>						
5.1	Wetland Delineation / Pre-Construction Notice	LS	\$ 4,500	1	\$ 4,500	
5.2	Project Management/ Administrative Costs	%	\$ 243,700	6%	\$ 14,600	
5.3	Engineering and Design	%	\$ 243,700	15%	\$ 36,600	
5.4	Construction Management	%	\$ 243,700	10%	\$ 24,400	
				<i>Subtotal</i>	<b>\$ 80,100</b>	
6.0	Contingency	%	\$ 228,500	25%	\$ 60,900	
<b>TOTAL DESIGN AND CONSTRUCTION COSTS</b>					<b>\$ 433,500</b>	

## **Engineer's Estimate**

### **Alternative 3: Mine Waste Removal & Disposal at Luttrell Pit**

#### **Expanded Engineering Evaluation and Cost Analysis**

#### **Lilly/Orphan Boy Mine**

##### **Assumptions**

1. Approximately 4,515 cubic yards of mine waste and impacted soil/sediment will be removed.
2. Excavated waste rock will be hauled to the Luttrell Pit (approx. 6.6 miles from the site) and stockpiled for future placement in the repository. Haul route to repository identified by Montana Department of Environmental Quality.
3. No tipping fees will be charged for disposal of the mine waste / soil at the Luttrell Pit.
4. No improvements will be required to the haul route between the site and the Luttrell Pit. Standard (highway) 10 yard dump trucks would be used to haul the waste.
5. During removal of Waste Rock Pile 3, access to the Lilly Adit will be improved to facilitate future remediation efforts. A physical barrier will be installed over the adit opening to prevent unauthorized access to the adit.
6. A diversion berm would be installed uphill of the Lilly shaft and above the upper-most adit to direct storm water / snow melt away from the mine workings.