RAINY MINE & MILL SITE

Mt. Baker-Snoqualmie National Forest
Snohomish County, Washington

ENGINEERING EVALUATION/ COST ANALYSIS

June 2008

Prepared For:
U.S. Forest Service

MSE
Millennium Science & Engineering, Inc.

ENGINEERING EVALUATION/COST ANALYSIS

Rainy Mine and Mill Site
Mount Baker-Snoqualmie National Forest, Washington

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ACRONYMS AND ABBREVIATIONS

μg/L	Microgram per liter
bcy	Bank cubic yard
cfs	Cubic feet per second
cm/sec	Centimeter per second
gpm	Gallon per minute
lcy	Loose cubic yard
mg/L	Milligram per liter
mg/kg	Milligram per kilogram
sf	Square foot
t $CaCO_3$/kt	Ton calcium carbonate per kiloton of waste
ABA	Acid base accounting
AGP	Acid generating potential
AMSL	Above mean sea level
APA	Abbreviated Preliminary Assessment
ARAR	Applicable or Relevant and Appropriate Requirements
BMP	Best management practice
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CES	Cascade Earth Sciences
CFR	Code of Federal Regulations
COI	Contaminant of interest
COPC	Contaminant of potential concern
COR	Contracting Officer's Representative
CPEC	Contaminant of potential ecological concern
EE/CA	Engineering Evaluation/Cost Analysis
EF	Exposure factor
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
FP S&Gs	Forest Plan Standards and Guidelines
FR	Forest Road
GCL	Geosynthetic clay liner
HDPE	High density polyethylene
HHRA	Human Health Risk Assessment
HI	Hazard index
LRMP	Land and Resource Management Plan
MDC	Maximum detected concentration
MDL	Method detection limit
MFSR	Middle Fork Snoqualmie River
MSE	Millennium Science and Engineering, Inc.
MTCA	Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFS	National Forest System
NNP	Net neutralization potential
NPR	Neutralization potential ratio
NWFP	Pacific Northwest Forest Plan
O&M	Operations and maintenance
PRG	Preliminary Remediation Goal
RAO	Removal action objective

ACRONYMS AND ABBREVIATIONS (continued)

RfD	Reference dose
RME	Reasonable maximum exposure
RTE	Rare, threatened or endangered
SHPO	State Historic Preservation Officer
SI	Site Inspection
SPLP	Synthetic precipitation leaching procedure
T&E	Threatened and endangered
TCLP	Toxicity characteristic leaching procedure
TEE	Terrestrial Ecologic Evaluation
WAC	Washington Administrative Code
WDOE	Washington Department of Ecology
WSDH	Washington State Department of Health
WRCC	Western Regional Climate Center
XRF	X-Ray fluorescence

EXECUTIVE SUMMARY

Millennium Science and Engineering, Inc. (MSE) prepared this Engineering Evaluation/Cost Analysis (EE/CA) for a proposed Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) removal action at the Rainy Mine in western Washington. This inactive copper mine is located on the Mt. Baker-Snoqualmie National Forest, about 12 miles northeast of the town of North Bend, (Figure 1). While the Site is currently inactive, several active mining claims still exist on the Site. The Site is in the Quartz Creek drainage, which is a tributary to the Taylor River and Middle Fork of the Snoqualmie River (MFSR). Sensitive ecosystems within 2 miles of the Site include jurisdictional wetlands on Quartz Creek. In addition, numerous sensitive or threatened species have potential habitat in the vicinity of the Site.

The scope of removal actions evaluated in this EE/CA focus on:

(1) Eliminating direct contact with high concentrations of metals in the waste rock, soil, and sediment for all receptors;
(2) Reducing or eliminating the migration of contaminants to the environment;
(3) Improving surface water quality; and
(4) Mitigating physical hazards at the Site.

Cascade Earth Sciences (CES) completed a Site Inspection (SI) of the Rainy Mine in 2005. The Site consists of a small concrete mill foundation, two waste rock piles, an open vertical shaft, one open adit and several apparent collapsed features. Public site use is moderate and physical hazards at the Site pose a significant public risk. The Site is adjacent to a large perennial stream (Quartz Creek) and two seeps emanating from waste rock pile WR-1, and a small unnamed ephemeral stream that flows across waste rock pile WR-2 contribute metals loading to the stream. MSE evaluated potential human health and ecological risks at the Site in 2006. The streamlined risk evaluation indicated significant potential risk to both human and ecological receptors at the Site from exposure to high concentrations of metals, particularly arsenic, in the mine waste, soil, sediment, and surface water. Maximum concentrations of arsenic in the mine waste/soil (15,800 milligrams per kilogram [mg/kg]) exceeded human and ecological screening criteria by 790 and 1,596 times; sediment (3.34 mg/kg) by 2 times (human health); and surface water (57.7 micrograms per liter [μg/L]) by 3,206 and 19 times, respectively. Risk-based cleanup levels were developed for soil and sediment in the risk evaluation using human health risk equations and site-specific exposure factors to back-calculate values based on acceptable risk levels (MSE 2006).

Mine waste and sediment at the seeps contain high concentrations of metals and are the primary contaminant sources at the Site. Fine-grained materials (i.e., sediment) that may have been deposited in, or migrated to, Quartz Creek is considered a secondary contaminant source. Surface and groundwater flowing through the mine waste are also considered secondary contaminant sources because impairments to surface water quality at the Site result from direct contact with the mine waste. Removal of the primary contaminant sources (i.e. mine waste and seep sediments) should eliminate surface water quality impairments and metals loading to Quartz Creek and significantly improve water quality. Therefore, the removal action alternatives focused on addressing the mine waste and treatment of the seeps and surface water at the Site was not included in the removal scope. Groundwater is not used for drinking water at the site and future use as a drinking source is not anticipated so treatment of groundwater was not included in the removal scope. Sediment that has migrated to Quartz Creek was also eliminated from the removal scope because it does not pose a significant human health risk, is generally consistent with background, and an in-stream removal would result in significant collateral damage to the stream channel. If future water quality monitoring indicates that a significant risk from surface water or sediment in Quartz Creek remains, additional removal actions may be necessary.

Three removal action alternatives were evaluated for the Rainy Mine:

- Alternative 1 – No Action
- Alternative 2 – Excavation and Off-site Disposal
- Alternative 3 – Excavation and On-site Disposal

Alternative 3 is recommended. Approximately 2,000 bank cubic yards (bcy) of mine waste, soil, sediment and concrete would be excavated and disposed of in an on-site repository to be constructed on a ridge above the mill site. Another 150 bcy of mine waste would be used to backfill the open shaft. The repository would be capped with an engineered low permeability cover to minimize infiltration through the waste material. The excavated waste areas would be covered with topsoil, seeded, and hydromulched. Trees and brush cleared during the removal action would be used to generate slash and cover for seeded areas. Physical hazards would be addressed by installing a bat gate in the open adit and filling the open shaft with mine waste. Approximately 20 loose cubic yards (lcy) of miscellaneous debris and litter would be removed and hauled to the nearest sanitary landfill for disposal. A temporary bridge must be erected to provide heavy equipment access to the Site. Because long-term maintenance (other than post-removal water quality monitoring) is not expected to be necessary, permanent vehicular access is not required and the bridge would be removed at completion of the removal action.

The total estimated cost for the recommended alternative is **$508,150.**

1.0 INTRODUCTION

Millennium Science and Engineering, Inc. (MSE) was contracted by the United States Department of Agriculture, Forest Service (Forest Service) to perform an Engineering Evaluation/Cost Analysis (EE/CA) for a contemplated non-time critical removal action at the Rainy Mine ("the Site") on the Mt. Baker-Snoqualmie National Forest.

- This EE/CA is being performed by the Forest Service under its cleanup authorities (42 USC 9604(a), 7 Code of Federal Regulations (CFR) 2.60(a)(39) and Federal Executive Order 12580). The purpose of this EE/CA is to select an alternative to minimize or eliminate any release or threat of release of a hazardous substance into the environment or impact on public health and welfare as outlined in 40 CFR 300.415(b)(2)(i)-(viii).
- This EE/CA was prepared utilizing the U.S. Environmental Protection Agency (EPA) *"Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA"* and in accordance with the provisions of National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300.415(b)(4)(i).
- The purpose of a removal action is to "abate, prevent, minimize, stabilize, mitigate or eliminate the release or the threat of a release" (40 CFR 300.415). The EE/CA for a removal action is intended to:
  - Satisfy environmental review requirements for removal actions;
  - Satisfy administrative record requirements for documentation of removal action selection; and
  - Provide a framework for evaluating and selecting alternative technologies.
- To meet those purposes, this EE/CA identifies objectives for the removal action and evaluates the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives.
- The primary sources of data used to evaluate site conditions and to develop removal action alternatives, are the Streamlined Human Health and Ecological Risk Assessment report prepared by MSE (2006), the Site Inspection (SI) report prepared by Cascade Earth Sciences (CES 2005), and the Abbreviated Preliminary Assessment (APA) prepared by the Forest Service (2003).

2.0 SITE CHARACTERIZATION

A detailed site characterization is presented in the SI (CES 2005); please refer to that report for more information. A vicinity map is provided in Figure 1, and an overall site map showing primary site features is provided in Figure 2. Site features include:

- One open vertical shaft;
- One adit and several apparent collapsed features;
- Two waste rock piles; and
- Concrete mill foundation and miscellaneous debris.

2.1 Surrounding Land Use and Populations

Land uses in areas surrounding the Site include minerals prospecting, timber harvesting, firewood cutting, and recreational activities such as hiking, swimming, camping, fishing, and hunting. While the Site is currently inactive, there are four active claims on the Site (CES 2005). Site public use is moderate and the Site is promoted in *Discovering Washington's Historic Mines* (Northwest Underground Explorations 1997). The town of North Bend is about 12 miles southwest of the Site and has approximately 4,746 inhabitants (U.S. Census Bureau 2006). There are no known residences within a 4-mile radius of the Site (CES 2005).

2.2 Data Gap Investigation

MSE conducted a reconnaissance of the Site with the Forest Service Contracting Officer's Representative (COR) on June 12, 2007. Selected photographs taken during the site reconnaissance are provided in Appendix A. The estimated waste rock and contaminated soil quantities are presented in bank cubic yards (bcy). In general, the observed Site features were consistent with descriptions presented in the SI report and APA.

- Access along Forest Road (FR) 5640 is difficult and requires a high-clearance, 4-wheel drive vehicle. The road leading from FR 5640 to the Site is heavily overgrown and blocked by a large, deep ravine that has washed out about 100 feet of road. Access by heavy equipment would require significant effort to construct a suitable road and temporary bridge across the ravine.
- The Site is located along a steep, heavily forested slope adjacent to a perennial stream at an elevation of about 1,800 feet above mean sea level (AMSL).
- Site features fall into two zones about 900 feet apart:
  - The east zone consists of the mill site, open shaft, and waste rock pile WR-1. A 70-foot caved adit reportedly located approximately 150 feet south of the shaft could not be located.
    - The volume of waste rock in pile WR-1 appears to be generally consistent with the SI report (~2,000 bcy).
    - Two seeps emanate from the toe of WR-1 and flow for approximately 100 feet before entering Quartz Creek. Quartz Creek flows into the Taylor River about 1.5 miles downstream of the Site and into the Middle Fork of the Snoqualmie River (MFSR) about 1.0 mile further downstream.
    - Flows from the two seeps were measured during the SI and the combined flows averaged less than 1 gallon per minute (gpm).
    - Quartz Creek was not wadeable because of high flows and the rate of flow was not measured; however, during the SI flows were recorded upstream and downstream of the Site at 14.1 cubic feet per second (cfs) and 16.1 cfs, respectively.
    - Surface water was also observed flowing along the access road and the top of WR-1 where it infiltrated. The source of this water was unclear but there were numerous springs emanating from the hillside above the Site, as well as several small streams. This flow likely contributes to the seeps emanating from the toe of WR-1.
  - The west zone consists of an open adit (Adit 1) and waste rock pile WR-2.
    - The volume of waste rock in pile WR-2 appears to be generally consistent with the SI report (~25 bcy). The pile blends well with the surrounding soil and it was difficult to discern between waste rock and natural soil based solely on visual observation.
    - A small pool of standing water was observed inside Adit 1; however, no discharge was observed and there was no evidence of flow from the adit.
    - Flow in an unnamed drainage adjacent to Adit 1 was measured at approximately 1 gpm during the SI. The unnamed drainage flows across the edge of waste rock pile WR-2 and into Quartz Creek. A water sample collected from this drainage downstream of waste rock pile WR-2 during the SI contained arsenic at 57.7 microgram per liter (µg/L). A water sample collected from this drainage upstream of WR-2 by MSE during the site reconnaissance contained total arsenic below the method detection limit (MDL) of 3 µg/L.
- Climate data for the Site was obtained from the Western Regional Climate Center (WRCC 2007). The nearest climate station is located at the Snoqualmie Pass, Washington monitoring station, about 12 miles southeast of the Site at an elevation of about 3,020 feet AMSL.
  - The Site, located approximately 1,200 feet lower in elevation than the monitoring station, likely receives less total precipitation and has higher minimum and maximum temperatures.
  - The climate data is summarized in Table 1.

2.3 Source, Nature and Extent of Contamination

Based on information provided in the SI, contaminants of interest (COI) at the Site include: aluminum, arsenic, barium, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc. Analytical results of samples collected during the SI indicated concentrations of several COIs were above screening levels in the mine waste/soil, sediment, pore water, and surface water. The highest concentrations were found in the mine waste. The analytical results are summarized in Tables 2 through 6 and a summary of the estimated volumes of waste rock, sediment, and contaminated soil is provided in Table 7.

The mill site, waste rock pile WR-1, and shaft, are located along the north side of Quartz Creek and cover about 2.5 acres. A large perennial stream, Quartz Creek, flows adjacent to the Site along the south side of the mill site. Waste rock pile WR-2 and Adit 1 are located approximately 900 feet west of the mill site along Quartz Creek. Access is via an overgrown trail, with downed trees and rocks blocking the path. According to the SI, the entire Site encompasses about 9 acres (CES 2005).

Surface water features at the Site do not support a viable fish habitat; however, cutthroat trout, a federal species of concern, have been documented in the receiving stream (Quartz Creek), which flows adjacent to the Site.

The source, nature and extent of contamination at the Site are briefly described in the following paragraphs by media type. Refer to the SI (CES 2005) for more detailed information.

Surface Water

- A total of 10 surface water samples were collected during the SI: 4 from Quartz Creek, 2 from the Taylor River, 1 from the west seep below waste rock pile WR-1, 1 from the east seep below WR-1, 1 from an unnamed drainage downstream of WR-2, and 1 from an unnamed drainage upgradient of waste rock pile WR-1.
- The 10 samples included 2 background samples: 1 from Quartz Creek upstream of the Site, but downstream of other mining sites and associated disturbances, and 1 from an unnamed drainage upgradient of waste rock pile WR-1. Another sample intended to represent background was collected from the Taylor River, upstream of the confluence with Quartz Creek, but is not believed to be representative of the background conditions at the Site because of the significant distance from the Site and presence of other potential sources of contamination upstream in the Taylor River. Therefore, because only two samples were used to characterize background conditions at the Site, the reported background concentrations should be considered representative of "apparent background" conditions.
- Ten COIs in the seeps were elevated above apparent background levels: silver, arsenic, aluminum, barium, cadmium, copper, iron, manganese lead, and zinc.
- The seep samples had pH values ranging from 4.3 to 7.1, and hardness values ranging from 19 to 21 milligram per liter (mg/L) calcium carbonate ($CaCO_3$). Surface water samples from Quartz Creek had pH values ranging from 6.3 to 6.6, and a hardness value of 3 mg/L $CaCO_3$.
- Four COIs exceeded human health screening criteria: arsenic, copper, iron, and manganese. Arsenic exceeded human health screening criteria in all surface water samples, and iron and manganese exceeded human health screening criteria in the east seep from WR-1. Iron exceeded human health screening criteria in the west seep from WR-1.
- Nine COIs exceeded ecological screening criteria: arsenic V, barium, cadmium, copper, iron, mercury, manganese, lead, and zinc. The most notable exceedances were arsenic from the unnamed drainage after flowing over WR-2, and copper in the east seep from WR-1.
- The results for several COIs were reported as analyzed for but not detected; however, the MDLs for arsenic, beryllium, cadmium, chromium, copper, nickel, and selenium were above one or more screening criteria.

- Several COIs were also detected in the samples collected from Quartz Creek: aluminum, arsenic, copper, iron, and mercury. In general, COI concentrations in the downstream sample were consistent with apparent background levels and significantly lower than in the seep samples.
- The total combined flow from the seeps and the unnamed drainage is estimated at 1.3 gpm, which represents less than 1 percent of the total flow in Quartz Creek.
- There was no noticeable change in COI concentrations in samples from Quartz Creek upstream and downstream of the Site.

Sediment and Pore Water

- Eight sediment and six pore water and samples were collected during the SI. Single background samples of each were collected from Quartz Creek upstream of the Site; therefore, the reported background concentrations should be considered representative of "apparent background" conditions.
- Sediment samples were co-located with surface water samples and collected from two locations on the Taylor River, four locations on Quartz Creek, and from the two seeps.
  - One COI exceeded human health screening criteria in all sediment samples: arsenic. All samples exceeded the EPA Region 9 Industrial Soil Preliminary Remediation Goal (PRG) for arsenic (1.6 milligram per kilogram [mg/kg]).
  - Seven COIs exceeded one or more ecological screening criteria in all samples: silver, arsenic, cadmium, copper, mercury, lead and antimony. The most notable exceedance was copper.
  - In general, COI concentrations in the downstream sediment sample from Quartz Creek were consistent with, or only slightly above, apparent background levels.
- Pore water samples were collected from four locations on Quartz Creek and from the two seeps.
  - Seven COIs in pore water exceeded ecological screening criteria: arsenic V, beryllium, cadmium, copper, iron, lead, and zinc
  - pH values ranged from 4.6 to 6.5 with a hardness value of 3 mg/L $CaCO_3$ at all locations except seep-PW1 where the hardness was 19 mg/L $CaCO_3$.
  - In general, most COI concentrations were consistent with apparent background levels.

Groundwater

- Groundwater conditions at the Site are not well documented and no groundwater samples were collected during the SI.
- No water wells are reportedly located within a 4-mile radius of the Site.
- Groundwater pathway is considered incomplete.
- Groundwater will be addressed indirectly in the consideration of the seeps and contaminated soils.

Air

- Air quality at the Site has not been characterized and no air samples were collected during the SI. The most likely source of air contamination at the Site is windblown dust particulates from the waste rock piles.
- COI concentrations in the waste rock were all below EPA's soil screening level for inhalation of particulates (EPA 2004).
- Air pathway is considered complete but insignificant.

Mine Waste and Soil

- Two mine waste piles were identified during the SI: WR-1 and WR-2. The mine waste appears to consist primarily of waste rock excavated during underground operations.
- According to the SI, the total estimated volume of waste rock at the Site is about 2,025 bcy (CES 2005).

- Three background soil samples were collected during the SI. This is a relatively small data set for adequately characterizing background conditions at the Site; therefore, the reported background concentrations should be considered representative of "apparent background" conditions. The results indicated:
  - pH values ranged from 4.4 to 5.1.
  - Two COIs exceeded human health screening criteria: arsenic and chromium.
  - 10 COIs exceeded one or more ecological screening criteria: aluminum, arsenic, chromium, copper, mercury, lead, antimony, selenium, vanadium, and zinc. The most notable exceedances were aluminum, copper, vanadium, and zinc.
- A total of nine waste rock and soil samples were collected during the SI. The results indicated:
  - pH values ranged from 3.1 to 5.0.
  - One COI exceeded human health screening criteria: arsenic.
  - Thirteen COIs exceeded one or more ecological screening criteria: silver, aluminum, arsenic, cadmium, chromium, copper, mercury, lead, antimony, selenium, thallium, vanadium, and zinc. The most notable exceedances were silver, arsenic, copper, mercury, lead, selenium, thallium, vanadium and zinc.
- Acid-base accounting (ABA), toxicity characterization leaching procedure (TCLP), and synthetic precipitation leaching procedure (SPLP) tests were conducted on mine waste/soil samples from five areas: waste rock piles WR-1 and WR-2, and three areas around the mill foundation. The results indicated the following:
  - Acid generating potential (AGP) values ranged from 10 to 36 tons of calcium carbonate per kiloton of waste (t $CaCO_3$/Kt), and neutralization potential ratios (NPR) ranged from 0.03 to 0.1.
  - Waste rock piles WR-1 and WR-2, and soils around the mill foundation are likely to generate acid.
  - None of the samples had TCLP or SPLP results exceeding the RCRA TCLP disposal limits.

<u>Mill Foundation and Debris</u>

- There are no framed structures on site and only the concrete mill foundation remains.
- Miscellaneous litter and debris are on site, particularly around the mill site and on the steep hillside above the mill foundation.

2.4 Risk Assessment Conclusion

MSE completed a streamlined human health and ecological risk assessment of the Rainy Mine to evaluate risks associated with exposure to mining-related contaminants at the Site (MSE 2006). Analytical data and other information presented in the SI (CES 2005) were used in the risk calculations. Results of the streamlined risk assessment indicated significant potential risks to both human and ecological receptors at the Site.

2.4.1 Human Health Risk Assessment

The streamlined human health risk assessment (HHRA) indicated non-carcinogenic hazard and carcinogenic risk from exposure to metals, particularly arsenic, in mine waste, sediment, and surface water at the Site.

- Non-carcinogenic Hazard Indices (HI) ranged from 0.2 to 4 for the adult recreationalist, and from 3 to 100 for the child recreationalist. An HI greater than 1 indicates a potential health risk because the estimated contaminant intake exceeds the reference dose (RfD). The RfD is a contaminant-specific value established by the EPA that represents the exposure level above which represents potential adverse health effects. Six human health contaminants of potential concern

(COPC) were identified for non-carcinogenic risk: arsenic, cadmium, chromium, copper, iron, and manganese.

- Carcinogenic risks ranged from 9.E-06 to 8.E-04 for the adult recreationalist, and from 1.E-04 to 5.E-03 for the child recreationalist. Under CERCLA, EPA generally considers carcinogenic risks to an individual ranging from 1.E-06 to 1.E-04 to be acceptable depending on specific site and exposure characteristics (EPA 1991). Three COPCs were identified for carcinogenic risks: arsenic, cadmium, and chromium.
- The most significant exposure pathway is ingestion of and dermal contact with arsenic in the mine waste. Ingestion of surface water also poses a slight human health risk.
- Inhalation of particulates from the mine waste, and dermal contact with sediment and surface water contribute minimal risk and are insignificant pathways.

2.4.2 Ecological Risk Assessment

Results of the streamlined ecological risk assessment (ERA) indicated significant potential risk to ecological receptors, particularly rare, threatened, or endangered (RTE) ecological species that have potential habitat in vicinity of the Site.

- Several contaminants of potential ecological concern (CPEC) were identified at the Site, most notably aluminum, arsenic, copper, and iron.
- The highest risk ratios to terrestrial receptors were from exposure to the mine waste. There is also risk to aquatic receptors from exposure to CPECs in surface water and sediment, particularly from copper.
- With the possible exception of amphibian species, the risks appear to be limited to individual receptors rather than whole populations. This is because while individual receptors may be exposed to metals in mine wastes at the Site, their populations are unlikely to be significantly impacted because it is improbable that entire populations of receptors reside strictly within the site boundaries.
- Some sensitive species, such as the Oregon tailed frog or western toad, may have individual receptors that are at risk because they have much smaller home ranges and may inhabit areas around the seeps. This is critical because threatened and endangered (T&E) species are to be protected to the individual level. A biological survey should be conducted to determine whether those species are present at the Site in areas around the seeps, and whether bats inhabit the open shaft. A Forest Service Biologist should be consulted to determine whether protective measures need to be taken if these sensitive species are present on site.

2.4.3 Physical Hazards

Physical hazards at the Site include:

- One open shaft,
- One open adit,
- Miscellaneous debris, and
- Deep ravine across access road to the site.

<u>Adit</u>

- Adit 1 is located 900 feet west of the mill site (Figure 2).
  - The adit is in sound condition and is large enough for entry (approximately 5-feet wide by 7-feet high).

Shaft

- The shaft is located approximately 10 feet uphill of the mill foundation, approximately 5-feet by 5-feet and is partially open posing a fall hazard.

Miscellaneous Debris

- There is miscellaneous debris scattered at the mill site, particularly along the hillside above the shaft.
  - The debris consists primarily of scattered wooden timbers, mining debris, sheet metal, and other general litter.
  - There is a large (~5-foot diameter by 8-foot long) steel tank near the southwest edge of waste rock pile WR-1. The tank appeared to be empty during the site reconnaissance.
  - The concrete mill foundation is cut into the hillside and covers an area of about 75 square feet (sf).

Ravine

- The ravine that has washed out about 100 feet of the access road leading to the site from FR 5640 is about 30 feet deep with extremely steep slopes and poses a significant fall hazard to hikers and all-terrain vehicles (ATV).

3.0 SITE CLEANUP CRITERIA

There are two general types of cleanup criteria:

(1) Applicable or Relevant and Appropriate Requirements (ARAR), and
(2) Risk-based cleanup criteria developed from human health risk equations using acceptable risk levels and site-specific factors.

ARARs are "applicable" or "relevant and appropriate" federal and state environmental requirements. Applicable requirements include cleanup standards and other substantive requirements, criteria, or limitations promulgated under federal or state laws that apply to hazardous substances and removal actions at the Site. Relevant and appropriate requirements are not applicable to the Site but may be suitable for use because they address issues or problems sufficiently similar to those at present at the Site. In addition to ARARs, federal and state environmental and public health guidance and proposed standards that are not legally binding but may prove useful are "to be considered" standards.

Risk-based cleanup criteria are site-specific levels determined to be protective of human health based on acceptable risk levels, and site-specific contaminant concentrations, land uses, and exposure pathways. Risk-based cleanup levels were developed for soil and sediment at the Rainy Mine as part of the streamlined HHRA (MSE 2006).

The ARARs and proposed cleanup criteria for each media at the Site are discussed below and summarized in Tables 8, 9 and 10.

3.1 Applicable or Relevant and Appropriate Requirements

ARARs are "applicable" or "relevant and appropriate" federal and state environmental requirements used to:

(1) Evaluate the extent of site cleanup needed;
(2) Scope and develop removal action alternatives; and
(3) Guide the implementation and operation of the preferred alternative.

The NCP (40CFR 300.415(j)) establishes that a removal action shall "to the extent practical, considering the exigencies of the situation, attain ARARs under federal environmental or state environmental facility siting laws."

To determine whether compliance with ARARs is practicable, two factors are specified in 40 CFR 415(j):

- Urgency, and
- Scope of the removal action.
  - The scope of the removal action is often directed at minimizing and mitigating potential hazard rather than totally eliminating the hazard; even though a particular standard may be an ARAR for a particular medium, it may be outside the scope of the immediate problem the removal action is addressing.

A comprehensive list of potential ARARs generated and evaluated for the Site is presented in Appendix B. A request for any additional Washington State-specific ARARs was submitted to the WDOE during preparation of this EE/CA; however, no response was received. The ARARs were used to determine the design specifications and performance standards for the project. They are grouped as federal or State of Washington ARARs, and are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR, and whether the ARAR is applicable, or relevant and appropriate.

- Administrative requirements are not ARARs and thus do not apply to actions conducted entirely on-site. Administrative requirements are those that involve consultation, issuance of permits, documentation, reporting, record keeping, and enforcement.
- The CERCLA program has its own set of administrative procedures, which assure proper implementation of CERCLA. The preamble to the final NCP states that the application of additional or conflicting administrative requirements could result in delay or confusion.
- Provisions of statutes or regulations that contain general goals that merely express legislative intent about desired outcomes or conditions, but are non-binding, are not ARARs. In accordance with Section 121(e) of CERCLA, no permits are required for the removal action.

Potential key chemical-, action-, and location-specific ARARs for a removal action at the Rainy Mine include, respectively:

- **Chemical-specific Water, Soil, and Sediment Quality Standards:**
  - Washington State Water Quality Standards for Surface Water (WAC Chapter 173-201A)
  - Washington State Drinking Water Standards (WAC Chapter 246-290)
  - Federal Water Quality Criteria for Surface Water (40 CFR 131.26)
  - 2007 Aquatic Life Ambient Freshwater Quality for Copper[1] (40 CFR 131.26)
  - National Toxics Rule Water Quality Standards (40 CFR 131.26)
  - Washington Model Toxics Control Act (MTCA) Industrial Soil Cleanup Levels – Human Receptors (WAC Chapter 173-340)
  - EPA PRGs for Industrial Soil (EPA 2004)
  - Washington Freshwater Sediment Management Standards (WAC Chapter 173-204)

[1] The federal Aquatic Life Ambient Freshwater Quality Criterion for copper was revised in 2007 and is potentially relevant and applicable to the Site (EPA 2007). The 2007 copper criterion uses the Biotic Ligand Model to determine acute and chronic concentrations that are protective of aquatic organisms based on ambient conditions and site-specific factors. However, because there was insufficient data to calculate the 2007 criterion for the Site, the 2006 criterion was used.

- **Solid/Dangerous Waste (Solids) Disposal Requirements:**
  - Washington MTCA Terrestrial Ecologic Evaluation (TEE) Criteria (WAC Chapter 173-340)
  - Washington State Hazardous Waste Management Act and Dangerous Waste Regulations (WAC Chapter 173-303)
  - RCRA Hazardous Waste Management Subtitle C (40 CFR Part 261 to 279)
- **Forest Plan Standard and Guidelines (FP S&Gs):**
  - Mt. Baker Snoqualmie National Forest Land and Resource Management Plan as amended by the Pacific Northwest Forest Plan (i.e. PacFish Riparian Standards and Guidelines)

3.1.1 Water, Soil, Sediment and Pore Water Quality Standards

The surface water ARARs are based on Washington State and federal standards for the protection of aquatic life and human health and are summarized in Table 8. The values for hardness dependent metals were adjusted based on an apparent background value of 3 in the two background samples. Only a few COIs in surface water at the Site exceeded the surface water quality ARARs:

- Both seeps exceed ecological ARARs for aluminum, barium, cadmium, copper, and zinc. The eastern seep exceeded the ecological ARAR for lead and the human health ARAR for manganese. The western seep exceeded human health ARARs for arsenic and iron.
- The unnamed drainage (AWR-SW3) that flows across waste rock pile WR-2 exceeded the ecological ARARs for aluminum and copper, and the human health ARAR for arsenic.
- Quartz Creek immediately downstream of the Site (QC-SW3) exceeded ecological ARARs for aluminum and copper. Immediately upstream of the confluence with the Taylor River, Quartz Creek (QC-SW4) exceeded the ecological ARAR for copper.
- Neither sample from Taylor River exceeded the surface water quality ARARs.
- One background sample from the unnamed drainage upgradient of waste rock pile WR-1 exceeded the ecological ARAR for aluminum.
- Future sampling will be required to confirm background concentrations.

The soil ARARs are based on Washington State and federal standards for the protection of human health and the environment and are summarized in Table 9. Several COIs in the background soil and waste rock at the Site exceeded the soil quality ARARs:

- Several COIs in background soil exceeded human health or ecological ARARs:
  - Arsenic and hexavalent chromium exceeded human health ARARs.
  - Arsenic, copper, lead, antimony, selenium, vanadium, and zinc exceeded ecological ARARs.
- Several COIs in waste rock at the Site exceeded human health or ecological ARARs:
  - Arsenic exceeded the human health ARAR.
  - Silver, aluminum, arsenic, cadmium, copper, lead, antimony, selenium, thallium, and vanadium exceeded ecological ARARs.
- Future sampling will be required to confirm background concentrations and risk-based cleanup criteria.

The sediment ARARs are based on Washington State and federal standards for the protection of human health and the environment and are summarized in Table 10. Several COIs in sediment at the Site exceeded the sediment quality ARARs:

- Sediment at all sample locations, including the background, exceeded the human health ARAR for arsenic and the ecological ARAR for copper.

- Sediment at both seeps exceeded ecological ARARs for silver, arsenic, cadmium, copper, and antimony.
- Sediment at seep SS-2 also exceeded ecological ARARs for mercury and lead.
- Future sampling will be required to confirm background concentrations.

The pore water ARARs are based on Washington State and federal standards for the protection of aquatic life and are listed as ecological screening criteria in Table 6. Several COIs in pore water at the Site exceeded the pore water quality ARARs:

- Pore water at all sample locations, including background, exceeded the ARARs for beryllium and cadmium; however, most of the results were non-detect but the MDLs were above the ARARs.
- Pore water at one location on Quartz Creek (QC-PW4) exceeded the copper ARAR.
- Pore water at seep PW-1 exceeded ARARs for beryllium, cadmium, copper, iron, lead, and zinc.
- Pore water at seep PW-2 exceeded ARARs for arsenic V, beryllium, cadmium, and copper.
- Future sampling will be required to confirm background concentrations.

3.1.2 Solid/Dangerous Waste (Solids) Disposal Requirements

These ARARs set minimum functional performance standards for proper handling and disposal of solid waste; describe responsibilities of various entities; and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure. All substantive requirements for closure and post-closure of limited purpose landfills (WAC 173-350-400) are potential ARARs (WAC 173-340-710[7][c]). The waste rock/soils at the Site are landfills that contain solid waste and are releasing hazardous substances above both state and federal cleanup standards.

3.1.3 Forest Plan Standard and Guidelines (FP S&Gs)

Portions of the Land and Resource Management Plan (LRMP) for Mt. Baker Snoqualmie National Forest (1990), as amended by Pacific Northwest Forest Plan (NWFP) (1994) are potentially applicable or relevant and appropriate for assessing Site remedial alternatives. The LRMP and NWFP include standards and guidelines that are potentially relevant and appropriate to actions at the Site, including activities within, or that affect Riparian Management Areas along Quartz Creek. These standards and guidelines include RF-2 through RF-7, which control the design, construction, and use of temporary and permanent roads and other modifications within Riparian Reserves; and MM-3, which controls solid waste and mine waste facilities within Riparian Reserves. Particular aspects of MM-3 that are potentially relevant and appropriate to closure of the waste rock piles at the Site include requirements for: (1) analysis based on best conventional methods; (2) designing waste facilities using best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials; and (3) reclamation and monitoring waste facilities to ensure chemical and physical stability, and to meet ACS objectives.

3.2 Risk–based Cleanup Concentrations

Risk-based cleanup criteria were developed for soil and sediment at the Site as part of the streamlined HHRA and for comparison to ARARs criteria in the event the latter were not practicable considering the exigencies of the circumstances (MSE 2006). Groundwater is not used for drinking water at the Site and future use as a drinking source is not anticipated; therefore, no cleanup criteria were identified for groundwater. Cleanup criteria for soil and sediment were developed for each COPC using the human health risk equations for the most sensitive receptor (child recreationalist) under the reasonable maximum exposure (RME) scenario and site-specific exposure factors (EF). EFs are variables that determine the

chronic daily intake rate, and include receptor body weight, exposure frequency and duration, averaging time, intake rates, chemical bioavailability, and other factors.

Cleanup levels for soil and sediment were established using an acceptable non-carcinogenic HI of 1.E+00 and a carcinogenic risk of 1.E-05 for the most sensitive receptor (child recreationalist) under the RME scenario (EPA 1991)[2]. The ARARs and the risk-based cleanup levels for soil and sediment are summarized in Tables 9 and 10. Typically risk-based criteria calculated for remote areas, such as the Rainy Mine, are higher than chemical-specific ARARs because of the reduced exposure frequency and duration at remote sites. For example, EPA's industrial PRGs for soil are based on an exposure frequency of 250 days per year, whereas the streamlined HHRA used an exposure frequency of 14 days for a recreationist at the Rainy Mine under the RME.

No COIs in sediment exceeded the risk-based cleanup criteria. Areas exceeding the soil risk-based cleanup levels are presented in Table 11 and summarized below.

- Arsenic concentrations in all soil samples collected from the waste rock piles exceeded the cleanup level of 33 mg/kg:
  - Samples from waste rock pile WR-1 had arsenic concentrations ranging from 49 to 222 mg/kg.
  - The single sample (WR-2-1) from waste rock pile WR-2 had an arsenic concentration of 15,800 mg/kg.
- Arsenic concentrations in sediment samples collected from both seeps exceeded the clean up level of 132 mg/kg:
  - Sediment from the west seep (SEEP-SS-1) had an arsenic concentration of 179 mg/kg.
  - Sediment from the east seep (SEEP-SS-2) had an arsenic concentration of 205 mg/kg.

Cleanup criteria for lead in soil and sediment could not be calculated using standard risk assessment algorithms because toxicological reference values (i.e. reference doses and slope factors) have not been established for lead. However, according to the risk assessment, there does not appear to be a human health risk from exposure to lead at the Site. The maximum detected lead concentration in soil at the Site (80 mg/kg) is well below Washington Department of Ecology's (WDOE) MTCA Method A Industrial Soil Cleanup Level of 1,000 mg/kg (2001), and EPA Region 9's Industrial Soil PRG of 800 mg/kg. In addition, the maximum detected lead concentration (31 mg/kg) in sediment is well below Washington's recommended freshwater sediment quality standard of 335 mg/kg (WDOE 2004).

4.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The general goal of a removal action is to protect human health and the environment by preventing or minimizing the potential release of a hazardous substance and reducing the potential for direct contact and transport of contaminants to the environment. Based on the human health and ecological risks identified at the Rainy Mine, the following non-time critical removal action objectives (RAO) were developed for the Site:

- Reduce human and wildlife exposure surface exposure to metals in the waste rock piles;
- Improve surface water quality and decrease metals loading to Quartz Creek;
- Improve public safety by addressing physical hazards at the Site; and

[2]Washington ARARs specify 1.E-06 excess cancer risk for individual carcinogens and 1.E-05 total risk for multiple carcinogens.

- Attain ARARs to the extent practical considering the urgency of the situation and scope of the removal.

The following sections discuss the justification for a removal action at the Site, scope of the removal action, and the proposed removal action schedule.

4.1 Removal Action Justification

40 CFR 300.415(b), lists several factors to be considered in determining whether a removal action is appropriate. The factors relevant at this Site, and the conditions establishing the presence of those factors, are summarized below:

- **Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminates:**
  - The streamlined risk assessment indicated potential risk to human and ecological receptors from exposure to metals in the mine waste, surface water, and sediment.
    - The maximum detected concentration of arsenic (15,800 mg/kg) in the mine waste exceeds the human health risk-based cleanup level of 33 mg/kg by a factor of nearly 500.
    - The MDC of one metal (arsenic) in the mine waste exceeds WDOE's MTCA Method A Industrial Soil cleanup levels.
    - The MDC of 8 metals (aluminum, antimony, arsenic, copper, lead, selenium, silver, and vanadium) in the mine waste exceed WDOE's MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Plant and Animals.
    - Metals concentrations in surface water discharging from the seeps and the unnamed drainage also exceed human health and ecological screening criteria. The seeps also contribute metals loading to Quartz Creek.
  - Land uses in areas surrounding the Site include minerals prospecting, timber harvesting, firewood cutting, and recreational activities such as hiking, swimming, camping, fishing, and hunting.
    - Since abandoned mines, especially those sites containing old structures, equipment, and mineral specimens attract these forest users, it is likely they would come into contact or potentially be exposed to high concentrations of arsenic, cadmium, chromium, copper, iron, and manganese.
    - Children's groups are known to visit the area for educational purposes.
    - The area is open to recreational use and the public is not restricted from entering the area or coming into contact with contaminated soils, rock and water at the Site.
  - Sensitive Oregon tailed frog or western toad populations are at risk because their small home ranges may include Site seep areas containing sediment and water containing high concentrations of aluminum, arsenic, copper, and iron.
  - Some impact to benthic invertebrate populations in Quartz Creek is indicated (CES 2005).
- **Actual or potential contamination of drinking water supplies or sensitive ecosystems:**
  - The seeps emanating from waste rock pile WR-1 and the unnamed drainage that flows across waste rock pile WR-2 both discharge to Quartz Creek.
  - There are no public water supplies at the Site and no drinking water wells within a 4-mile radius; however, recreationists may occasionally use water from Quartz Creek for cooking and as a drinking source.
    - Four COIs in the seeps and unnamed drainage exceeded human health screening criteria: arsenic, copper, iron, and manganese.

    - The maximum detected concentration of arsenic (57.7 μg/L) in the unnamed drainage exceeds WDOE and EPA human health screening criteria (0.018 μg/L) by a factor of more than 3,000.
  - Quartz Creek is habitat to the cutthroat trout, a federal species of concern.
    - Ten COIs in the seeps and unnamed drainage exceeded ecological screening criteria: aluminum, arsenic, barium, beryllium, cadmium, copper, iron, lead, selenium, and zinc. The maximum detected concentration of copper (2,020 μg/L) in the seep exceeds WDOE (1.86 μg/L) and EPA (1.0 μg/L) ecological screening criteria by factors of more than 1,000 and 2,000, respectively.
- **Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release:**
  - One partially buried tank was observed onsite. The tank is believed to be empty.
- **High levels of hazardous substances, pollutants, or contaminants in soils, at or near the surface that may migrate:**
  - The two waste rock piles on site contain a total of approximately 2,000 bcy.
    - The waste rock contains high concentrations of several metals.
    - Both waste rock piles are unvegetated and subject to erosion. Waste fines eroding from the piles will migrate to Quartz Creek.
    - The toe of waste rock pile WR-1 appears to be in the Quartz Creek floodplain.
- **Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released:**
  - The waste rock piles are subject to erosion during rain events and snowmelt.
  - The Site is estimated to received more than 100 inches of rain and 400 inches of snow per year.
- **Other situations or factors that may pose threats to public health or the environment:**
  - Physical hazards at the site pose a significant risk to the public and include one open shaft and one open adit.

4.2 Scope of Removal Action

The scope of removal actions evaluated in this EE/CA focus on:

1) Eliminating direct contact with high concentrations of COIs in the waste rock and soil;
2) Reducing or eliminating the migration of contaminants to the environment;
3) Improving surface water quality; and
4) Mitigating physical hazards at the Site.

The primary sources of contaminants at the Site contain high concentrations of metals and consist of the mine waste rock and fine-grained sediment at the seeps. Fine-grained material (i.e., sediment) that may have been deposited in, or migrated to Quartz Creek is considered a secondary contaminant source. Surface and groundwater flowing through the mine waste (i.e. seeps at WR-1 and unnamed drainage that flows across WR-2) are also considered secondary contaminant sources because impairments to surface water quality at the Site result from direct contact with the mine waste. The seeps and unnamed drainage are believed to have good initial water quality that is impacted by direct contact with the waste rock. A comparison of arsenic concentrations in samples from the unnamed drainage upstream and downstream of waste rock pile WR-2 supports this hypothesis. Arsenic in the downstream sample collected by CES during the SI was at a concentration of 57.7 μg/L while arsenic in the upstream sample collected by MSE during the site reconnaissance was undetectable (i.e. <3.0 μg/L).

Removal of the primary contaminant sources (i.e. mine waste and seep sediment) should eliminate surface water quality impairments and metals loading to Quartz Creek and significantly improve water quality.

Therefore, scope of this removal action focuses on addressing the mine waste, and treatment of the seeps and surface water at the Site was not included in the removal scope. Groundwater is not used for drinking water at the site and future use as a drinking source is not anticipated; therefore, treatment of groundwater is beyond the scope of this removal action. Sediment that has migrated to Quartz Creek was also eliminated from the scope of this removal action because it does not pose a significant human health risk, metals concentrations are generally consistent with background levels, and the collateral damage to the stream channel that would result from an in-stream removal action. If future water quality monitoring indicates that a significant risk from surface water or sediment in Quartz Creek remains, additional removal actions may be necessary.

Post-removal action monitoring will be required to evaluate the removal action effectiveness and compliance with the ARARs. The monitoring should include confirmation soil sampling during mine waste and contaminated soil removal, and post-removal monitoring of the aquatic habitat in Quartz Creek immediately downstream of the Site. The number and type of samples, analytical suite, MDLs, and sampling frequency should be determined in coordination with the applicable Washington State agencies.

4.3 Removal Action Schedule

The removal action is tentatively scheduled for 2009; however, the date is dependent on federal funding and may be subject to change by the Forest Service.

5.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section describes the selection of a removal action using a three–step process:

1) Identify potential removal action options and alternatives applicable to the Site and screen to eliminate ineffective or unfeasible alternatives;
2) Analyze selected removal action alternatives based on effectiveness, implementability, and cost; and
3) Identify existing data gaps that are relevant to the selected alternatives.

Removal action technologies applicable to the Site were identified based on a review of technical literature and previous experience at similar mine sites. The technologies, described in Table 12, were screened to eliminate inappropriate, ineffective, infeasible or cost prohibitive methods. In addition, technologies with unproven or uncertain performance were eliminated if they had relatively high implementation costs and/or would likely require implementation with other costly mitigation components. Technologies with uncertain or unproven performance were retained if they represented potentially cost effective mitigation and the performance can be investigated through pilot or bench scale testing. For this EE/CA, a potentially cost effective technology is one that could provide protection comparable to other standard methods utilized in mine reclamation, at a cost similar to or less than the costs of those methods. All components not screened out were retained as potential technologies that could be implemented at the Site.

The technologies were assessed relative to others in the same sub-category based on effectiveness, implementability, and cost. This allowed each technology to be assigned a relative ranking of high, medium, or low for each evaluation criterion. Table 12 summarizes the results of the removal action technology screening process, including the technologies retained for incorporation into removal action alternatives.

5.1 Identification and Screening of Removal Action Options and Alternatives

Conceptual removal alternative designs (Figures 3 through 5) were developed from the technologies that passed the screening process. Key design features are estimates only and provided for comparison purposes. The material quantities and flow rates provided in this section are estimates only and should be more accurately quantified for final design and removal action. Bulk excavated waste rock and contaminated soil quantities are presented in bcy; all other bulk material quantities are presented in loose cubic yards (lcy). The referenced figures are conceptual only.

Based on results of the removal action technology screening process, three removal action alternatives were selected for detailed analysis. The alternatives include:

- **ALTERNATIVE 1 – NO ACTION**
- **ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL**
- **ALTERNATIVE 3 – EXCAVATION AND ON-SITE DISPOSAL**

Each alternative is discussed below.

Removal Action Elements Common to all Action Alternatives

Certain work elements would be employed and implemented regardless of the action alternative selected. These elements include: (1) improving site access, (2) addressing physical hazards at the Site, and (3) best management practices (BMP) to be implemented during on-site removal actions. Site access via FR 5640 is narrow and currently requires a high-clearance, 4-wheel drive vehicle. Some improvement will be needed to accommodate heavy equipment. The road leading from FR 5640 to the Site is very narrow and heavily overgrown; there is also a large ravine that must be crossed to reach the Site. The remains of an old bridge constructed of fallen trees currently spans the ravine; however, the remnants are structurally unstable and a temporary bridge would be required for heavy equipment to access the Site.

Physical hazards may be mitigated through institutional controls such as fencing, gating and/or signs, which limit public access, or by removal of the hazard, e.g. plugging with foam or filling the hazard. The open shaft would be filled with ~150 lcy of soil and rock from waste rock pile WR-1. Alternatively, if bats are determined to inhabit the shaft, a bat cupola would be installed over the open shaft. A bat gate would be installed in the open adit to prevent public access. The BMPs and proposed actions for each hazard are discussed below:

- **Site Access.** Minimally improving FR 5640 by removing obstructions, widening the road, and placing road base material (total of ~20 lcy of 2-inch minus material) in selected areas to minimize hazards along 2 miles of FR 5640 to the Site access road.
- **Physical Hazards.** Physical hazards at the Site are minimal. Each hazard is described below:
  - **Open Adit 1.** Installing a bat gate, shown in Figure 5, to prevent public access while maintaining potential bat habitat.
  - **Open Shaft.** Backfilling the open shaft with ~150 lcy of waste rock to fill the cavity and remove the hazard. Prior to filling, the Forest Service should determine if the shaft represents important bat habitat to be preserved. Alternatively, a bat cupola would be installed over the shaft to maintain bat habitat.
  - **Miscellaneous Debris.** Removing miscellaneous debris (including the large steel tank) and litter from the mill site and surrounding hillside and placing in an on-site repository, or transporting off site for disposal in a sanitary landfill depending on the final removal action alternative selection.
  - **Ravine Across Access Road.** Installing a barrier consisting of large boulders on the access road at the large ravine following completion of the removal action to prevent ATV and

vehicular access. A warning sign would be posted along the road approximately 100 feet from the ravine.

- **Best Management Practices.** During removal activities, BMPs will be employed to contain run-off, minimize erosion, and prevent sedimentation of Quartz Creek during the removal action. Specific BMPs will depend on the removal action selected and may include, but not be limited to: silt fencing, straw bales, check dams, temporary surface water diversions, sediment retention, and dust suppression.

ALTERNATIVE 1 – No Action

This alternative consists of no further action and leaving the Site as is:

- Waste rock would remain in its current location;
- Site safety issues (i.e. open adit, open shaft, debris, etc.) would remain as is; and
- Seeps discharging from the toe of waste rock pile WR-1 and the unnamed drainage flowing across waste rock pile WR-2 would continue contributing metals loading to Quartz Creek.

ALTERNATIVE 2 – Excavation and Off-site Disposal

This alternative involves excavating soil, waste rock, and sediment with COI concentrations above the risk-based cleanup levels, and transporting to an off-site facility for disposal. This alternative also includes demolition and off-site disposal of the concrete mill foundation. Disposal options depend on whether the waste rock and contaminated soil are considered a hazardous waste under Washington Dangerous Waste Rules (WAC Chapter 173-303). The waste rock is not a listed discarded chemical product or dangerous waste source, nor does it exhibit the characteristics of a hazardous waste. The results of all waste rock leachate samples analyzed during the SI using SPLP and TCLP were well below RCRA TCLP disposal limits. Therefore, the mine waste is not considered to be a Washington Dangerous Waste or a RCRA Hazardous Waste. The mine waste may be considered a special waste though because it poses a relatively low hazard to human health and the environment. The Roosevelt Regional private landfill in Klickitat County was contacted and confirmed that they will accept mine waste rock that passes TCLP disposal limits (Dillishaw 2008). Rabanco provides 25-ton capacity bins that they pick up and haul to a rail station for transport to the landfill. The rail station is located about 70 miles from the Site.

- Under this option, waste rock piles WR-1 and WR-2, contaminated soil around the mill foundation (S1 & S3), and contaminated sediment at the two seeps would be excavated and removed.
  - Clearing ~2,000 feet of the 15-foot-wide existing access road along the hillside.
    - Constructing a 100-ft temporary bridge for access to the Site.
    - Compacting and placing ~300 lcy of coarse road base.
    - Installing temporary erosion control BMPs.
  - Excavating waste rock, contaminated soil, and sediment with arsenic concentrations above the risk-based cleanup levels (soil = 33 mg/kg, sediment = 132 mg/kg).
    - ~2,000 bcy from waste rock pile WR-1 at the mill site.
    - ~25 bcy from waste rock pile WR-2 near Adit 1.
    - ~25 bcy of contaminated soil from around the mill foundation (including the concrete foundation).
    - ~100 bcy of sediment from the two seeps areas.
  - Using heavy equipment to demolish the concrete mill foundation.
  - Backfilling the open shaft with ~150 bcy of waste rock from WR-1.
  - Loading the remaining waste rock, contaminated soil, sediment and concrete (~2,000 bcy total) in 12-cy dump trucks and transporting to the temporary staging area for transfer to the 25-ton Rabanco bins.

- Using a Niton X-ray fluorescence (XRF) to assist in delineating the extent of excavation and to field check removal efforts. Collecting a minimum of one composite confirmation sample from each area for verification of contaminant removal.
- Transporting the bins to the rail station (~70 miles) for transfer to the Roosevelt Regional Landfill for disposal.
- Grading the mill site and areas (~0.4 acre) from which waste rock and soil has been excavated to blend with the surrounding topography and promote drainage. Applying 6 to 12 inches of growth media (~130 lcy), applying fertilizer, seeding with a Forest Service approved seed mix, hydromulching, and planting tree seedlings in the mill site.
- Reclaiming 2,000 feet of access road by ripping compacted surfaces, grading to blend with the natural hillside to the extent possible, seeding ~1 acre with a Forest Service approved seed mix and hydromulching.
- Placing large boulders on the access road to block vehicular and ATV traffic, and posting a warning sign at the ravine.

ALTERNATIVE 3 – Excavation and On-site Disposal

This alternative involves excavating soil, waste rock, and sediment with COI concentrations above the cleanup criteria, and disposing in an on-site repository. Two repository locations and two cover options were evaluated for this alternative:

- Under this option, waste rock piles WR-1 and WR-2, contaminated soil around the mill foundation (S1 & S3), and contaminated sediment at the two seeps would be excavated and removed.
  - Clearing 2,000 feet of the 15-foot-wide existing access road.
    - Constructing a 100-ft temporary bridge for access to the Site.
    - Compacting and placing ~300 lcy of coarse road base.
    - Installing temporary erosion control BMPs.
  - Excavating waste rock, contaminated soil, and sediment with arsenic concentrations above the risk-based cleanup levels (soil = 33 mg/kg, sediment = 132 mg/kg).
    - ~2,000 bcy from waste rock pile WR-1 at the mill site.
    - ~25 bcy from waste rock pile WR-2 near Adit 1.
    - ~25 bcy of contaminated soil from around the mill foundation (including the concrete foundation).
    - ~100 bcy of sediment from the two seeps areas.
  - Using heavy equipment to demolish the concrete mill foundation.
  - Backfilling the open shaft with ~150 bcy of waste rock from WR-1.
  - Loading the remaining waste rock, contaminated soil, sediment and concrete (~2,000 bcy total) in 12-cy dump trucks and transporting to an on-site repository. Two repository locations were evaluated and are discussed below.
  - Using a Niton XRF to assist in delineating the extent of excavation and to field check removal efforts. Collecting a minimum of one composite confirmation sample from each area for verification of contaminant removal.
  - Grading the areas (~0.4 acre) from which waste rock and soil has been excavated to blend with the surrounding topography and promote drainage. Applying 6 to 12 inches of growth media (~130 lcy), applying fertilizer, seeding with a Forest Service approved seed mix, hydromulching, and planting tree seedlings in the mill site.
  - Reclaiming 2,000 feet of access road by ripping compacted surfaces, grading to blend with the natural hillside to the extent possible, seeding ~1 acre with a Forest Service approved seed mix and hydromulching.
  - Removing the temporary bridge that was installed to access the Site.

- **Repository Option 1 – Primary Location Along Ridge:**
  Under this option, the repository would be constructed on a ridge above the Site, about 1 mile northeast of the mill site (Figure 3). This location is well above the Quartz Creek floodplain, has a slight depression, and is relatively close to the Site. With the conceptual configuration shown in Figure 3, the area can easily accommodate the estimated volume of mine waste with capacity to accommodate swell (~2,400 lcy total).
  - Clearing and grubbing the repository site (~0.3 ac) and stockpiling the woody debris. Excavating 2.3 feet of topsoil (~1,130 bcy) from the repository footprint and stockpiling for use in the repository cap and to cover the excavated waste areas and other disturbed areas.
  - Excavating a diversion channel along the uphill edge of the repository to intercept surface water run on. The earthen, V-shaped channel will be constructed with a slope of 1 to 2 percent, 1 to 2 feet deep, and 2H:1V side slopes. For cost estimation purposes, the assumed channel length is 200 feet. Riprap protection (~2 lcy) would be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened on site.
  - Excavating a concave pit for the mine waste. Soil that is excavated will be stockpiled during construction and used for the cap.
  - Placing and compacting the waste rock, concrete, and contaminated soil and sediment in the repository in 8-inch-thick lifts to the approximate configuration shown in Figure 3. The proposed design is conceptual and the actual engineered designs may differ considerably based on site-specific conditions and constraints. However, the general design configurations and site preparation tasks described in the following bullets will likely be very similar independent of location.
  - Shaping the repository to blend with the surrounding topography. The foundation slope should not exceed 10 percent. The repository side slopes should not exceed a 3:1 horizontal to vertical (3H:1V) ratio and the top surface should be graded to minimize erosion, promote drainage, and prevent ponding on the repository surface.
  - Installing the repository cover. Two cover options were evaluated for the repository and are discussed below.
- **Repository Option 2 – Alternate Location At Mill Site:**
  Under this option, the repository would be constructed at the mill site against the base of the hillside. The repository will have a minimum available storage capacity of 2,400 lcy (estimated volume of mine waste plus 20 percent swell).
  - Clearing and grubbing the repository site (~0.3 ac) and stockpiling the woody debris. Excavating topsoil (~450 bcy) from the repository footprint and stockpiling for use in the repository cap and to cover the excavated waste areas and other disturbed areas.
  - Importing an additional 1,290 lcy of clean soil from an off-site source for use in the repository cap. Assumed to be an available source within 50 miles of the Site.
  - Excavating a diversion channel along the uphill edge of the repository to intercept surface water run on. The V-shaped channel will be constructed with a slope of 1 to 2 percent, 1 to 2 feet deep with 1H:1V side slopes, and lined with riprap erosion protection (~50 lcy). For cost estimation purposes, the assumed channel length is 400 feet. Riprap protection (~2 lcy) would also be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened on site.
  - Excavating a shallow area for the repository base and stockpiling the excavated material for use in the cap.
  - Installing a French drain system (Figure 4) between the repository and hillside to intercept flows that may discharge as seeps from the hillside during wet conditions and divert flow around the mine waste material.
    - Excavating a 430-feet long, 2-feet deep and 2-feet wide trench between the repository and hillside, lining the trench with 40-mil HDPE, placing a 6-inch layer of coarse drain rock (1 to 2 inch minus) in the trench bottom, installing a 6-inch diameter perforated

drain pipe in the trench and filling with coarse drain rock (1 to 2 inch minus). The trench and pipe would be sloped at a minimum of 2 percent and routed around the ends of repository to discharge below the existing bench. Riprap erosion protection (~2 lcy) would be placed at the outlet to prevent erosion.

  - Construction of the drain would proceed in lifts coordinating with placing of the mine waste. A minimum 12-inch-thick layer of coarse drain rock (1 to 2 inch minus) would be placed between the mine waste and hillside, with a layer of filter fabric (~1,500 square yards [sy]) between the hillside and drain rock, and a layer of 40-mil HDPE (~1,500 sy) between the drain rock and mine waste.
  - Presumably, all drain rock (~500 lcy) would be obtained from on off-site source within 50 miles of the Site.

- Placing and compacting the waste rock, concrete, and contaminated soil and sediment in the repository in 8-inch-thick lifts to the approximate configuration shown on Figure 4. The proposed design is conceptual and the actual engineered design may differ considerably based on site-specific conditions and constraints. Before commencing final design, the site should be inspected and additional information gathered regarding the suitability of the proposed site. However, the general design configuration and site preparation tasks described in the following bullets will likely be very similar independent of location.
- Shaping the repository to blend with the surrounding topography. The foundation slope should not exceed 10 percent. The repository side slopes should not exceed a 3:1 horizontal to vertical (3H:1V) ratio and the top surface should be graded to minimize erosion, promote drainage, and prevent ponding on the repository surface.
- Installing the repository cover. Two cover alternatives were evaluated for the repository and are discussed below.

- **Repository Cover Options**

  Two cover options were evaluated for the mine waste repository and are discussed below. Repository cover material quantities will differ depending on the repository location, and cover options selected.

  - **Option 1 – Engineered Cover:**

    Consists of a geosynthetic membrane sandwiched between a 12-inch-thick fine bedding layer and a 6-inch-thick drainage layer, overlain by 2 feet of well-graded soil (Figure 3).

    - Generating ~820 lcy of fine bedding material on site by screening the mine waste and contaminated soil. Placing and compacting the screened fines over the waste material in one 12-inch lift.
    - Installing ~2,450 sy of geosynthetic membrane (geosynthetic clay liner [GCL] or high density polyethylene [HDPE] liner) over the bedding layer and testing per the manufacturer's specifications.
    - Carefully placing a 6-inch-thick drainage layer (~410 lcy) over the GCL in one loose lift.
    - Placing a single layer of filter fabric (~2,450 sy) over the drainage layer to prevent piping of fines from the cover soil into the coarse material.
    - Placing a 24-inch-thick, well-graded soil cover (~1,640 lcy) over the filter fabric in one lightly compacted 12-inch lift and one loose 12-inch lift. Adding soil amendments and seeding the cover with a Forest Service approved seed mix and hydromulching (~0.5 ac).
    - Placing woody debris generated during the removal action over the final cover surface to prevent erosion and provide natural habitat.

  - **Option 2 – Earthen Clay Cover:**

    Consists of a 12-inch-thick earthen clay liner overlain with a 6-inch-thick drainage layer and 24 inches of well-graded soil (Figure 3).

    - Placing ~820 lcy of clay material over the waste material and compacting in two 6 inch-thick lifts to achieve a permeability of less than $1x10^{-6}$ centimeters per second (cm/sec).

- Carefully placing a 6-inch-thick drainage layer (~410 lcy) over the compacted clay in one loose lift.
- Placing a single layer of filter fabric (~2,450 sy) over the drainage layer to prevent piping of fines from the cover soil into the coarse material.
- Placing a 24-inch-thick, well-graded soil cover (~1,640 lcy) over the filter fabric in one lightly compacted 12-inch lift and one loose 12-inch lift. Adding soil amendments and seeding the cover with a Forest Service approved seed mix and hydromulching (~0.5 ac).
- Placing woody debris generated during the removal action over the final cover surface to prevent erosion and provide natural habitat.

5.2 Analysis of Selected Removal Action Alternatives

The removal action alternatives were evaluated based on the following criteria:

- Effectiveness
- Implementability
- Relative cost

Effectiveness is defined as the ability of an alternative (relative to other options in the same technology sub-category) to:

- Protect public health and the community, protect workers during implementation, and protect the environment – addresses whether or not the remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls; and
- Comply with ARARs – addresses whether or not a remedy will meet all ARARs or other federal and state environmental statutes and/or provide grounds for invoking a waiver.

Implementability encompasses the technical and administrative feasibility of implementing a removal action and the availability of resources needed to implement the removal action. It also takes into account legal considerations. Factors of particular consideration include removal action and operational feasibility; availability of equipment, personnel, and treatment capacity; community acceptance; and the ability to obtain necessary permits for off-site actions.

- Technical feasibility – refers to construction and operational considerations, the demonstrated performance and useful life, adaptability to site-specific environmental conditions, whether it contributes to remedial performance, and whether it can be implemented within 1 year[3].
- Administrative feasibility – refers to the permits required, easements or right-of-ways required, impacts on adjoining properties, the ability to implement institutional controls, and the likelihood of obtaining an exemption from statutory limits, if needed.
- Availability – includes the availability of equipment, personnel and services, outside laboratory testing services (if needed), off-site treatment and disposal capacity (if needed).

[3] The ability to be implemented in 1 year is a specific criterion to be used in the alternative comparative analysis as outlined in EPA's "Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA" (1993). There is a 1-year statutory limit for fund-financed removal actions.

The relative cost of each alternative was evaluated based on professional experience, engineering judgment, and standard cost estimating tools. Primary cost considerations include:

- Capital costs,
- Engineering and design costs, and
- Operation and maintenance (O&M) costs.

The estimated costs for each task are provided in Appendix C and summarized in Table 13. Costs are based on experience at similar sites, on published data and reports, and on inquiries to possible vendors. Many removal action unit costs were obtained from R.S. Means data, and include overhead and profit (2005). Estimated costs relied on several significant assumptions regarding site conditions and are based on conceptual design only. The estimated costs are intended for alternative comparison only and are not suitable for construction bidding purposes.

Assumptions made in preparing the cost estimate include:

- All removal actions can be completed in one field season using standard removal action equipment.
- All borrow soil for covering the repository and excavated waste areas will be available either (1) from within the repository footprint, or (2) from a nearby (within 50 miles) off-site source.
- Significant cost savings may be realized from using a suitable on-site borrow source for growth medium and other materials.
- The coarse drainage material, riprap, clay material, and additional needed soil will be available and purchased from a nearby (within 50 miles) off-site source and transported to the Site.
- A temporary staging area can be established at the intersection of County Road 56 and FR 5640 for offloading equipment and materials. This will enable the use of smaller equipment at the Site and lessen the degree of required improvements to FR 5640.
- Improvements to FR 5640 will be minimal to accommodate site access.
- Improvements to the site access road will require using special construction methods and a temporary bridge to cross the ravine.
- The mine waste and contaminated soil will be screened on site to provide the fine bedding materials needed in the repository cover.
- The proposed locations for the repository are suitable and accessible, and will not require significant modification.
- The concrete mill foundation and site debris are non-hazardous and can be disposed of in a sanitary landfill.
- The Forest Service and State Historic Preservation Officer (SHPO) will approve demolition of the concrete mill foundation and the Forest Service will confirm approval for backfilling the open shaft.
- All trees and brush felled during the removal action will be stockpiled and placed over the seeded areas to minimize erosion, or burned on site.
- Post-removal monitoring costs are based on biannual site visits for a 3-year period following completion of removal action.
- Post-removal monitoring will be limited to the aquatic habitat in Quartz Creek and consist of surface water, pore water, sediment, and benthic macroinvertebrate samples from three locations on Quartz creek. The analytical suite will be limited to a select set of metals based on samples results from the SI.
- Data collected during the SI will be used as the baseline for post-removal monitoring and a pre-removal monitoring event will not be required.

- The estimated fees for removal action design and work plan preparation were based on the removal action cost for each task and ranged from 10 to 15 percent depending on the complexity of the removal action.
- The estimated fees for removal action oversight were based on the anticipated duration of the removal action and ranged from $40,000 to $60,000.
- The total estimated removal action costs include a 20 percent contingency.
- Present value corrections were not calculated because of the short duration of the removal action and monitoring.

5.3 Identification of Data Gaps

Several data gaps were identified during the preparation of this EE/CA, including:

- Lack of sufficient background samples to develop reasonably accurate average background COI concentrations for all media;
- Concrete mill foundation not characterized;
- Potential presence of T&E amphibian species in areas around the seeps and unnamed drainage at the Site, and bat species in the open shaft and adit; and
- Minimal topographical data for the Site, particularly the area between the mill site and Adit 1, and at the primary and alternate mine waste repository locations.

The data gaps, potential issues, recommended actions, and estimated costs are summarized in Table 14. Broad assumptions regarding material quantities and site conditions were used to address the data gaps in the development of conceptual designs presented in this EE/CA. However, additional data that is critical to the removal action should be collected before preparing the final design.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The removal action alternatives were compared based on the following criteria:

- **Effectiveness**
  - Protective of human health and the environment
  - Complies with ARARs, especially key ARARs identified for the Site
  - Achieves RAOs
- **Implementability**
  - Technical Feasibility
  - Administrative Feasibility
  - Availability of Resources
- **Cost**

The comparative analysis of removal action alternatives is described in Table 15 and summarized below by criteria. An anticipated level of state and community acceptance is presented for each alternative; actual acceptance will be determined during the public comment period. Physical hazards were assumed to be equally addressed in all of the action alternatives as discussed in Section 5.1.

<u>Effectiveness</u>

- Alternative 1 – No Action is the least effective.
  - The mine waste and physical hazards would continue to pose a significant threat to public visiting the Site.
  - The mine waste and seeps would also continue to pose a threat to ecological receptors and continue contributing metals loading to Quartz Creek and the Taylor and Snoqualmie Rivers.

- Not protective of human health and the environment, and would not comply with ARARs or achieve any RAOs.

- Alternative 2 – Off-site Disposal provides the most protection to human health and the environment by removing the mine waste from the Site and disposing of in a controlled facility.
  - Most RAOs would be achieved under this alternative by removing mine waste from the Site.
  - Removal criteria are protective of human health.
  - Most key chemical-specific ARARs would be attained:
    - Surface Water Quality ARARs – It is anticipated that chemical-specific ARARs (Table 10) would be attained after removal and isolation of the waste rock that is leaching contaminants into the water. Post-removal monitoring would determine compliance success.
    - Soil Quality ARARs – Soils would be cleaned up to risk-based cleanup levels, apparent background levels, or to the lowest MTCA criteria (Table 9), whichever is greater.
    - Sediment Quality ARARs – Sediment in Quartz Creek contain metals concentrations that may slightly exceed ARARs (i.e., background levels). Stream sediments would not be addressed to avoid excessive collateral environmental impacts (see Section 4.2). Most seep-associated sediment would be removed with the waste rock and soils. Some remaining seep sediment may exceed MTCA ecological criteria for arsenic, cadmium, and copper (Table 10).
  - Compliance with Solids Disposal ARARs – Key action-specific ARARs would be attained. Contaminated wastes would be isolated from the environment in off-Site permitted waste facilities.
  - Compliance with FP S&G ARARs – Key location-specific ARARs would be attained. Wastes would be removed from and stored outside the Riparian Reserve; roads and disturbance in the Riparian Reserve would be minimized.
  - High short-term and long-term effectiveness and permanence (see Table 15).
  - Minimal potential risk to human health and the environment during off-site transportation of mine waste.
  - No reduction in toxicity or volume through treatment, but moderate to high reduction in toxicity through containment and capping.

- Alternative 3 – On-site Disposal is moderate to highly protective of the human health and environment.
  - Most RAOs would be achieved under this alternative by containing and capping mine waste.
  - Most key chemical-specific ARARs will be attained:
    - Surface Water Quality ARARs – It is anticipated that chemical-specific ARARs (Table 10) would be attained after removal and isolation of the waste rock that is leaching contaminants into the water. Post-removal monitoring would determine compliance success.
    - Soil Quality ARARs – Soils would be cleaned up to apparent background levels, risk-based cleanup levels, or the lowest MTCA criteria (Table 9), whichever is greater.
    - Sediment Quality ARARs – Sediment in Quartz Creek contain concentrations that may slightly exceed ARARs (i.e., background levels). Stream sediments would not be addressed to avoid excessive collateral environmental impacts (see Section 4.2). Most seep-associated sediment would be removed with the waste rock and soils. Some remaining seep sediment may exceed MTCA ecological criteria for arsenic, cadmium, and copper (Table 10).
  - Compliance with Solids Disposal ARARs – Key action-specific ARARs would be attained. Contaminated wastes would be isolated from the environment in an earthen repository.
    - Repository option 1 (ridge) would be more effective than option 2 (mill site) and better comply with FP S&Gs because the mine waste would be relocated to an area above the 500-year (as well as the 100-year) Quartz Creek flood elevation and out of the Riparian Habitat Conservation Area. Option 1 may also provide a more stable configuration because of the concave base.

- Repository option 1 may be subject to more potential vandalism and require more maintenance because it would be visible from FR 5640.
- Repository option 2 (mill site) would be more difficult to construct because the area is prone to storm water run on and seepage along the hillside. This option would require a drainage system and O&M to prevent clogging.
- Cover option 1 (engineered cover) would be slightly more effective than option 2 (earthen clay cover) in reducing infiltration through the waste material. Option 1 meets the substantive Solids Disposal ARARs by capping them in accordance with state landfill standards (WAC 173-350-400). The cap would consist of 2 feet of soil and a geomembrane (the presumptive cover prescribed by state regulations). Option 2 may meet ARARs if analyses during removal design indicate the alternative cover would satisfy performance standards in the regulations (WAC 173-350-400(3)(e)(I)).

  - Compliance with FP S&G ARARs – Key location-specific ARARs would be attained. Wastes would be removed from and stored outside the Riparian Reserve; roads and disturbance in the Riparian Reserve would be minimized.
  - Moderate short-term effectiveness and high long-term effectiveness and permanence (see Table 15).
  - No reduction in toxicity or volume through treatment, but moderate to high reduction in toxicity through containment and capping.

Implementability

- Alternative 1 – No Action is most technically feasible and easiest to implement; however, state and community acceptance would likely be minimal.
- Alternative 2 – Off-site Disposal would be moderately to highly implementable.
  - The availability of service and materials is high.
- Alternative 3 – On-site Disposal is moderately to highly implementable.
  - The availability of service and materials is high.
  - All options are implementable using standard construction equipment and methods.
  - Repository option 1 (ridge) would be slightly more difficult to implement than option 2 because of the additional access road improvements and site clearing required; however, option 2 would require importing ~1,290 lcy of soil from an off-site source unless a nearby borrow source could be identified.
  - Both cover options are easily implementable and agency and community acceptance should be relatively equal.

Cost

- Alternative 1 – No Action is the least expensive alternative.
- Alternative 2 – Off-site Disposal is highly expensive.
- Alternative 3 – On-site Disposal is moderately to highly expensive.
  - Repository location option 2 (mill site) would be more expensive than option 1 (ridge) because of the added cost of importing soil; however, some cost savings may be recognized by finding an nearby borrow source.
  - Cover option 2 (earthen clay cover) would be more expensive than option 1 (engineered cover) because of the cost of importing clay material and the compaction requirements.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Key features of the recommended removal action alternative are discussed below. Details are provided in Section 6.2 and on Figures 3 through 5. The recommendation expressed here is based on the analysis

discussed in Sections 6.3 and 7.0, and summarized in Table 8. The recommended alternative is Alternative 3 with the options listed below:

- **Alternative 3 – Excavation and On-site Disposal**
  - Repository Location Option 1: Ridge Location
  - Cover Option 1: Engineered Cover

A temporary bridge would be installed across the ravine to provide heavy equipment access to the Site. Physical hazards would be mitigated as described in Section 5.1 under Removal Action Elements Common to All Removal Action Alternatives. Mine waste, contaminated soil and sediment with contaminant concentrations above the risk-based cleanup levels would be removed and disposed of in a repository to be located on the ridge above the Site along FR 5640. Water quality in the seeps and unnamed drainage should significantly improve once the waste rock is removed; therefore, treating surface water and groundwater was excluded from the scope of this removal action.

Specifics of the recommended removal action alternative are described below:

- **Excavation and On-site Disposal:**
  - Excavating ~2,000 bcy of waste rock from WR-1.
  - Excavating ~25 bcy of waste rock from WR-2.
  - Excavating ~25 by of contaminated soil from around the mill foundation (including the concrete foundation) and demolishing the foundation.
  - Excavating ~100 bcy of contaminated sediment from the two seeps at the mill site.
  - Using a Niton XRF to assist in delineating the extent of excavation and to field check removal efforts. Collecting a minimum of one composite confirmation sample from each area for verification of contaminant removal.
  - Backfilling the open shaft with ~150 bcy of mine waste from WR-1.
  - Preparing a repository on the ridge above the Site along FR 5640.
  - Transporting the remaining waste (~2,000 bcy) to the repository and placing the material in the repository in 8-inch compacted lifts.
  - Constructing an engineered cover over the repository consisting of:
    - Screening the mine waste and contaminated soil to generate fine bedding material (~500 lcy). Placing and compacting the screened fines over the waste material in one 12-inch lift.
    - Installing a GCL (~1,500 sy) over the bedding layer and testing per the manufacturer's specifications.
    - Carefully placing a 6-inch-thick drainage layer (~250 lcy) over the GCL in one loose lift.
    - Laying a single layer of filter fabric (~1,500 sy) over the drainage layer to prevent piping of fines from the cover soil into the coarse material.
    - Placing 24 inches of well-graded soil (~1,000 lcy) over the filter fabric in one lightly compacted 12-inch lift and one loose 12-inch lift.
    - Adding soil amendments and seeding with a Forest Service approved seed mix and hydromulching (~0.3 ac).
  - Excavating a diversion channel along the uphill edge of the repository to intercept surface water run on. The earthen, V-shaped channel will be constructed with a slope of 1 to 2 percent, 1 to 2 feet deep, and 2H:1V side slopes. For cost estimation purposes, the assumed channel length is 200 feet. Riprap protection (~2 lcy) would be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened on site.
  - Grading the areas (0.5 ac) from which waste rock and soil was excavated to blend with the surrounding topography and promote drainage. Covering disturbed areas with 6 to 12 inches of topsoil (~130 lcy), applying fertilizer, seeding with a Forest Service approved seed mix, hydromulching, and planting tree seedlings in the mill site.

- Placing woody debris generated during the removal action over the reclaimed areas and repository cover to prevent erosion and provide natural habitat.

The recommended alternative would dispose of a total of ~2,150 bcy of waste rock, concrete, and contaminated soil and sediment. The removal action would achieve RAOs and attain ARARs to the extent practical by eliminating the surface exposure pathway to mine waste, improving surface water quality and reducing contaminant loading to Quartz Creek, and mitigating physical hazards at the Site. The recommended alternative would eliminate human health risk from exposure to the mine waste by removing waste material with contaminant concentrations above the risk-based cleanup levels.

The recommended alternative will satisfy the eight factors in 40 CFR 300.415(b) as described below.

Factor	Site Condition	Satisfied?
(1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants	Public access to contaminated soil and waste rock will be eliminated by removing the source. Overall surface water quality at the Site should improve significantly following removal of the primary waste source.	Yes
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	There is no public water supply and, although water discharging from seeps exceeds ARAR-based criteria, there is no measurable impact to Quartz Creek. The seeps water quality will be improved by preventing contact with mine wastes and promoting suspended solids removal.	Yes
(3) Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release	One, (presumed empty) storage tank is near the mill site. The tank will be removed and transported to an off-site facility for disposal.	Yes
(4) High levels of hazardous substances, pollutants, or contaminants in soils largely at, or near, the surface that may migrate	Contaminated soil and waste rock will be removed.	Yes
(5) Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released	The waste rock and contaminated soils will be removed.	Yes
(6) Threat of fire or explosion	No flammable materials on site	Yes
(7) The availability of other appropriate federal or state response mechanisms to respond to the release	The Site is on Forest Service land and is being addressed by the Forest Service.	Yes
(8) Other situations or factors that may pose threats to public health or the environment	Physical hazards will be mitigated.	Yes

The total estimated removal action cost is **$508,150.**

8.0 FOREST SERVICE DISCLAIMER

This abandoned mine/mill site was created under the General Mining Law of 1872 and is located solely on National Forest System (NFS) lands administered by the Forest Service. The Forest Service has conducted a PRP search relating to this Site and has been unable to identify any current claimants or viable PRPs at this time. The United States has taken the position and courts have held that the United States is not liable as an "owner" under CERCLA Section 107 for mine contamination left behind on NFS lands by miners operating under the 1872 Mining Law. Therefore, Forest Service believes that this Site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this Site should be included on EPA's CERCLIS database. Consistent with the June 24, 2003 OECA/FFEO "Policy on Listing Mixed Ownership Mine or Mill Sites Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA

Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this Site on the Federal Agency Hazardous Waste Compliance Docket.

The proposed removal action designs presented in this EE/CA are conceptual only and not intended for removal action. All material quantities are estimates only and should be verified for final design.

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Tables

Table 1. Monthly Climatic Averages for Snoqualmie Pass, Washington WSO
Rainy Mine EE/CA

Parameter	Month												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average Maximum Temperature (°F)	31.9	37	42.4	49.3	57.2	62.9	70.4	69.6	64.6	53.9	39.3	33.4	51
Average Minimum Temperature (°F)	21.1	23.6	26.1	30.4	34.5	40.4	46	46.2	41.7	35.6	28.2	24.1	33.2
Average Total Precipitation (in)	15.91	12.39	11.18	6.39	4.25	3.97	1.58	2.2	4.75	9.73	14.94	17.46	104.76
Average Total Snowfall (in)	106.9	81.1	78	27.2	5.1	0.1	0.1	0.0	0.2	6.7	43.5	91.5	440.4
Average Snow Depth (in)	70	91	96	76	32	2	0	0	0	0	10	37	34

Notes:
Source: National Weather Service, Period of Record 2/19/70 to 4/30/07 (WRCC 2007)
Percent of possible observations for period of record: maximum temperature = 96%, minimum temperature = 95.9%, precipitation = 95.6%, snowfall = 97.2%, snow depth = 96.8%
°F = Degrees Fahrenheit
in = inches

Table 2. Mine Waste Analytical Results Summary
Rainy Mine EE/CA

Sample ID	Date Collected	pH	Analyte Concentration (mg/kg)																												
			Ca	K	Mg	Na	CN	Ag	Al	As_3	As_5[b]	As_T	Ba	Be	Cd	Co	Cr_3[b]	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
RM-WR1-1	6/27/2004	3.1	1700	2150	4700	730	NA	29.5	8070	0.28	221.7	222	65	*0.5*	0.34	*2.5*	9	*0.49*	10	1260	70400	0.67	149	3.7	14.5	1.6	7.6	0.25	49	39
RM-WR1-2	6/28/2004	3.4	3000	4160	9500	1860	NA	41.3	15500	*0.02*	48.7	48.7	70	*0.5*	0.27	*2.5*	11.2	*0.40*	12	1970	95300	0.1	363	4	8.31	1.7	11.1	0.2	67	69
RM-WR1-3	6/28/2004	3.9	790	990	3270	290	*0.3*	12.5	13500	0.21	155.8	156	32.7	*0.1*	0.20	3	6.1	*0.47*	7	1140	40100	0.08	142	4	22	1.6	3	*0.25*	37.2	50
RM-WR1-4	6/28/2004	3.8	660	1030	3600	290	NA	18	7660	0.19	128.8	129	37.9	*0.1*	0.22	2	5	0.98	6	1620	47900	0.09	158	7	13.7	1.3	4.8	0.08	26.7	50
RM-WR1-5	6/28/2004	4.1	600	770	2410	160	NA	5.04	17500	0.25	137.7	138	35.9	*0.1*	0.23	3	6.1	*0.46*	7	1080	24100	0.06	112	5.6	7.2	0.4	1.6	0.11	28.6	35
RM-WR2-1	6/28/2004	4.5	1500	470	1990	410	NA	15	7690	28.1	15772	15800	17.7	*0.1*	0.61	10	1.2	*0.40*	2	1310	47100	1.08	190	*5*	40	*5*	4.4	*1.5*	6.1	*50*
RM-S1	6/27/2004	3.3	900	1390	3600	30	NA	41.1	6130	0.60	298.4	299	54.5	*0.5*	0.13	*2.5*	4.2	*0.40*	5	1380	100000	0.1	159	4	79.6	5.3	10.2	0.11	33	30
RM-S2	6/27/2004	4.9	1170	710	2410	260	*0.3*	3.62	12800	0.08	21.9	22	24.3	*0.1*	0.23	4	6	*0.50*	7	986	28500	*0.02*	147	7.5	30.5	1.2	1	0.08	23	60
RM-S3	6/27/2004	5.0	470	1180	2500	200	*0.35*	28	26200	0.43	224.6	225	38.4	0.3	0.38	3	4.7	*0.64*	6	1660	27500	0.11	129	12	12.6	0.9	5.3	0.11	22.3	50
minimum =		3.1	470	470	1990	30	*0.3*	3.62	6130	*0.02*	21.9	22	17.7	*0.1*	0.13	2.0	1.2	*0.40*	2	986	24100	*0.02*	112	3.7	7.2	0.4	1	0.08	6.1	30
MDC =		**5.0**	**3000**	**4160**	**9500**	**1860**	***0.35***	**41.3**	**26200**	**28.1**	**15772**	**15800**	**70**	***0.5***	**0.61**	**10**	**11.2**	**0.98**	**12**	**1970**	**100000**	**1.08**	**363**	**12**	**79.6**	**5.3**	**11.1**	***1.5***	**67**	**69**
average[a] =		4.0	1199	1428	3776	470	*0.32*	21.6	12783	3.3	1890	1893	41.8	*0.3*	0.29	3.6	5.9	0.53	6.9	1378	53433	0.26	172	5.9	25.4	2.1	5.4	0.30	32.5	48
# of samples = 9, Standard deviation =		0.6	747	1068	2173	524	0.02	13.4	6044.5	8.7	4909	4917	16.8	0.2	0.13	2.3	2.7	0.18	2.7	299	27105	0.35	70	2.5	21.7	1.7	3.4	0.43	16.4	11
95% UCL =			1690	2272	5334	976		30.4	16757	10.8	19158	19192	52.8	*0.5*	0.38	5.1	7.7	0.64	8.7	1575	71254	0.65	218	7.7	44.1	3.7	7.7	0.64	43.3	56
Frequency detected =		100%	100%	100%	100%	100%	0%	100%	100%	89%	100%	100%	100%	11%	100%	67%	100%	11%	100%	100%	100%	89%	100%	89%	100%	89%	100%	78%	100%	89%
Human Health Screening Criteria:																															
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)			NS	NS	NS	NS	20	NS	NS	2	NS	2000	19	19	NS	NS	2	NS	NS	1000	NS	NS	NS	NS	NS					
EPA Region IX Industrial Soil PRGs (EPA 2004)			5100	100000	NS	NS	1.6	67000	1900	450	1900	100000	30	450	41000	100000	310	19000	20000	800	410	5100	67	1000	100000					
Ecological Screening Criteria:																															
WDOE MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals (WDOE 2001b)			2	50	7	10	NS	102	10	4	20	NS	NS	42	50	NS	0.1	1100	30	50	5	0.3	1	2	86					
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2005)			NS	NS	NS	NS	18	330	21	0.36	13	26	81	NS	NS	NS	NS	NS	NS	11	0.27	NS	NS	7.8	NS					

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
Bold values are the maximum detected concentrations (MDC)
Screening criteria exceeded
[a]95 Percent upper confidence levels not computed because fewer than four samples.
[b]Calculated value.
EPA = U.S. Environmental Protection Agency
MTCA = Model Toxics Control Act
NA = Not analyzed for
NS = No standard
PRG = Preliminary remediation goal
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

Table 3. Background Soil Analytical Results Summary
Rainy Mine EE/CA

Sample ID	Date Collected	pH	Analyte Concentration (mg/kg)																										
			Ca	K	Mg	Na	Ag	Al	As_3	As_5[b]	As_T	Ba	Be	Cd	Co	As_5[b]	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
RM-BGS-1	6/27/2004	4.4	670	250	930	150	0.71	21900	0.534	58.3	58.8	21.3	0.3	0.15	2	4.0	*0.52*	5	38.6	13000	0.08	52.9	2.2	5.37	0.1	0.6	0.07	24.1	13
RM-BGS-2	6/27/2004	5.1	1490	550	1620	160	0.43	23800	0.465	26.5	27	47.9	0.2	0.25	4	5.9	*0.53*	7	547	19500	0.08	196	7.1	82	0.8	0.5	0.1	29.5	166
RM-BGS-3	6/27/2004	4.9	670	240	730	210	0.13	14300	0.235	7.5	7.7	14.1	*0.1*	0.14	3	NC	27.1	4	15	12600	0.11	161	1.9	6.71	0.2	*0.25*	0.08	25.5	12
minimum =		4.4	670	240	730	150	0.13	14300	0.24	7.5	7.7	14.1	*0.1*	0.14	2	4.0	*0.52*	4	15	12600	0.08	52.9	1.9	5.4	0.1	*0.25*	0.07	24.1	12
MDC =		**5.1**	**1490**	**550**	**1620**	**210**	**0.71**	**23800**	**0.53**	**58.3**	**58.8**	**47.9**	**0.3**	**0.25**	**4**	**5.9**	**27.1**	**7**	**547**	**19500**	**0.11**	**196**	**7.1**	**82**	**0.8**	**0.60**	**0.10**	**29.5**	**166**
average[a] =		4.8	943	347	1093	173	0.65	20000	0.41	30.8	31.2	27.8	0.2	0.18	3	5.0	9.4	5.3	200	15033	0.09	137	3.7	31.4	0.4	0.45	0.08	26.4	64
# of samples = 3, Standard deviation =		0.3	387	144	381	26	0.24	4104	0.13	21.0	21.1	14.5	0.1	0.05	1	1.0	12.5	1.2	245	3163	0.01	61	2.4	35.8	0.3	0.15	0.01	2.3	72
Frequency detected =			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	67%	100%	100%	100%	33%	100%	100%	100%	100%	100%	100%	100%	100%	67%	100%	100%	100%
Human Health Screening Criteria:																													
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)			NS	NS	NS	NS	20	NS	NS	2	NS	2000	19	19	NS	NS	2	NS	NS	1000	NS	NS	NS	NS	NS				
EPA Region IX Industrial Soil PRGs (EPA 2004)			5100	100000	NS	NS	1.6	67000	1900	450	1900	100000	30	450	41000	100000	310	19000	20000	800	410	5100	67	1000	100000				
Ecological Screening Criteria:																													
WDOE MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals (WDOE 2001b)			2	50	7	10	NS	102	10	4	20	NS	NS	42	50	NS	0.1	1100	30	50	5	0.3	1	2	86				
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2005)			NS	NS	NS	NS	18	330	21	0.36	13	26	81	NS	NS	NS	NS	NS	NS	11	0.27	NS	NS	7.8	NS				

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
Bold values are the maximum detected concentrations (MDC)
Screening criteria exceeded
[a]95 Percent upper confidence levels not computed because fewer than four samples.
[b]Calculated value.
EPA = U.S. Environmental Protection Agency
MTCA = Model Toxics Control Act
NC = Not computed
NS = No standard
PRG = Preliminary remediation goal
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

Table 4. Surface Water Analytical Results Summary
Rainy Mine EE/CA

Sample ID	Date Collected	Analyte Concentration (µg/L)[a]																						
		Ag	Al	As_3	As_5[e]	As_T	Ba	Be	Cd	Co	Cr_3[e]	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
QC-SW1 - background	6/27/2004	*0.025*	80	0.192	0.908	1.1	*1.5*	*1*	*0.05*	*5*	5	*0.50*	*5*	*0.25*	*5*	0.00089	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
RM-BG-SW4 - background	6/28/2004	*0.025*	90	0.043	0.018	*0.25*	*1.5*	*1*	*0.05*	*5*	5	*0.05*	*5*	*0.25*	20	NA	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
minimum =		*0.025*	80	0.043	0.018	*0.25*	*1.5*	*1*	*0.05*	*5*	5	*0.05*	*5*	*0.25*	*5*	0.00089	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
MDC =		***0.025***	**90**	**0.192**	**0.908**	**1.1**	***1.5***	***1***	***0.05***	***5***	**5**	***0.5***	***5***	***0.25***	**20**	**0.00089**	***2.5***	***5***	***0.05***	***0.1***	***1***	***0.025***	***2.5***	***5***
average =		*0.025*	85	0.1175	0.463	0.675	*1.5*	*1*	*0.05*	*5*	5	*0.275*	*5*	*0.25*	12.5	0.00089	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
SW-1 (collected by MSE)[c]	6/12/2007					*1.5*																		
Taylor River[d]:																								
TR-SW1	6/26/2004	*0.025*	50	0.069	0.216	*0.25*	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00046	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
TR-SW2	6/26/2004	*0.025*	50	0.115	0.193	*0.25*	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00053	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
Site:																								
QC-SW2	6/27/2004	*0.025*	70	0.131	1.269	1.4	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	20	0.00091	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
QC-SW3	6/27/2004	*0.025*	100	0.117	1.283	1.4	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	1.1	10	0.00082	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
QC-SW4	6/26/2004	*0.025*	70	0.163	0.937	1.1	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	0.8	*5*	0.00089	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
RM-SEEP-SW1	6/28/2004	*0.025*	1260	0.044	14.1	14.1	8	*1*	0.2	*5*	5	*0.5*	*5*	687	580	0.00065	34	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	20
RM-SEEP-SW2	6/28/2004	0.16	2890	*0.0035*	1.893	1.9	14	*1*	0.7	*5*	5	*0.5*	*5*	2020	150	0.00079	54	*5*	0.5	*0.1*	*1*	*0.025*	*2.5*	60
RM-AWR-SW3	6/28/2004	*0.025*	110	5.43	52.3	57.7	4	*1*	*0.05*	*5*	5	*0.5*	*5*	2.1	30	0.00033	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
minimum (excluding BG) =		*0.025*	70	*0.0035*	0.937	1.1	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00033	*2.5*	*5*	*0.05*	*0.1*	*1*	*0.025*	*2.5*	*5*
MDC (excluding BG) =		**0.16**	**2890**	**5.43**	**52.3**	**57.7**	**14**	***1***	**0.7**	***5***	**5**	***0.5***	***5***	**2020**	**580**	**0.00091**	**54**	***5***	**0.5**	***0.1***	***1***	***0.025***	***2.5***	**60**
average (excluding BG) =		0.05	750	0.98	12.0	12.9	5.1	*1*	0.2	*5*	5	*0.5*	*5*	452	133	0.00073	16.3	*5*	0.13	*0.1*	*1*	*0.025*	*2.5*	16.7
95% UCL =		0.03	5416	15.8	68.4	71.9	9.2	*1*	1.2	*5*	5	*0.5*	*5*	10076	1330	0.00091	107	*5*	0.45	*0.1*	*1*	*0.025*	*2.5*	106
# of samples = 10, Standard deviation =		0.04	1049	2.0	18.6	20.5	4.6	0	0.2	0	0	0	0	745	206	0.00020	20	0	0.17	0	0	0	0	20
Frequency detected =		10%	100%	90%	80%	70%	70%	0%	20%	0%	0%	0%	0%	50%	60%	100%	20%	0%	10%	0%	0%	0%	0%	20%
Human Health Screening Criteria:																								
1a - Washington HH		NS	NS	NS	NS	0.018	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.14	NS	610	NS	14	170	1.7	NS	NS
1b - Washington HH		100	NS	NS	NS	10	2000	4	5	NS	NS	NS	100	1300	300	2	50	100	15	6	50	2	NS	5000
2- EPA HH		NS	NS	NS	NS	0.018	1000	NS	NS	NS	NS	NS	NS	1300	300	NS	50	610	NS	5.6	170	0.24	NS	7400
Ecological Screening Criteria:																								
3- Washington Eco[b]		NS	NS	NS	NS	190	NS	NS	0.08	NS	10.1	10.0	NS	0.57	NS	0.012	NS	8.1	0.05	NS	5	NS	NS	5.4
4- EPA Eco[b]		0.36	NS	NS	3.1	150d	4	0.66	0.02	23	4	11d	NS	0.45	1000	0.77d	120	3	0.05	30	5	12	20	6.1

Sample ID	Flow (gpm)	pH	Analyte Concentration (µg/L)[a]					
			Ca	Hard	K	Mg	Na	Sulfate
QC-SW1 - background	NM	6.3	1200	3	300	*100*	900	20
RM-BG-SW4 - background	NM	6.1	1300	NA	*150*	*100*	*150*	NA
minimum =		6.1	1200	3	*150*	*100*	*150*	20
MDC =		**6.3**	**1300**	**3**	**300**	***100***	**900**	**20**
average =		6.2	1250	3	225	*100*	525	20
Taylor River:								
TR-SW1	NM	6.5	1200	3	*150*	*100*	600	*5*
TR-SW2	NM	6.5	1200	3	*150*	*100*	700	10
Site:								
QC-SW2	14.1	6.6	1200	3	*150*	*100*	900	10
QC-SW3	16.4	6.5	1200	3	*150*	*100*	1000	*5*
QC-SW4	NM	6.5	1000	3	*150*	*100*	900	*5*
RM-SEEP-SW1	0.0007	6.7	7800	21	500	400	3200	20
RM-SEEP-SW2	0.0005	4.3	6700	19	600	600	3500	50
RM-AWR-SW3	0.002	7.1	7600	20	500	300	3200	20
minimum (excluding BG) =		4.3	1000	3	*150*	*100*	900	*5*
MDC (excluding BG) =		**7.1**	**7800**	**21**	**600**	**600**	**3500**	**50**
average (excluding BG) =		6.3	4250	11.5	342	267	2117	18.3
95% UCL =			10840		721	437	4042	**32.3**

Notes:
Italics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
Bold values are the maximum detected concentrations (MDC)
Screening criteria exceeded
[a]Total concentrations
[b]Screening criteria for hardness dependent metals are based on an apparent background hardness of 3 and were converted to total concentrations where applicable.
[c]Sample collected during site reconnaissance by MSE from unnamed drainage upstream of waste rock pile WR-2; only analyzed for total arsenic.
[d]Samples from Taylor River were not included with samples from the site in determining minimum, maximum, and average concentrations.
[e]Calculated value.
BG = Background
d = Dissolved
EPA = U.S. Environmental Protection Agency
NOAA = National Oceanic and Atmospheric Administration
NM = No measurement
NS = No standard
UCL = Upper confidence limit
WDOE = Washington Department of Ecology
WSDH = Washington State Department of Health
µg/L = Microgram per liter
gpm = gallon per minute

1a-State of Washington ambient water quality criteria for protection of human health (WDOE 2003)
1b-State of Washington drinking water standards, WAC 246-290-310 (WSDH 2006)
2-EPA recommended chronic ambient water quality criteria for human consumption of water and fish (EPA 2006)
3-State of Washington ambient water quality criteria for protection of aquatic life, chronic criterion (WDOE 2003)
4-EPA recommended chronic ambient water quality criteria for freshwater aquatic life (EPA 2006); if none existed then used Tier II secondary chronic values (NOAA 1999)

Table 5. Sediment Analytical Results Summary
Rainy Mine EE/CA

Sample ID	Date Collected	TOC (%)	Analyte Concentration (mg/kg)																											
			Ca	K	Mg	Na	CN	Ag	Al	As_3	As_5[a]	As_T	Ba	Be	Cd	Co	Cr_3[a]	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
QC-SS-1 - Background	6/27/2004	0.5	960	1670	2770	130	*0.3*	0.04	6950	0.161	9.3	9.5	66.8	*0.1*	0.39	4	5	0.955	6	18	10600	*0.02*	181	2.7	4.78	0.1	*0.25*	0.11	23.9	31
Taylor River:																														
TR-SS-1	6/26/2004	0.2	1690	1750	3270	190	NA	0.13	6490	0.086	3.5	3.6	53.1	*0.1*	0.14	4	2.2	0.786	3	19	12100	*0.02*	216	3.8	7.4	*0.05*	*0.25*	0.13	22.6	40
TR-SS-2	6/28/2004	0.2	1920	1510	2990	280	NA	0.08	6790	0.068	5.3	5.4	44.1	*0.1*	0.12	3	3.2	0.823	4	16	10500	*0.02*	189	3.1	3.48	*0.05*	*0.25*	0.11	20.3	30
Site:																														
QC-SS-2	6/27/2004	2.2	1490	1300	2540	230	NA	0.06	7550	0.098	12.2	12.3	61.6	*0.1*	0.22	4	3.1	0.936	4	27	9540	*0.02*	184	2.3	4.97	*0.05*	*0.25*	0.09	20.5	31
QC-SS-3	6/27/2004	0.6	1180	1090	2390	190	*0.25*	0.28	6950	0.101	22.5	22.6	48.1	*0.1*	0.17	3	5.2	0.764	6	145	9700	*0.02*	135	2.4	3.6	*0.05*	*0.25*	0.07	17.7	30
QC-SS-4	6/26/2004	0.2	1590	1350	2110	250	*0.25*	0.09	5750	0.137	15.2	15.3	36.8	*0.1*	0.14	3	2.2	0.765	3	30	8150	*0.02*	152	1.6	3.12	0.2	*0.25*	0.09	17	23
RM-SEEP-SS-1	6/28/2004	8.8	3210	1420	3150	220	*2*	4.79	44200	1.025	178	179	66.3	0.6	1.27	8	8.4	2.573	11	4410	23300	*0.025*	167	7	27.2	0.5	0.8	0.23	39.9	82
RM-SEEP-SS-2	6/28/2004	6.8	2360	1330	5100	320	*0.5*	33.9	19500	3.342	201.7	205	63.1	*0.1*	0.69	4	9.9	1.119	11	2620	49700	0.19	198	7	31.2	*1.0*	7	0.18	50.2	90
minimum (excluding BG) =		0.2	1180	1090	2110	190	*0.25*	0.06	5750	0.098	12.2	12.3	36.8	*0.1*	0.14	3	2.2	0.76	3	27	8150	*0.02*	135	1.6	3.12	*0.05*	*0.25*	0.07	17.0	23
MDC (excluding BG) =		**8.8**	**3210**	**1420**	**5100**	**320**	***2.0***	**33.9**	**44200**	**3.34**	**201.7**	**205**	**66.3**	**0.6**	**1.27**	**8**	**9.9**	**2.57**	**11**	**4410**	**49700**	**0.19**	**198**	**7**	**31.2**	**1.0**	**7.0**	**0.23**	**50.2**	**90**
average (excluding BG) =		3.7	1966	1298	3058	242	*0.8*	7.8	16790	0.94	85.9	86.8	55.2	0.2	0.50	4	5.8	1.23	7	1446	20078	0.06	167	4.1	14.0	0.36	1.7	0.13	29.1	51
95% UCL =			2748	1417	4205	288	4.1	207	32330	5.60	393	398	67.0	0.6	0.96	7	8.9	2.3	11	3346	36924	0.20	191	6.6	27.3	0.74	10.3	0.20	43.5	82
# of samples = 9, Standard deviation =			667	199	860	55	0.7	11	12510	1.07	78	79	10	0.2	0.38	2	2.7	0.6	3	1569	13242	0.06	24	2.0	10.8	0.32	2.2	0.05	11.2	24
Frequnecy detected =			100%	100%	100%	1%	0%	100%	100%	100%	100%	100%	100%	11%	100%	100%	100%	100%	100%	100%	100%	11%	100%	100%	100%	33%	22%	100%	100%	100%
Human Health Screening Criteria:																														
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)			NS	NS	NS	NS	20	NS	NS	2	NS	2000	19	19	NS	NS	2	NS	NS	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS
EPA Region IX Industrial Soil PRGs (EPA 2004)			5100	100000	NS	NS	1.6	67000	1900	450	1900	100000	30	450	41000	100000	310	19000	20000	800	410	5100	67	1000	100000					
Ecological Screening Criteria:																														
State of Washington Development of Freshwater Sediment Quality Values (WDOE 2004) - recommended only			2.0	NS	NS	NS	20.0	NS	NS	0.6	NS	NS	NS	95.0	80.0	NS	0.5	NS	60.0	335	0.4	NS	NS	NS	140					
State of Washington Development of Freshwater Sediment Quality Values (WDOE 2004) - in development			3.9	NS	NS	NS	5.9	NS	NS	0.6	NS	NS	NS	26.0	16.0	NS	0.17	NS	16.0	31.0	35.0	NS	NS	NS	110					
EPA Threshold Effects Level (NOAA 1999)			NS	NS	NS	NS	5.9	NS	NS	0.596	NS	NS	NS	37.3	35.7	NS	0.174	NS	18	35	NS	NS	NS	NS	123					
EPA Freshwater Probable Effects Level (NOAA 1999)			NS	NS	NS	NS	17	NS	NS	3.53	NS	NS	NS	90	197	NS	0.486	NS	35.9	91.3	NS	NS	NS	NS	315					

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
Bold values are the maximum detected concentrations (MDC)
Screening criteria exceeded
[a]Calculated value.
BG = Background
EPA = U.S. Environmental Protection Agency
MTCA = Model Toxics Control Act
NOAA = National Oceanic and Atmospheric Administration
NS = No standard
ORNL = Oak Ridge National Laboratory
UCL = Upper confidence limit
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

Table 6. Pore Water Analytical Results Summary
Rainy Mine EE/CA

Sample ID	Date Collected	Analyte Concentration (µg/L)[a]																						
		Ag	Al	As_3	As_5[c]	As_T	Ba	Be	Cd	Co	Cr_3[c]	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
QC-PW-1 - background	6/27/2004	*0.025*	50	0.186	0.91	1.1	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.0008	*2.5*	*5*	*0.05*	*0.1*	*0.05*	0.2	*2.5*	*5*
QC-PW2	6/27/2004	*0.025*	50	0.083	1.22	1.3	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00088	*2.5*	*5*	*0.05*	*0.1*	*0.05*	0.18	*2.5*	*5*
QC-PW3	6/27/2004	*0.025*	40	0.051	1.35	1.4	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00177	*2.5*	*5*	*0.05*	*0.1*	*0.05*	0.08	*2.5*	*5*
QC-PW4	6/26/2004	*0.025*	60	0.028	0.97	1	4	*1*	*0.05*	*5*	5	*0.5*	*5*	1.9	*5*	0.00286	*2.5*	*5*	*0.05*	*0.1*	*0.05*	0.05	*2.5*	*5*
RM-seep-PW1	6/28/2004	*0.025*	1320	8.08	0.02	8.1	17	*1*	0.5	*5*	5	*0.5*	*5*	409	9360	0.0011	60	*5*	0.2	*0.1*	*0.05*	6.0	*2.5*	70
RM-seep-PW2	6/28/2004	*0.025*	40	3.68	28.42	32.1	*1.5*	*1*	0.2	*5*	5	*0.5*	*5*	0.6	*5*	0.00013	*2.5*	*5*	*0.05*	*0.1*	*0.05*	*0.05*	*2.5*	*5*
minimum (excluding BG) =		*0.025*	40	0.028	0.02	1	*1.5*	*1*	*0.05*	*5*	5	*0.5*	*5*	*0.25*	*5*	0.00013	*3*	*5*	*0.1*	*0.1*	*0.1*	*0.05*	*2.5*	*5*
MDC (excluding BG) =		***0.025***	**1320**	**8.08**	**28.42**	**32.1**	**17**	***1***	**0.5**	***5***	**5**	***0.5***	***5***	**409**	**9360**	**0.0029**	**60**	***5***	**0.2**	***0.1***	***0.05***	**6.0**	***2.5***	**70**
average (excluding BG) =		*0.03*	302	2.38	6.4	8.8	5.1	*1*	0.2	*5*	5	*0.5*	*5*	82	1876	0.0013	14.0	*5*	0.08	*0.1*	*0*	1.27	*2.5*	18
95% UCL =		*0.025*	2835	5.77	1539	49.7	20	*1*	0.47	*5*	5	*0.5*	*5*	438	10031	0.0023	128	*5*	0.21	*0.1*	*0.05*	6.42	*2.5*	147
# of samples = 6, Standard deviation =		0	474	3.01	10	11.3	6	0	0.17	0	0	0	0	152	3486	0.0009	21	0	0.06	0	0	2.20	0	24
Frequency detected =		0%	100%	100%	100%	100%	33%	0%	33%	0%	0%	0%	0%	50%	17%	100%	17%	0%	17%	0%	0%	83%	0%	17%
Ecological Screening Criteria																								
1- Washington Eco[b]		NS	NS	NS	NS	190	NS	NS	0.08	NS	10.1	10.0	NS	0.57	NS	0.012	NS	8.1	0.05	NS	5	NS	NS	5.4
2- EPA Eco[b]		0.36	NS	NS	3.1	150d	4	0.66	0.02	23	4.2	11d	NS	0.45	1000	0.77d	120	2.7	0.05	30	5	12	20	6.1

Sample ID	pH	Analyte Concentration (µg/L)[a]						
		Ca	Hard	K	Mg	Na	Sulfate	CN
RM-BG-SW4 - background	6.5	1200	3	*150*	*100*	1000	*5*	*0.005*
QC-PW2	6.1	1200	3	*150*	*100*	1000	20	NA
QC-PW3	6.4	1200	3	*150*	*100*	1000	20	*0.005*
QC-PW4	6.2	1000	3	*150*	*100*	1000	10	*0.005*
RM-seep-PW1	5.6	6400	19	600	600	2600	40	NA
RM-seep-PW2	4.6	1200	3	*150*	*100*	1000	40	NA
minimum (excluding BG) =	4.6	1000	3	*150*	*100*	1000	10	*0.005*
MDC (excluding BG) =	**6.4**	**6400**	**19**	**600**	**600**	**2600**	**40**	***0.005***
average (excluding BG) =	5.8	2200	6.2	240	200	1320	26	*0.005*
95% UCL =		6780		632	636	2002	39	

1-State of Washington ambient water quality criteria for protection of aquatic life, chronic criterion (WDOE 2003)
2-EPA recommended chronic ambient water quality criteria for freshwater aquatic life (EPA 2006); if none existed, used Tier II secondary chronic values (NOAA 1999)

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
Bold values are the maximum detected concentrations (MDC)
Screening criteria exceeded
[a]Dissolved concentrations
[b]Screening criteria for hardness dependent metals are based on a average hardness of 6.2.
[c]Calculated value.
BG = Background
EPA = U.S. Environmental Protection Agency
NOAA = National Oceanic and Atmospheric Administration
NS = No standard
UCL = Upper confidence limit
WDOE = Washington Department of Ecology
µg/L = Microgram per liter

Table 7. Summary of Waste Volumes and Selected Metal Concentrations
Rainy Mine EE/CA

Area	Location	Estimated Volume (bcy)	Selected Metal Concentration (mg/kg)		
			Arsenic	Copper	Silver
		Average background soil =	0.41	200	0.65
		Average background sediment =	9.5	18	0.04[a]
WR-1	Mill Site (east zone)	2000	222	1970	41.3
WR-2	West zone	25	15800	1310	15.0
S1 and S3	Soil around mill foundation	20	298	1660	41.1
RM-SEEP-SS-1	Sediment at west toe of waste rock pile WR-1	10	179	4410	4.8
RM-SEEP-SS-2	Sediment at east toe of waste rock pile WR-1	10	205	2620	33.9

Notes:

Data in this table represent analytical results of samples collected during the Site Inspection (CES 2005).

[a] Analytical result between the method detection limit (MDL) and practical quantitation limit (PQL); value = detected concentration

bcy = Bank cubic yard

mg/kg = Milligram per kilogram

Table 8. Surface Water Quality ARARs and Proposed Cleanup Criteria (total recoverable µg/L)
Rainy Mine EE/CA

Analyte	Apparent Background Concentration[a]	Maximum Detected Concentration	State of Washington		Federal				Proposed Surface Water Cleanup Criteria
			WAC 173-201A	WAC 246-290	Clean Water Act Section 304		National Toxics Rule 40 CFR 131.26		
			Protection of Aquatic Life, Chronic[b,c]	Drinking Water Criteria	Human Health Consumption of Water+Organism	Freshwater Chronic[b]	Human Health Consumption of Water+Organism	Freshwater Chronic[b]	
Aluminum	85	2890							87
Arsenic	0.68	57.7	190	10	0.018	150	0.018	190	10
Barium	*1.5*	14		2000	1000				4
Cadmium	*0.05*	0.7	0.08	5		0.02		0.08	0.08
Copper	*0.25*	2020	0.57	1300	1300	0.45[d]		0.57	0.57
Iron	12.5	580		300	300	1000			300
Manganese	*2.5*	54		50					50
Lead	*0.05*	0.5	0.05	15		0.05		0.05	0.05
Zinc	*5*	60	5.4	50000	7400	6.1		5	5.4

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
µg/L = Microgram per liter
[a]Based on one background sample from Quartz Creek upstream of the site and one sample from unnamed drainage.
[b]Hardness dependent criteria adjusted based on an apparent background hardness of 3; also converted to total concentrations where applicable.
[c]For protection of human health, State of Washingon defaults to National Toxics Rule 40 CFR 131.26.
[d]The federal Aquatic Life Ambient Freshwater Quality Copper Criterion was revised in 2007 and is to be calculated using site-specific water quality parameters (EPA 2007); however, there is insufficient site data available to calculate the criterion. Therefore, the 2006 criterion was used.
ARAR = Applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
PRG = Preliminary Remediation Goal
WAC = Washington Administrative Code

Table 9. Soil Quality ARARs and Proposed Cleanup Criteria (mg/kg)
Rainy Mine EE/CA

Analyte	Apparent Background Concentration[a]	Maximum Detected Concentration	State of Washington			Federal	Human Health Risk-based Criteria[c]	Proposed Soil Cleanup Criteria
			WAC 173-340-740	WAC 173-340-7492	WAC 170-340-7493	EPA		
			MTCA Method A Industrial Soil (Table 745-1)	Method B Unrestricted Land Use (Table 749-2)	Method B Ecological Receptor[b] (Table 749-3)	Region 9 PRGs - Industrial Soil		
Aluminum	20000	26200	NS	NS	50p	100000		20000
Antimony	0.37	5.3	NS	NS	5p	410		5
Arsenic	31.2	15800	20 (As^3)	20 (As^3)	10p (As^5)	1.6	33	33
Cadmium	0.18	0.61	2	25	4p	450		2
Chromium	5.3	12	19 (Cr^6)	42	42p,s	450		19
Copper	200	1970	NS	100	50s	41000		200
Mercury	0.09	1.08	2	9	0.1s	310		0.1
Lead	31.4	79.6	1000	220	50p	800		50
Selenuim	0.45	11.1	NS	0.8	0.3w	5100		0.45
Silver	0.65	41.3	NS	NS	2p	5100		2
Thallium	0.08	*1.5*	NS	NS	1p	67		1
Vanadium	26.4	67	NS	26	2p	1000		26.4
Zinc	63.7	69	NS	270	86p	100000		86

Notes:
Itailics - result below method detection limit, reported at 1/2 reporting limit
Underline - result between method detection limit and practical quantitation limit, reported at detected concentration
mg/kg = Milligram per kilogram

[a]Based on three background soil samples.

[b]Lowest value selected from plant(p), soil biota(s), and wildlife(w) receptors

[c]From Rainy Mine Streamlined Human Health and Ecological Risk Assessment (MSE 2006). Value calculated using human health risk equations, site-specific exposure factors, and an allowable non-carcinogenic hazard index of 1 and a carcinogenic risk of 1.E-05.

ARAR = Applicable or relevant and appropriate requirement

EPA = U.S. Environmental Protection Agency

MTCA = Model Toxics Control Act

NS = No standard

PRG = Preliminary Remediation Goal

WAC = Washington Administrative Code

Table 10. Sediment Quality ARARs and Proposed Cleanup Criteria (mg/kg)
Rainy Mine EE/CA

Analyte	Apparent Background Concentration[a]	Maximum Detected Concentration	State of Washington		Federal		Human Health Risk-based Criteria[c]	Proposed Sediment Cleanup Criteria
			WDOE 2004	WAC 173-204-320	EPA/NOAA 1999			
			Freshwater Sediment Quality Standards (Recommended Only)	Marine Sediment Management Standards[b]	Threshold Effects Level	Probable Effects Level		
Arsenic	9.5	205	20	57	5.9	17	132	132
Cadmium	0.39	1.27	0.6	5.1	0.596	3.53		0.6
Copper	18	4410	80	390	35.7	197		80
Lead	4.78	31.2	335	450	35	91.3		335
Silver	0.04	33.9	2	6.1	NS	NS		2

Notes:

Underline - result between method detection limit and practical quantitation limit, reported at detected concentration

mg/kg = Milligram per kilogram

[a]Based on a single background sample collected from Quartz Creek upstream of the site.

[b]For reference only - not applicable.

[c]From Rainy Mine Streamlined Human Health and Ecological Risk Assessment (MSE 2006). Values calculated using human health risk equations, site-specific exposure factors, and an allowable non-carcinogenic hazard index of 1 and a carcinogenic risk of 1.E-05.

ARAR = Applicable or relevant and appropriate requirement

EPA = U.S. Environmental Protection Agency

NOAA = National Oceanic and Atmospheric Administration

NS = No standard

PRG = Preliminary Remediation Goal

WAC = Washington Administrative Code

WDOE = Washington Department of Ecology

Table 11. Summary of Areas Exceeding Risk-based Cleanup Levels
Rainy Mine EE/CA

Media	Area	Contaminant	Risk-based Cleanup Level (mg/kg)	Maximum Detected Concentration (mg/kg)	Estimated Volume (bcy)
Soil/Waste Rock	Soil around mill foundation (S-1 & S-3)	Arsenic	33	299	25
	Waste rock pile WR-1			222	2,000
	Waste rock pile WR-2			15800	25
Sediment	Sediment at west seep	Arsenic	132	179	80
	Sediment at east seep			205	20
				Total Estimated Volume of Waste Material =	**2150 bcy**

Notes:

bcy = Bank cubic yard

mg/kg = Milligram per kilogram

Table 12. Removal Action Technology Screening Matrix
Rainy Mine EE/CA

Technology Class	Process Option	Description	Effective–ness	Implemen–tability	Cost	O&M	Land Impact	Pros	Cons	Retained?
No Action										
No action	**No action**	Leave feature(s) as is	0	0	0	none	none	Cheap, easy	No risk reduction	**Yes**
Institutional Controls										
Access restriction	Barbed-wire fencing	3-strand barbed-wire fence around site.	Low	High	Low	Medium–subject to vandalism	Minimal	Simple	Only a mild impediment to access	No
	Chain-link fencing	8-foot chain-link security fence around site	Medium	Low	High	Medium–subject to vandalism	Visual contrast	Simple, more effective than barbed-wire	Difficult to install on steep, uneven slopes	No
	Warning signs	Signs posted at physical hazards to warn of potential risks	Low	High	Low	Medium–subject to vandalism	Minimal	Simple, more effective than barbed-wire	Difficult to install on steep, uneven slopes	No
Physical Hazards										
Access restriction	**Bat gate**	Install bat gate in open adit	High	High	Low	Medium—subject to vandalism	None	Reduces ecoreceptor exposure; maintains bat habitat	Potential vandalism	**Yes**
	Backfill open shaft	Backfill open shaft	High	Medium	Low	Low–subject to further subsidence	Low	Eliminates physical hazard; may be able to use waste rock for fill material	Potential for future collapse; removes potential bat habitat	**Yes**
	Plug open adit	Install PUF or concrete plug in addition to backfill and cover	Medium	Medium	Medium	Low–inspect vandalism	Minimal	Eliminates physical hazard	Removes potential bat habitat.	No
	Cap open shaft with cupola	Install bat cupola over open shaft	High	Medium	Low	Low–inspect for sloughing around cap and vandalism	Minimal	Eliminate physical hazard; not as prone to collapse; mainatains bat habitat	Not natural looking, potential vandalism	**Yes**
	Remove or bury debris	Remove scattered debris or bury on site	High	High	Low	None	Minimal	Cheap and easy, particularly for on-site disposal	May require waste characterization	**Yes**

Table 12. Removal Action Technology Screening Matrix
Rainy Mine EE/CA

Technology Class	Process Option	Description	Effective–ness	Implemen–tability	Cost	O&M	Land Impact	Pros	Cons	Retained?
Engineering Controls										
Surface controls	Runoff diversion	Use diversion channels to intercept surface water run on	Medium	High	Medium	Minimal; inspect for erosion	Low—channel	Reduce erosion and percolation of water through waste rock	Not independently effective	No
Solids containment	Soil evapo-transpiration cover	Soil cover designed to store precipitation until it evaporates	Low	Low	Medium	Low–inspect for erosion	< 1 ac repository and topsoil stockpile	Simple design/installation	More applicable to arid/semi-arid climates; would require very thick soil cover	No
	Geosynthetic cover	Engineered multilayer cover with a synthetic liner (GCL or HDPE)	High	Medium	High	Low–inspect for erosion		Eliminates infiltration through waste material	Must be installed/tested correctly	**Yes**
	Clay cover	Bentonite or composite clay geosynthetic cover + soil & seed	Low	Medium	Medium	High–clay subject to desication in semi-arid climate		Nearly eliminate infiltration; more forgiving installation than geosynthetics	Clay prone to decomposition from desiccation and freeze/thaw (ITRC 2004)	**Yes**
	Biological cover	Add carbohydrate– or protein–based nutrient mixes to cover soil	Medium	High	Medium	Low–inspect for erosion		Reduced leachate metals conc. (EPA 2000)	Strongly depends on mixture; design parameters not developed (EPA 2000)	No
	Cementitious cover	Fiber–reinforced concrete/mortar cover	High	Medium	High	Low–inspect for erosion		Reduce leachate metals conc.	Subject to cracking; not natural looking	No
	Polyurethane grout	Spray cover of polyurethane grout to inhibit infiltration	Medium	Medium	Medium	Low–inspect for erosion		Reduced infiltration, leachate metals conc. < MCLs (EPA 2000); more plasticity than cement grouts	Long term stability unknown (EPA 2000)	No
Land Disposal										
On-site repository	**Constructed repository**	Excavate waste rock and place in on–site repository	High	High	Medium	Medium—inspect cap and analyze leachate; inspect reclaimed areas	<1 ac (reclaimed)	Eliminates or reduces direct exposure	Waste remains on site; potential for re-exposure	**Yes**
Off-site disposal	**Landfill**	Excavate waste rock and dispose in landfill	High	High	High	Low–material hauled off site; inspect reclaimed areas	None	Eliminates direct exposure by removing waste from site	Risk of highway spills	**Yes**

Table 12. Removal Action Technology Screening Matrix
Rainy Mine EE/CA

Technology Class	Process Option	Description	Effective–ness	Implemen–tability	Cost	O&M	Land Impact	Pros	Cons	Retained?
Treatment										
Solidification/ Stabilization	Stabilization	Inject waste rock with cement or other material to physically stabilize	Medium to High	High	Medium	Low–inspect for erosion/settling	Minimal for access to waste rock piles	Does not require waste excavation	Leaves waste in the 100-year floodplain	No
Vitrification	Vitrification	Heat waste rock >2800ºF to melt minerals	High	Low	High	Low–inspect for erosion/settling	Minimal for access to waste rock piles	Does not require waste excavation	Requires high energy source; high cost; leaves waste in floodplain	No
Washing	Washing	Excavate and wash waste rock with aqueous solution	Medium	Low	High	Low–inspect for erosion/settling	Minimal for access to waste rock piles and wash area	Reduces waste toxicity	Requires water source, significant waste handling; and chemical disposal	No

Table 13. Estimated Removal Action Cost Summary
Rainy Mine EE/CA

TASK	Description	Alternative 2 Cost	Alternative 3 Cost		Recommended Alternative Cost
			Alt 3A	Alt 3B	
Access Road Improvement		$5,000	$5,000	$5,000	$5,000
	subtotal =	**$5,000**	**$5,000**	**$5,000**	**$5,000**
Physical Hazards Mitigation	Bat Gate Installation	$5,500	$5,500	$5,500	$5,500
	Debris Removal	$5,556	$5,556	$5,556	$5,556
	subtotal =	**$11,056**	**$11,056**	**$11,056**	**$11,056**
Mine Waste Removal	Access Road Construction	$107,032	$107,032	$107,032	$107,032
	Mine Waste Excavation and Disposal	$195,267	$40,241	$40,481	$40,241
	French Drain Construction			$52,803	
	Repository Construction[(a)]		$27,169	$126,659	$27,169
	Mine Waste Area Reclamation	$18,651	$11,370	$9,375	$11,370
	Access Road Reclamation	$27,075	$33,365	$33,365	$33,365
	subtotal =	**$348,025**	**$219,175**	**$369,715**	**$219,175**
Miscellaneous	Staging Area Preparation	$2,000	$500	$500	$500
	Mobilization	$20,000	$30,000	$30,000	$30,000
	Temporary Erosion Control BMPs	$5,000	$4,000	$5,000	$4,000
	Install Diversion Channel Above Repository		$1,532	$8,370	$1,532
	Install Temporary Fence Around Repository		$1,768	$2,652	$1,768
	subtotal =	**$27,000**	**$37,800**	**$46,522**	**$37,800**
	Removal Action Subtotal =	**$391,081**	**$273,031**	**$432,293**	**$273,031**
Design and Oversight	Design	$39,108	$40,955	$64,844	$40,955
	Removal Action Oversight	$40,000	$60,000	$60,000	$60,000
	subtotal =	**$79,108**	**$100,955**	**$124,844**	**$100,955**
Post-removal Monitoring	Post-removal Monitoring for 3 years	$49,472	$49,472	$49,472	$49,472
	subtotal =	**$49,472**	**$49,472**	**$49,472**	**$49,472**
	SUBTOTAL =	**$519,662**	**$423,458**	**$606,609**	**$423,458**
Contingency	20% Contingency	$103,932	$84,692	$121,322	$84,692
	TOTAL COST =	**$ 623,594**	**$ 508,150**	**$ 727,931**	**$ 508,150**

Notes:

[a]Cost based on repository cover option 1 - engineered cover; cover option 2 - earthen clay cover would increase cost from $25,000 to $31,000 based on options selected

Table 14. Data Gaps Summary
Rainy Mine EE/CA

Data Gap	Potential Issues	Recommended Action	Estimated Cost
Lack of sufficient background samples: -Minimal background samples collected for each media type	-Background surface water, pore water, and sediment samples may have been impacted by mining activities upstream of the Site -Prevents establishing statistically representative Background concentrations for any media at the site -May result in applying site cleanup criteria that are below background levels -Makes it difficult to evaluate removal action effectiveness or compliance with ARARs	It is generally good practice to adequately characterize background conditions at a removal action site to ensure that cleanup criteria are above background levels, to evaluate removal action effectiveness, and determine post-removal compliance with ARARs. Additional background sampling should be conducted to develop statistically valid background concentrations for all media, and the analytical MDLs should be well below applicable screening criteria.	$3,000 - $5,000
Concrete mill foundation not characterized: -No samples of the concrete mill foundation have been collected.	-Concrete may contain elevated leachable concentrations of metals. -May be considered a hazardous waste.	A sample from the concrete mill foundation should be collected and analyzed to determine whether the material can be disposed of in an on-site repository or sanitary landfill.	
Potential presence of T&E amphibian species: -SI indicates T&E amphibian species may be present at the site.	–T&E species are to be protected to the individual level. -May require special measures to accommodate a sensitive species.	A detailed biological survey should be conducted to determine whether T&E amphibian species are present at the site, specifically around the seeps. Should also determine whether bats inhabit the open shaft and adit. Consult with USFS biologist.	USFS
Minimal site topography: -Topography generated in the SI covers a limited portion of the mill site and surrounding area. -No detailed topography for the area between the mill site and Adit 1, or the proposed repository areas	-Difficult to prepare an engineered design for removal actions. -Difficult to delineate floodplain	Areas that will be addressed in the selected removal action alternative should be surveyed to provide adequate topography needed to prepare engineered designs and accurately estimate costs.	$3,000-$5,000
		Total Estimated Cost =	**$6,000-$10,000**

Table 15. Comparative Analysis of Removal Action Alternatives
Rainy Mine EE/CA

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Disposal
Compliance with Removal Action Goals and Objectives			
Attributes:	Does not comply	Waste material removed from site and physical hazards mitigated.	Waste material encapsulated on site and physical hazards mitigated.
Advantages:	None	+Eliminates potential exposure at site	+Reduces exposure potential at site
Overall Protectiveness of Public Health, Safety and Welfare			
Attributes:	No protection	All waste material exceeding cleanup levels removed from site.	All waste material exceeding cleanup levels encapsulated on site.
Advantages:	None	+Higher level of human protection +Eliminates potential for future releases at the site	+High level of human protection +Eliminates risk to community from long-distance transport of waste
Environmental Protectiveness			
Attributes:	No protection	All waste material exceeding cleanup levels removed from site.	All waste material exceeding cleanup levels encapsulated on site.
Advantages:	None	+Higher level of ecological protection +Eliminates potential for future releases at the site	+High level of ecological protection
Compliance with Key ARARs			
Attributes:	Does not comply	Moderate compliance with Soil Quality ARARs High compliance with Solids Disposal ARARs High compliance with FP S&G ARARs	Moderate compliance with Soil Quality ARARs Moderate to high compliance with Solids Disposal ARARs High compliance with FP S&G ARARs
Advantages:	None	+Eliminates potential for future non-compliances from waste material	+Repository option 1 (ridge location) would better comply with FP S&Gs +Cover option 1 (engineered cover) meets substantive Solids Disposal ARARs
Long-term Effectiveness and Permanence			
Attributes:	No action	Waste source removed from site. Bat gate may be subject to vandalism.	Waste source encapsulated on site. Effectiveness dependent on cover selection. Bat gate may be subject to vandalism.
Advantages:	None	+Most effective and permanent long term	+Effective and provides long-term permanence

Table 15. Comparative Analysis of Removal Action Alternatives
Rainy Mine EE/CA

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Disposal
Reduction of Toxicity, Mobility and Volume			
Attributes:	No action	No reduction in toxicity or mobility, but waste is removed from site.	No reduction in toxicity or mobility, but waste is encapsulated.
Advantages:	None	+Complete reduction of waste volume +Most likely for reduction of mobility	+Significant reduction of waste volume +Reduction in mobility dependent on cover option selected; option 1 will be more effective at minimizing mobility.
Short-Term Effectiveness			
Attributes:	No action	Waste removed from the site within one field season.	Waste encapsulated on site within one field season. Short-term effectiveness will depend on cover selected; option 1 will be more effective in the short term.
Advantages:	None	+Most easily constructed +Minimal risk to community and workers	+Easily constructed +Minimal risk to community and workers +Does not require off-site transport of waste
Implementability			
Attributes:	Not applicable	Waste removal, transport, and site reclamation accomplished using standard construction equipment and methods.	Waste removal, transport, site reclamation, and repository construction accomplished using standard construction equipment and methods.
Advantages:	None	+Easiest to implement; technically and administratively feasible.	+Easily implemented; technically and administratively feasible.
State and Federal Agency, and Community Acceptance			
Attributes:	Not acceptable	Waste removed from site and physical hazards mitigated.	Waste encapsulated on site and physical hazards mitigated.
Advantages:	None	+Most acceptable	+Acceptable

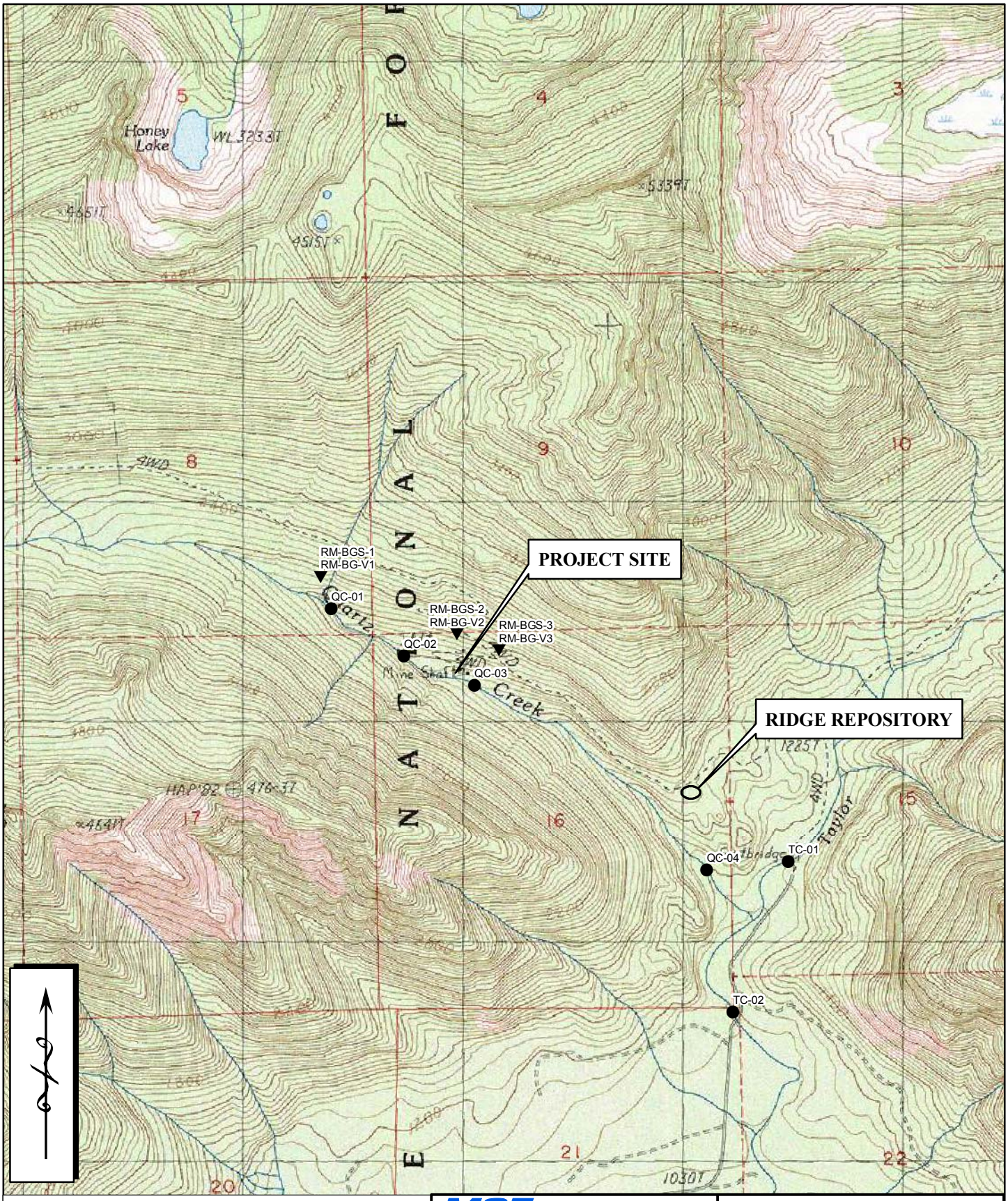
Table 15. Comparative Analysis of Removal Action Alternatives
Rainy Mine EE/CA

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Disposal
Estimated Total Present Worth Cost			
Attributes:	$0	$623,594	Repository Location 1 - Ridge[a] = $508,150 Repository Location 2 - Mill Site[a] = $727,931
Advantages (= cost savings over most expensive option):	+$727,931	+$104,337 savings	Using Repository Location 1 (Ridge)[a] = +$219,781 Using Repository Location 2 (Mill Site)[a] = +$0

Notes:

[a]Costs based on engineered cover option; an earthen clay cover would increase costs $25,000 to $31,000 based on options selected.
ARAR = Applicable or Relevant and Appropriate Requirement
FP S&Gs = Forest Plan Standard and Guidelines

Figures



Legend

QC-01 ● Aquatic Sampling Station (Quartz Creek)

TC-01 ● Aquatic Sampling Station (Taylor Creek)

RM-BGS ▼ Background Soil Sample Location

REFERENCE: U.S.G.S. 7.5 MINUTE QUADRANGLE, LAKE PHILIPPA, WASHINGTON 1987

0 500 1,000 2,000 Feet

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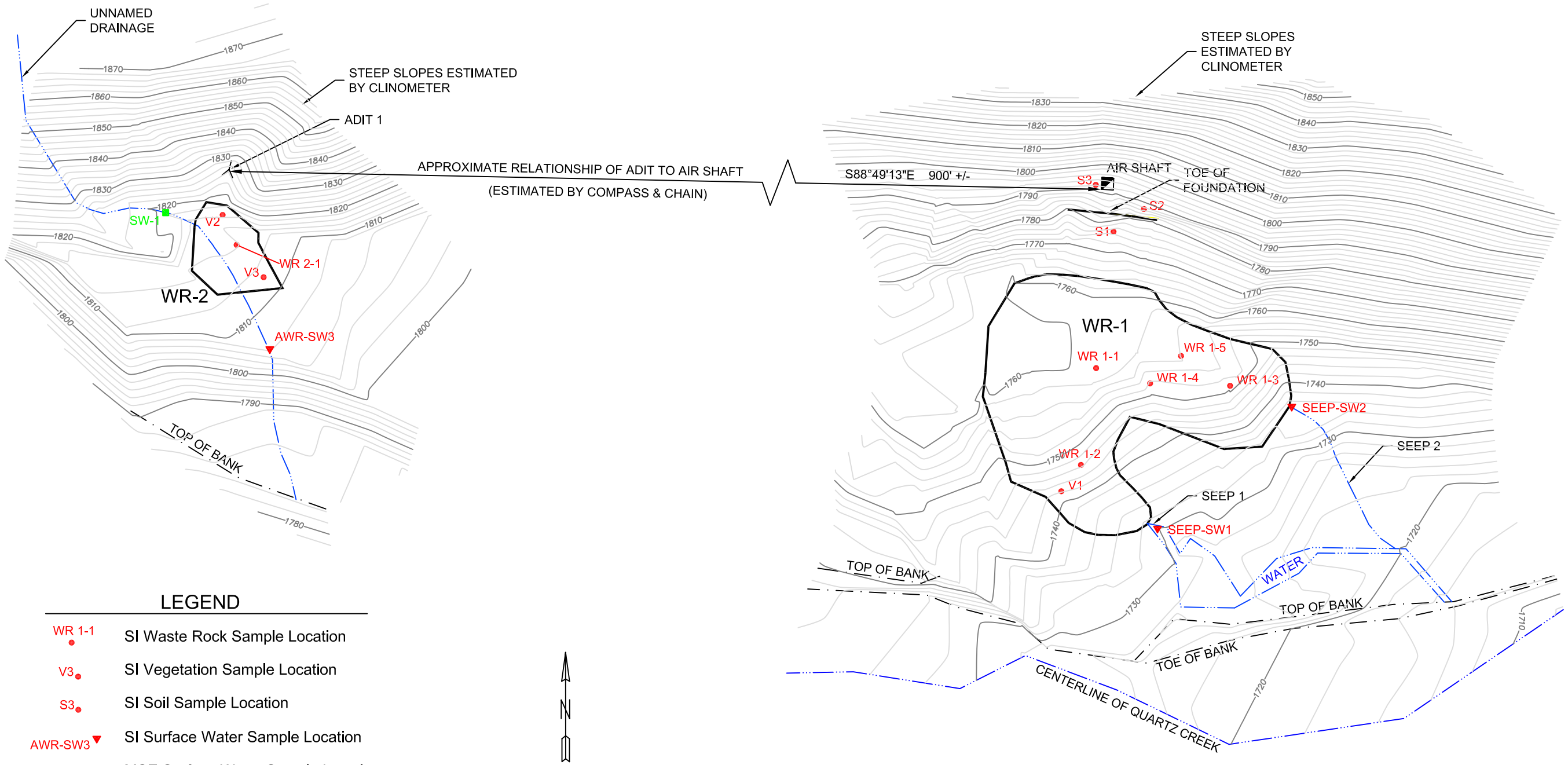
Boise, ID 83702 USA
Phone: (208) 345-8292

Vicinity Map
Rainy Mine

B2473.F	rainy_mine_fig1.mxd	5/08/08	Figure 1

:MSE\puettl\wash_mines\rainy_mine_fig1.mxd 3.17.08



LEGEND

WR 1-1	SI Waste Rock Sample Location
V3	SI Vegetation Sample Location
S3	SI Soil Sample Location
AWR-SW3	SI Surface Water Sample Location
SW-1	MSE Surface Water Sample Location
	Stream or Drainage
WR-2	Waste Rock Pile
	Air Shaft
	Open Adit

N

0 50 FEET

(SCALE & LOCATIONS ARE APPROXIMATE)

NOTE:
The prefix "RM" (Rainy Mine) has been removed from the sample IDs.

Base Map Source: Site Inspection, Cascade Earth Sciences, 2005

DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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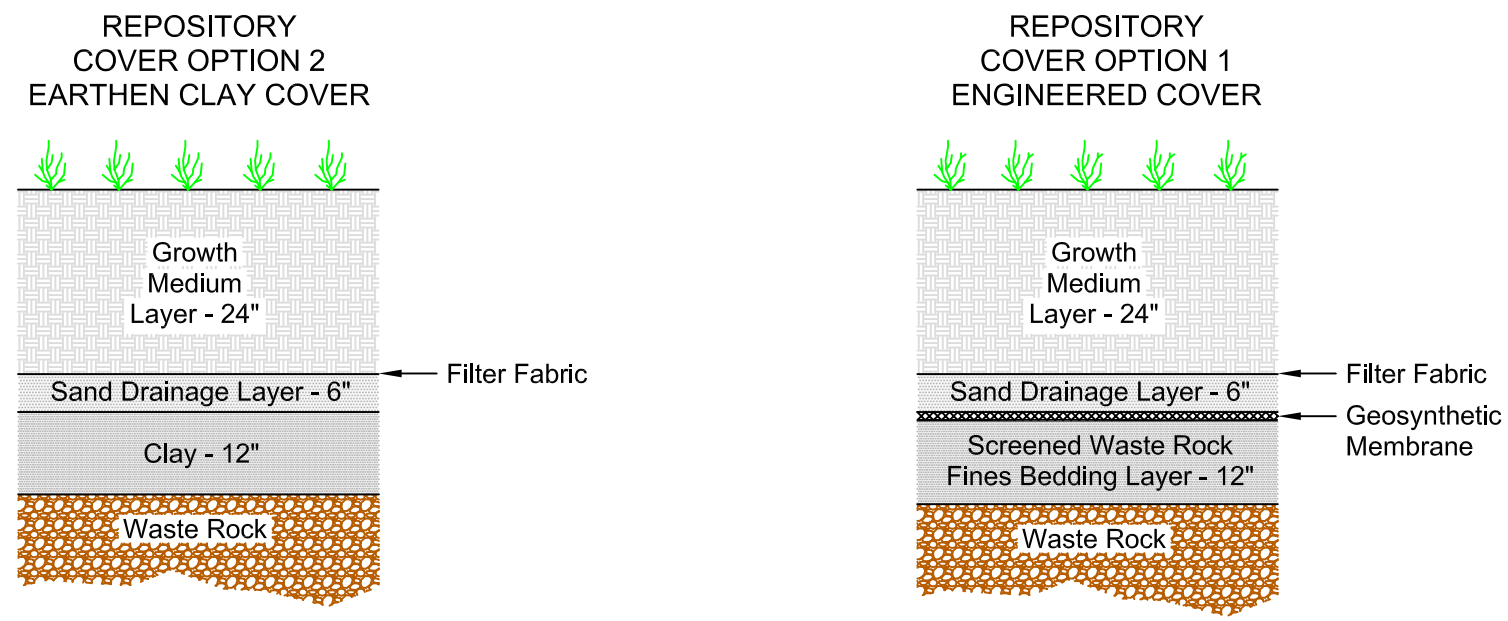
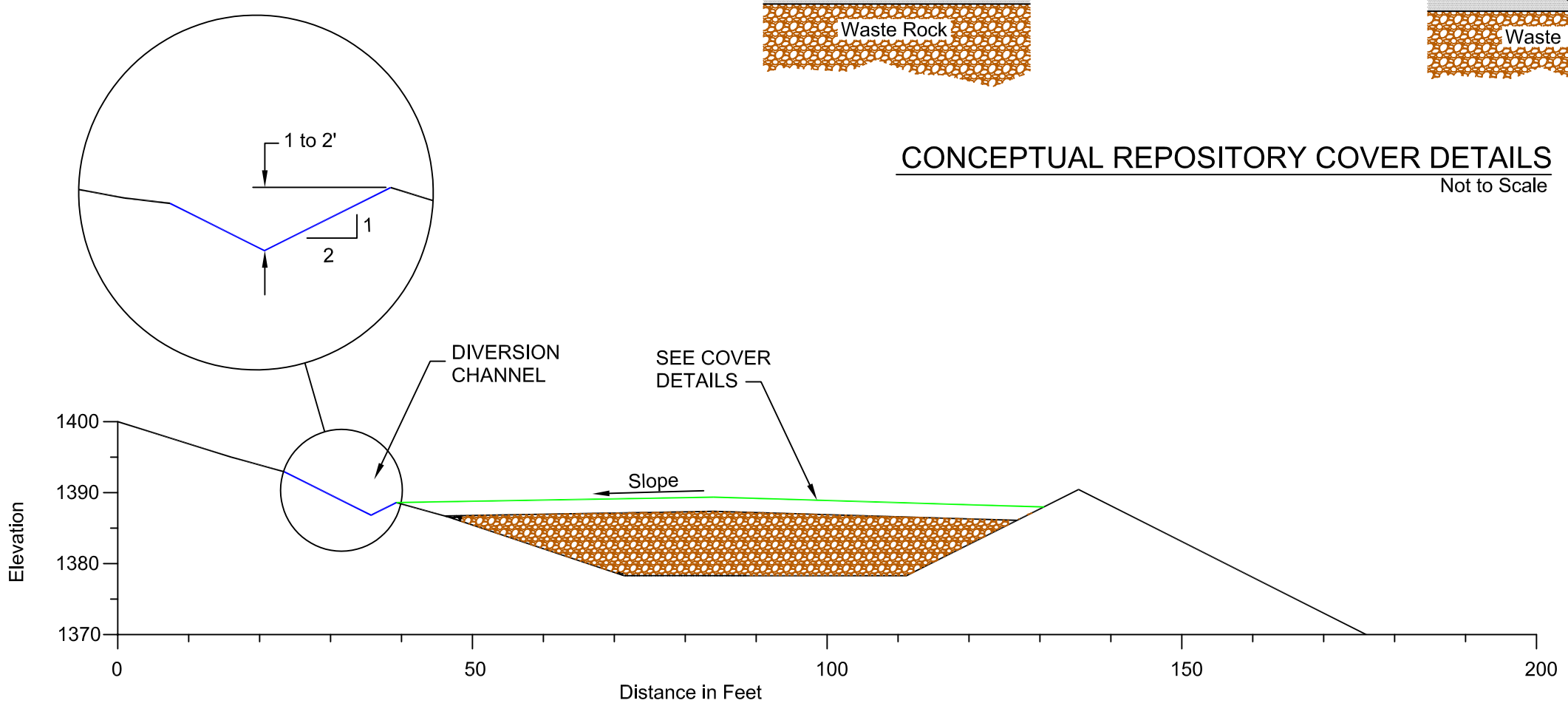
Rainy Mine
Primary Site Features

B2473G	figure2.dwg	4/25/08	Figure 2



CONCEPTUAL REPOSITORY COVER DETAILS

Not to Scale



Note: Elevation and horizontal distance are conceptual only.

CONCEPTUAL RIDGE REPOSITORY CROSS SECTION

Not to Scale

CONCEPTUAL DESIGN DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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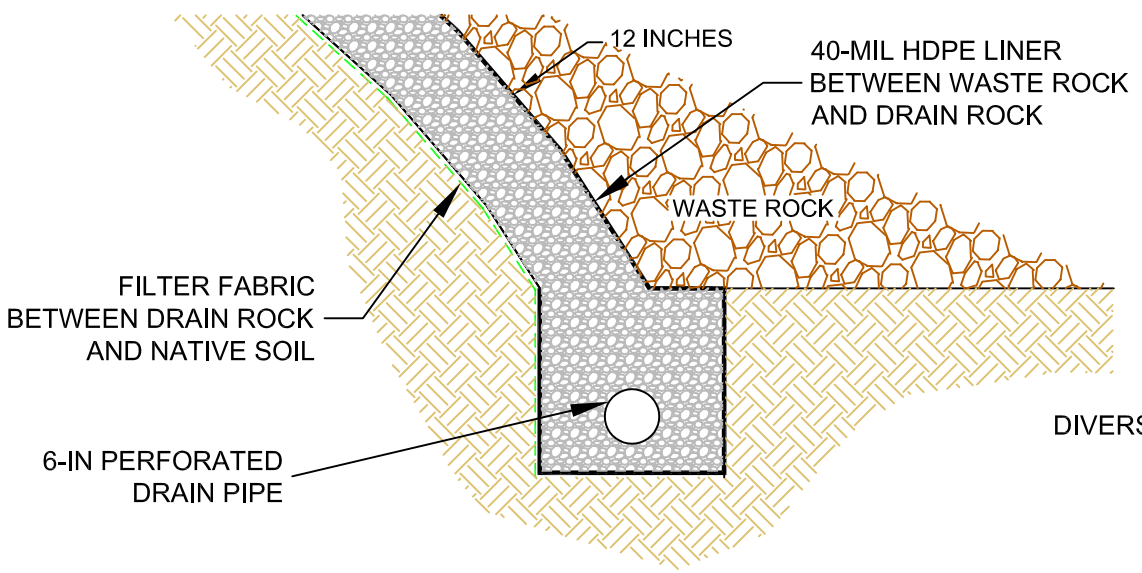
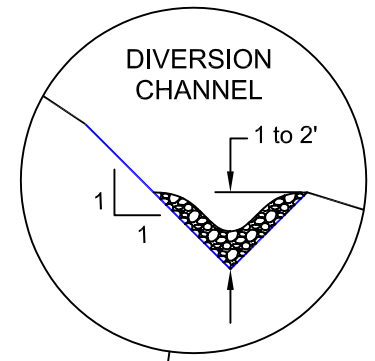
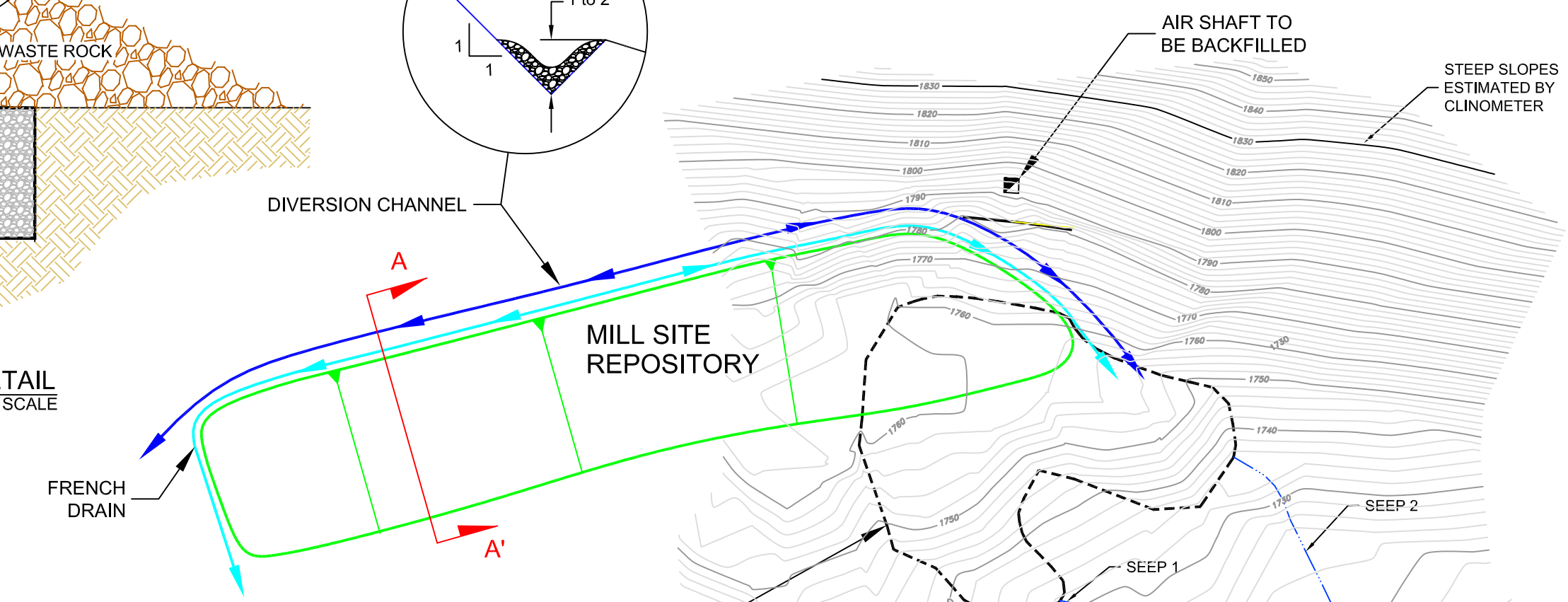
Rainy Mine Ridge Repository

B2473G	figure3.dwg	3/12/08	Figure 3

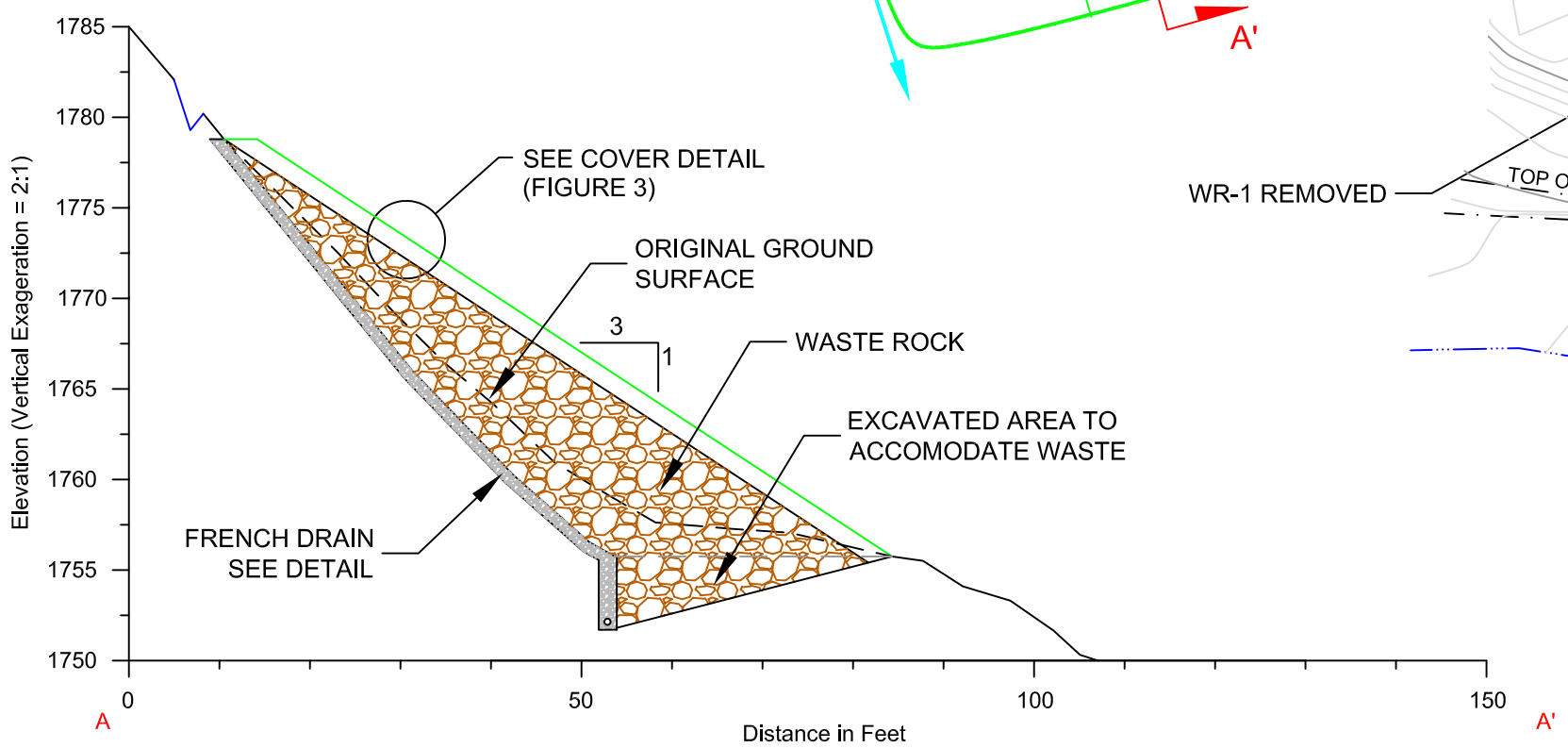


FRENCH DRAIN DETAIL
NOT TO SCALE





MILL SITE REPOSITORY PLAN VIEW
Scale: 1" = 100'



CONCEPTUAL MILL SITE REPOSITORY CROSS SECTION A-A'
Not to Scale

LEGEND

- Stream and Seep
- Removed Waste Rock
- Repository
- Diversion Channel
- French Drain

Base Map Source: Site Inspection, Cascade Earth Sciences, 2005

CONCEPTUAL DESIGN DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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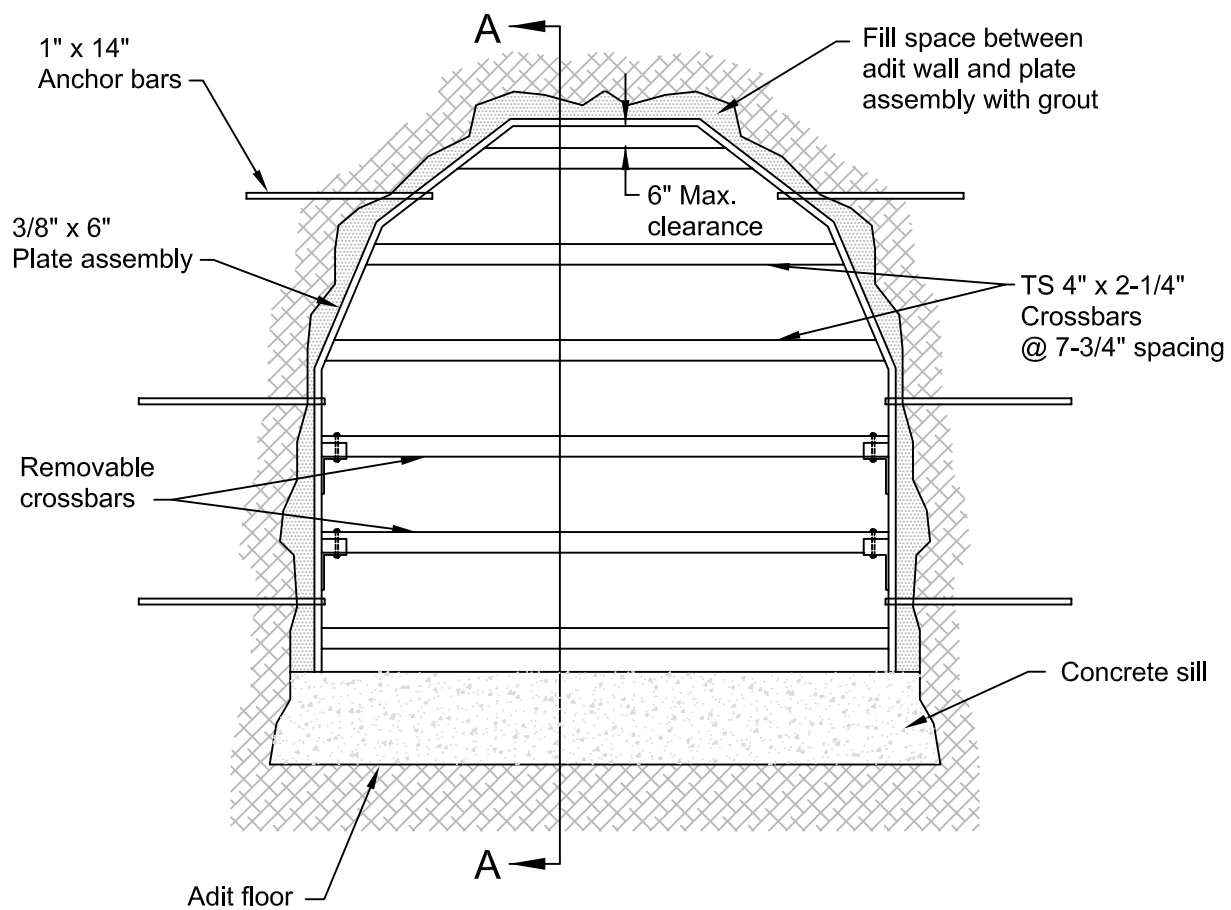
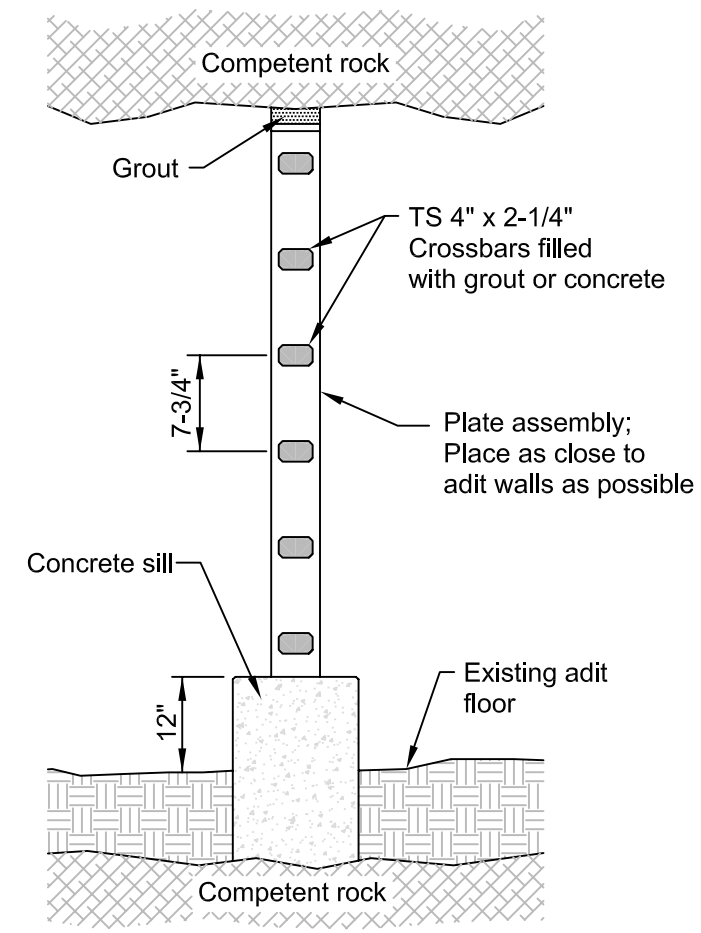
Rainy Mine
Mill Site Repository

B2473G	figure4.dwg	4/25/08	Figure 4



BAT GATE ELEVATION

Not to scale



SECTION A-A

Not to scale

CONCEPTUAL DESIGN DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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Rainy Mine
Bat Gate Details

B2473G	figure5.dwg	3/12/08	Figure 5

APPENDIX A

SITE PHOTOGRAPHS

Photo 1: Access road from FR5640 to Site

Photo 2: Ravine crossing

Photo 3: West side of waste rock pile WR-1

Photo 4: East side of waste rock pile WR-1

Photo 5: Waste rock pile WR-1 from toe

Photo 6: Mill foundation and shaft from below

Photo 7: Mill foundation

Photo 8: Shaft

Photo 9: Waste rock pile WR-1 from shaft

Photo 10: Debris on hillside above mill foundation

Photo 11: Big tank below waste rock pile WR-1

Photo 12: Seep (SW-1) below waste rock pipe WR-1

Photo 13: Seep (SW-2) below waste rock pile WR-1

Photo 14: Seep area below waste rock pile WR-1

Photo 15: Quartz Creek looking upstream

Photo 16: Quartz Creek looking downstream

Photo 17: Potential repository location at mill

Photo 18: Access (trail) to WR-2

Photo 19: Waste rock pile WR-2

Photo 20: Unnamed drainage flowing across waste rock pile WR-2

Photo 21: Unnamed drainage above waste rock pile WR-2

Photo 22: Adit 1

Photo 23: Proposed ridge repository location

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Chemical-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
Safe Drinking Water Act (SDWA)	40 USC § 300		
National Toxics Rule	40 CFR Part 131	Establishes water quality standards for protection of human health and aquatic organisms for states that fail to fully comply with Clean Water Act (CWA) Section 303(c)(2)(C).	Not Applicable—the State of Washington has been delegated this program.
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes health-based standards, maximum contaminant levels (MCL) and maximum contaminant level goals (MCLG), for public water systems.	Potentially Relevant and Appropriate to potable surface water at the site; however, Removal Action does not involve a public water supply.
Clean Water Act (CWA)	33 USC §§ 1314		
National Recommended Water Quality Criteria (NWQC)	33 USC § 1251 et seq., Section 304(a), 40 CFR Part 131	Establishes non-enforceable criteria for water quality based on toxicity to aquatic organisms and human health.	Not Applicable—the State of Washington has been delegated this program. Recommended but not enforceable criteria.
Clean Air Act (CAA)	40 USC § 7409		
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC §§ 7401 et seq.	Establishes air quality levels that protect public health.	Not Applicable—only "major" sources are subject to requirements related to NAAQS, defer to state regulation of fugitive dust emissions.
Resource Conservation and Recovery Act (RCRA)	40 USC § 6901-6992k		
Hazardous Wastes	40 CFR Part 261, Subpart D and C	Defines those solids wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Potentially Applicable or Relevant and Appropriate. Washington has not adopted the Bevill Amendment for mining waste. See action-specific ARARs for further discussion.

Chemical-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF WASHINGTON			
Hazardous Waste Removal Reduction Act	RCW Chapter 70.95C	Establishes state policies and goals that encourage the reduction of hazardous substance use and the generation of hazardous waste. Requires certain hazardous waste generators and hazardous substance users to prepare plans for voluntarily reducing hazardous substance use and hazardous waste generation.	Potentially Relevant and Appropriate
Persistent Bioaccumulative Toxins Rule	WAC Chapter 173-333	Establishes criteria to identify persistent bioaccumulative toxins that pose human health or environmental threats, defines chemical action plans preparation, and defines the processes ecology will use to coordinate the implementation of this chapter with the department of health and other agencies.	Potentially Relevant and Appropriate
Surface Water Beneficial Uses	WAC Chapter 173-201A-200 and -600	Requires that surface water bodies be protected for their designated beneficial uses	Potentially Relevant and Appropriate
Dangerous Waste Regulations	WAC Chapter 173-303	(1) Designates solid wastes that are dangerous or extremely hazardous to the public health and environment; (2) provides for surveillance and monitoring of dangerous and extremely hazardous wastes; (3) establishes a system for manifesting, tracking, reporting, monitoring, recordkeeping, sampling, and labeling dangerous and extremely hazardous wastes; (4) establishes siting, design, operation, closure, postclosure, financial, and monitoring requirements for dangerous and extremely hazardous waste transfer, treatment, storage, and disposal facilities; (5) establishes design, operation, and monitoring requirements for managing the state's extremely hazardous waste disposal facility; (6) establishes a program for permitting dangerous and extremely hazardous waste management facilities; and (7) encourages recycling, reuse, reclamation, and recovery to the maximum extent possible.	Potentially Relevant and Appropriate

Chemical-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF WASHINGTON (continued)			
Drinking Water Standards	Revised Code of Washington (RCW) 70.119A, WAC Chapter 246-290	Established health-based MCLs for public water supplies.	Potentially Relevant and Appropriate to surface water drinking sources at the site.
Water Quality Standards for Surface Water	RCW 90.48, WAC Chapter 173-201A	Establishes aquatic life criteria for hazardous substances in freshwater.	Potentially Applicable. State of Washington is authorized by EPA to implement CWA.
Model Toxics Control Act (MTCA)	RCW 70.105D, WAC Chapter 173-340	Specifies that surface water cleanup standards be based on estimates of the highest beneficial use and the reasonable maximum potential exposure under current and future site uses. Establishes administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances have come to be located. It defines the role of the department and encourages public involvement in decision making.	Potentially Relevant and Appropriate
	WAC Chapter 173-340-7490	Specifies procedures for a Terrestrial Ecological Evaluation (TEE) to determine if the existence of hazardous substances at a site could harm terrestrial plants or animals, and to establish cleanup levels to protect biota.	Potentially Relevant and Appropriate
Natural Background Soil Metals Concentrations	WDOE Publication 94-115, October 1994	Defines region–specific natural background concentrations for metals in surficial soils throughout the state.	To Be Considered
Sediment Management Standards	WAC 173-204	Establishes freshwater surface sediment management standards.	Potentially Relevant and Appropriate
Economic Impact Statement For Proposed Sediment Management Standards	WAC 173-204	The WDOE is proposing a management process for implementing sediment quality standards pursuant to requirements of the Model Toxics Control Act, the Water Pollution Control Act, and the Puget Sound Water Quality Authority Act.	To Be Considered

Location-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
RCRA	40 USC § 7601		
Hazardous and Solid Waste Regulations	40 CFR Part 264.18	Location standards and restrictions for hazardous waste treatment, storage, and disposal (TSD) facilities.	Potentially Relevant and Appropriate
	40 CFR §§ 257.3-1 through 257.3-4	Location standards and restrictions for municipal solid waste (MSW) facilities.	Potentially Relevant and Appropriate
Fish and Wildlife Coordination Act	16 USC §§ 661-667	Requires consultation with the USFWS when federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources.	Potentially Applicable
Fish and Wildlife Conservation Act	16 USC §§ 2901-2911	Promotes conservation of non-game fish and wildlife through assistance to states and use of federal authority.	Potentially Applicable
Protection of Wetlands Executive Order No. 11990	40 CFR Part 6; Appendix A, 40 CFR 6.302(a)	Established to avoid adverse impacts associated with the destruction or loss of wetlands and avoid support of new construction in wetlands if a practicable alternative exists.	Potentially Applicable
Floodplain Management Executive Order No. 11988	40 CFR Part 6, Appendix A 40 CFR 6.302(b)	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible.	Potentially Applicable
Dredge and Fill Regulations	33 USC § 1344, 33 CFR 323.1 et seq.	Prohibits discharge of dredged or fill material into waters of the United States without a permit	Potentially Relevant and Appropriate
Bald Eagle Protection Act	16 USC §§ 668 et seq.	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.	Applicable Requirement
Endangered Species Act (ESA)	16 USC §§ 1531-1544	Outlines procedures for federal agencies to follow if actions may jeopardize listed species. Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.	Potentially Applicable

Location-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
National Forest Management Act (NFMA), Mt. Baker Snoqualmie NF Land and Resource Management Plan (LRMP, 1989), as amended by Pacific Northwest Forest Plan (NWFP, 1994) and subsequent amendments (2001, 2004, and 2007)	16 USC §§ 1600-1614	NFMA requires land management based on multiple-use, sustained-use yields. The LRMP and NWFP establish guidelines and standards for design, construction, and use of various actions on USFS land.	Potentially Applicable or Relevant and Appropriate
National Historic Preservation Act (NHPA)	16 USC § 470; 36 CFR Part 800 40 CFR 6.301(b)	Requires federal agencies to take into account the effect of any federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places.	Potentially Applicable
Archaeological Resources Protection Act	16 USC § 470	Specifies actions that must be taken to preserve archaeological resources.	Potentially Applicable
Archeological and Historic Preservation Act (AHPA)	16 USC § 469 40 CFR 6.301(c)	Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	Potentially Applicable
Historic Site, Buildings, Objects, and Antiquities Act	16 USC § 461-467	Requires preservation of historic sites, buildings, and objects of national significance.	Potentially Applicable
Native American Graves Protection and Reparation Act	25 USC § 3001 et seq.	Establishes protective requirements to be followed when graves or Native American burial sites are encountered.	Potentially Applicable
The American Indian Religious Freedom Act (AIRFA)	42 USC § 1996	Requires federal agencies to protect the right of Indian tribes to practice their traditional religions.	Potentially Applicable
Wilderness Act	16 USC §§ 1131-1136	Established the National Wilderness Preservation System, which concerns leaving lands unimpaired for future use as a wilderness.	Potentially Applicable

Action-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
Clean Water Act	33 USC § 1342		
National Pollutant Discharge Elimination System	40 CFR Part 122.26	In general, Part 122 provides permit requirements for the discharge of pollutants from any point source into waters of the United States. Part 122.26 requires permits for storm-water discharges.	Potentially Applicable
CWA – Water Pollution Control Act (WPCA), Water Quality Certification	33 USC § 1341, Section 401	Requires certification from the state (WDOE) that discharges into navigable waters comply with applicable water quality standards.	Potentially Applicable
CWA/WPCA – National Pollution Discharge Elimination System (NPDES)	33 USC § 1342, Section 402	Establishes requirements for point source discharges and stormwater runoff.	Potentially Applicable
CWA/WPCA – Discharge of Dredge and Fill Materials	33 USC § 1344, Section 404	Regulates the discharge of dredge and fill into waters of the United States, including wetlands.	Potentially Applicable
Clean Air Act	42 USC § 7401 et seq., 40 CFR Part 50	Establishes limits for air emissions.	Potentially Applicable
Land Disposal Restrictions (LDRs)	40 CFR Part 268	LDRs place specific restrictions (conc. or trmt) on RCRA hazardous wastes prior to their placement in a land disposal unit. Relevant and appropriate LDR requirements will be met if any material accumulations are treated *ex situ*.	Applicable Requirement
RCRA Subtitle C – Hazardous Waste Management	42 USC § 6901, 40 CFR Parts 260 to 279	Specifies hazardous waste identification, management, and disposal requirements.	Potentially Applicable
Subtitle D – Managing Municipal and Solid Waste	42 USC § 6901, 40 CFR Parts 257 and 258	Establishes guidelines for the management of non-hazardous solid waste.	Potentially Applicable
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	40 CFR Part 264.13.14	Requirements for proper handling, treatment, storage, and disposal of hazardous wastes.	Potentially Applicable
Disposal of Solid Waste	42 U.S.C. § 6901 et seq; 40 CFR 257	Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste.	Potentially Applicable

Action-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
Closure Requirements	RCRA/HWMA 40 CFR & 264, Subpart G	Closure of hazardous waste repositories must meet protective standards. Regulations to minimize contaminant migration, provide leachate collection and prevent contaminant exposure will be met.	Potentially Applicable
Landfill Design and Construction	RCRA/HWMA 40 CFR & 264, Subpart N	Hazardous waste landfills must meet minimum design standards. Protectiveness will be achieved through capping and institutional controls.	Potentially Applicable
Groundwater Monitoring	RCRA/HWMA 40 CFR & 264, Subpart F 40 CFR & 264, Subpart X	Establishes standards for detection and compliance monitoring. Site wide monitoring will accommodate specific groundwater monitoring requirements.	Not Applicable or Relevant and Appropriate. Treatment of groundwater is outside the Removal Action scope.
Occupational Exposure to Asbestos	29 CFR Parts 1910 and 1926.	Establishes OSHA requirements for asbestos-related work in the construction and demolition industry. Requirements on exposure limits, work practices and engineering controls to provide worker safety in handling, removal, disposal, or other workplace exposure to asbestos.	Potentially Relevant and Appropriate
Superfund Remedial Design and Remedial Action Guidance	EPA OSWER Directive 9355.0-4A, June 1986	Provides guidance for site remediation and the design of remedial action components.	To Be Considered
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 49 CFR Parts 10, 171-177	Regulates transportation of hazardous materials.	Potentially Applicable
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328	Performance standards for surface mining activities.	Potentially Relevant and Appropriate
Indian Sacred Sites	Executive Order 13007	Requires federal agencies to avoid physical damage to Indian sacred sites and to avoid interfering with access to such sites.	To Be Considered
Protection and Enhancement of the Cultural Environment	Executive Order 11593	Directs federal agencies to nominate historic properties to the NRHP and treat properties that are eligible for the NRHP as though they were listed.	To Be Considered

Action-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
Invasive Species	Executive Order 13112	Requires federal agencies to prevent the introduction of invasive species.	To Be Considered
Migratory Bird Treaty Act (MBTA)	16 USC §§ 703 et seq.	Establishes federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.	Potentially Relevant and Appropriate
Responsibilities of Federal Agencies to Protect Migratory Birds	Executive Order 13186	Requires federal agencies to avoid or minimize adverse impacts to migratory bird resources to the extent practical.	To Be Considered

Action-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF WASHINGTON			
MTCA	RCW 70.105D, WAC Chapter 173-340	Establishes procedures and standards for investigating and cleaning up sites with hazardous substances present.	Potentially Applicable
Sediment Management Standards	WAC 173-204	Establishes freshwater surface sediment management standards.	Potentially Relevant and Appropriate
Regulation and Licensing of Well Contractors and Operators	RCW 18.104, WAC Chapter 173-162	Establishes procedures for well contractors and operators.	Potentially Applicable
Minimum Standards for Construction and Maintenance of Water Wells	RCW 18.104, WAC Chapter 173-160	Sets minimum standards for the construction of water and monitoring wells, and well decommissioning.	Potentially Applicable
Hazardous Waste Management Act and Dangerous Waste Regulations	RCW 70.105, WAC Chapter 173-303	Establishes regulations for the handling and deposition of dangerous waste, including identification, accumulation, storage, transport, treatment, and disposal.	Potentially Applicable – Washington has not adopted the Bevill Amendment for mining wastes.
Solids Waste Handling Standards	RCW 70.95, WAC Chapter 173-350	Establishes standards for the proper handling and disposal of solid waste, and requirements for the design, construction, operation, and closure of solid waste handling facilities.	Potentially Applicable or Relevant and Appropriate
Hydraulic Code	RCW 77.55, WAC Chapter 220-110	Requires a Hydraulics Project Approval permit for construction activities that use, divert, obstruct, or change the bed or flow of state waters.	Substantive provisions potentially Applicable
Shoreline Management Act (SMA)	RCW 90.58	Established to prevent harm to the state's shorelines, including streams with a mean annual flow greater than 20 cubic feet per second.	Applicable Requirement
Fugitive Dust Emissions	40 CFR Section 50.6	Establishes standards for PM-10	Applicable Requirement
Water Quality Standards for Surface Waters – Mixing Zones	RCW 90.48, WAC Chapter 173-201A-400	Establishes mixing zone effluent limits for discharges to surface water.	Potentially Applicable
Water Quality Standards for Surface Waters – Short-term Modifications	RCW 90.48, WAC Chapter 173-201A-410	Allows for short-term modification to water quality criteria for specific water bodies when necessary.	Potentially Applicable
Submission of Plans and Reports for Construction of Wastewater Treatment Facilities	RCW 90.48, WAC Chapter 173-240	Requires submission of wastewater treatment systems designs to the WDOE for review and approval.	Potentially Applicable

Action-Specific
Applicable or Relevant and Appropriate Requirements
Rainy Mine, Washington

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF WASHINGTON (continued)			
Aquatic Lands Management	RCW 79.90, WAC Chapter 332-30	Establishes criteria for the management of state-owned aquatic lands to promote uses and protect resources.	Potentially Applicable
Water Code and Regulation of Public Groundwater – Surface Water and Groundwater Withdrawal	RCW 90-90.03 and 90.44	Specify criteria and procedures for appropriating surface water and groundwater for beneficial uses.	Potentially Applicable
Maximum Environmental Noise Levels	RCW-70.107, WAC Chapter 173-60	Establishes maximum permissible noise levels.	Potentially Applicable
Washington Clean Air Act and Implementing Regulations	WAC Chapter 173-400-040(8)	Requires reasonable precautions be taken to prevent the generation of fugitive dust.	Potentially Relevant and Appropriate
General Regulations for Air Pollution Sources	RCW 70.94, WAC Chapter 173-400	Regulates air pollution from contaminant sources, and establishes rules for the control and prevention of air contaminant emissions.	Potentially Applicable

APPENDIX C

COST ESTIMATE

Cost Estimate for Rainy Mine
Alternative 2 - Excavation and Off–Site Disposal

Qty	Unit	Description	Unit Cost	Cost	Comment
RAINY MINE - ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL					
ACCESS ROAD IMPROVEMENT					
1	ls	**Access Road (FR 5640) Improvement**	$5,000.00	$5,000.00	Estimate based on minor improvements to FR 5640
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate Installation			
1	ea	Bat gate, installed at open adit	$5,500.00	$5,500.00	
		Bat Gate Installation Subtotal =		**$5,500.00**	
		Debris Removal			
20	cy	Load miscellaneous debris and litter, 1cy backhoe	$3.32	$66.44	
1	LS	Collect miscellaneous debris and litter including mobillization	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
6	hr	Haul mill debris to sanitary landfull, 12cy dump, 120mi r.t.	$81.62	$489.69	Assumes 3 hours per truckload
		Debris Removal Subtotal =		**$5,556.13**	
MINE WASTE REMOVAL:					
		Construction of Access Road			
100	ea	Clear trees, brush, and downfall	$19.27	$1,926.98	Rough approximation
2000	cy	Cut and widen road	$6.68	$13,354.22	Assumes riprable rock and soil, push with dozer, no hauling
1	ls	Install temporary bridge, 100-ft span	$70,000.00	$70,000.00	Bailey Bridges, Alabama, verbal estimate
800	lf	Benching	$1.43	$1,147.80	
230	sy	Compact and grade	$4.85	$1,114.36	
300	cy	Haul and spread 3in layer of gravel road base	$64.96	$19,488.33	Inc off-site material cost and delivery, handling, and spreading
		Access Road Construction Subtotal =		**$107,031.68**	
		Mine Waste Excavation and Disposal			
0.4	ac	Clear trees/brush from waste rock piles	$1,018.81	$419.98	Rough approximation
2000	cy	Excavate/load waste rock from main area (WR-1); 1cy backhoe	$3.68	$7,350.34	Assumes no stockpiling at site
25	sy	Demolish concrete foundation	$182.60	$4,564.99	Assumes 7 to 24inch reinforced concrete
25	cy	Excavate/load contaminated soil/concrete from around mill foundation; 1cy backhoe	$3.68	$91.88	
100	cy	Excavate/load contaminated sediment from two seeps; 1cy backhoe	$3.68	$367.52	
150	cy	Backfill open shaft	$5.51	$826.91	
25	cy	Excavate waste rock from west zone (WR-2); 1cy backhoe	$3.68	$91.88	
2000	cy	Transport waste rock to staging area, 12cy dump, 3 mi r.t.	$5.34	$10,683.37	
2000	cy	Load waste rock from staging area for transport to landfill, 2.25cy FE loader	$1.28	$2,560.48	
133	bins	Transport debris to landfill rail station for disposal, 60 miles, 15cy bulk waste	$1,200.00	$160,000.00	Rabanco bulk bin, 25 ton (~15 cy) capacity, $1200 per bin for haulage and rail fee
3	wk	XRF rental	$2,530.00	$7,590.00	Ashtead Technology Rentals +10%
6	ea	Confirmation samples (selected metals)	$120.00	$720.00	4 from main area and 2 from west zone; SVL
		Mine Waste Excavation and Disposal Subtotal =		**$195,267.35**	
		Mine Waste Area Reclamation (includes mill foundation footprint)			
130	cy	Purchase topsoil from off-site source	$23.18	$3,012.98	Assumes grading performed as part of removal
130	cy	Haul topsoil to staging area, 50 mi haul	$33.11	$4,304.25	
130	cy	Load and haul stockpiled soil into truck, 2.25cy FE loader, 12 cy dump, 5 mi	$6.35	$824.98	
130	cy	Place 6 to 12" soil cover over excavated waste areas, FE loader	$4.90	$637.03	
1	ls	Reclaim seep areas	$4,000.00	$4,000.00	Mimic natural channel to Quartz Creek
20	msf	Fertilizer, 800/lb/ac	$18.63	$372.59	
20	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,821.03	Means+50% for USFS seed mix
20	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,489.93	Means+50% for USFS seed mix
0.4	ac	Hydromulching, wood cellulose	$2,207.31	$882.92	
1	ls	Plant tree seedlings in main area	$1,000.00	$1,000.00	Estimate
0.4	ac	Place wood slash back over areas	$763.73	$305.49	
		Mine Waste Area Reclamation Subtotal =		**$18,651.21**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 2 - Excavation and Off–Site Disposal

Qty	Unit	Description	Unit Cost	Cost	Comment
		Access Road Reclamation			
1	day	Ripped compacted surface	$1,184.22	$1,184.22	Assumed duration
3	day	Grade to blend with surrounding topography	$1,184.22	$3,552.66	Assumed duration
1	ls	Disassemble temporary bridge	$10,000.00	$10,000.00	
1	ls	Install safety barrier and warning signs	$2,000.00	$2,000.00	Rock barrier to prevent vehicular and ATV access
40	msf	Fertilizer, 800/lb/ac	$18.63	$745.19	
40	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$3,642.06	Means+50% for USFS seed mix
40	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$2,979.87	Means+50% for USFS seed mix
1	ac	Hydromulching, wood cellulose	$2,207.31	$2,207.31	
1	ac	Place wood slash back over areas	$763.73	$763.73	
		Access Road Reclamation Subtotal =		**$27,075.03**	
		Miscellaneous			
1	ls	Staging area prep	$2,000.00	$2,000.00	
1	ls	Mobilization	$20,000.00	$20,000.00	
1	ls	Temporary erosion control BMPs	$5,000.00	$5,000.00	
		Miscellaneous Subtotal =		**$27,000.00**	
		Post-removal Monitoring (3 year total)			Assumes 3 years of monitoring, 6 events, 3 aquatic sampling locations, limited analysis,
1	ls	Biannual monitoring of aquatic habitat, 6 events total, annual reports	$49,472.00	$49,472.00	no baseline or pre-removal survey or sampling
		Post-removal Monitoring Subtotal =		**$49,472.00**	

SUMMARY

Access Road Improvement Subtotal =	$5,000	
Bat Gate Installation Subtotal =	$5,500	
Debris Removal Subtotal =	$5,556	
Access Road Construction Subtotal =	$107,032	
Mine Waste Excavation and Disposal Subtotal =	$195,267	
Mine Waste Area Reclamation Subtotal =	$18,651	
Access Road Reclamation Subtotal =	$27,075	
Miscellaneous Subtotal =	$27,000	
Removal Action Total =	**$391,081**	
Design =	$39,108.14	Design minimal because hauling waste off site, assumed 10% of removal action total
Removal Action Oversight =	$40,000	Assumes 20-day construction period
Post-removal Monitoring Subtotal =	$49,472	
Subtotal =	**$519,662**	
Contingency 20%	$103,932	
ALTERNATIVE 2 TOTAL =	**$623,594**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
RAINY MINE - ALTERNATIVE 3A: EXCAVATION AND ON-SITE DISPOSAL, RIDGE REPOSITORY LOCATION (OPTION 1)					
ACCESS ROAD IMPROVEMENT					
1	ls	**Access Road (FR 5640) Improvement**	$5,000.00	$5,000.00	Estimate based on minor improvements to FR 5640
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate Installation			
1	ea	Bat gate, installed at open adit	$5,500.00	$5,500.00	
		Bat Gate Installation Subtotal =		**$5,500.00**	
		Debris Removal			
1	ls	Collect miscellaneous debris and litter including mobillization	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
20	cy	Load miscellaneous debris and litter, 1cy backhoe	$3.32	$66.44	Assumes equivalent to 1 truckload
6	hr	Haul mill debris to sanitary landfull, 12cy dump, 120mi r.t.	$81.62	$489.69	Assumes 3 hours per truckload
		Debris Removal Subtotal =		**$5,556.13**	
MINE WASTE REMOVAL:					
		Access Road Construction			
100	ea	Clear trees, brush and downfall	$19.27	$1,926.98	Rough approximation
2000	cy	Cut and widen road	$6.68	$13,354.22	Assumes riprable rock and soil, push with dozer, no hauling
1	ls	Install temporary bridge, 100-ft span	$70,000.00	$70,000.00	Bailey Bridges, Alabama, verbal estimate
800	lf	Benching	$1.43	$1,147.80	
230	sy	Compact and grade	$4.85	$1,114.36	
300	cy	Haul and spread 3in layer of gravel road base	$64.96	$19,488.33	Inc off-site material cost and delivery, handling, and spreading
		Access Road Construction Subtotal =		**$107,031.68**	
		Mine Waste Excavation and Disposal			
0.4	ac	Clear trees/brush from waste rock piles	$1,018.81	$420.99	Rough approximation
2000	cy	Excavate waste rock from main area (WR-1); 1cy backhoe	$3.68	$7,350.34	Assumes no haulage
25	sy	Demolish concrete foundation	$182.60	$4,564.99	Assumes 7 to 24inch reinforced concrete
25	cy	Excavate contaminated soil/concrete from around mill foundation; 1cy backhoe	$3.68	$91.88	
100	cy	Excavate contaminated sediment from two seeps; 1cy backhoe	$3.68	$367.52	
150	cy	Backfill open shaft	$5.51	$826.91	
25	cy	Excavate waste rock from west zone (WR-2); 1cy backhoe	$3.68	$91.88	
2000	cy	Transport waste rock to repository,12cy dump, 2 mi rt	$4.83	$9,668.01	
16	hr	Screen waste material and stockpile fines for repository cover	$389.40	$6,230.44	On-site screening plant, 125 ton/hr
2000	cy	Compact waste material	$1.16	$2,317.67	Spread and compact, sheepsfoot, 8-inch lifts
3	wk	XRF rental	$2,530.00	$7,590.00	Ashtead Technology Rentals +10%
6	ea	Confirmation samples (selected metals)	$120.00	$720.00	4 from main area and 2 from west zone; SVL
		Mine Waste Excavation and Disposal Subtotal =		**$40,240.63**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
		Repository Construction - Option 1 Engineered Cover:			
0.3	ac	Clear and grub repository footprint	$7,057.87	$2,117.36	
2760	cy	Excavate and stockpile topsoil, 300hp dozer, 150ft push	$2.28	$6,305.40	
500	cy	Compact bottom of repository, 6" lift, sheepsfoot	$1.16	$579.42	
500	cy	Place and compact screened fines from waste material	$5.08	$2,538.40	
1500	sy	Install GCL	$1.69	$2,532.89	Assumes 20% extra for periphery
250	cy	Purchase clean drain material from off-site source	$8.72	$2,179.72	
250	cy	Haul drain material to staging area, 100 mi	$33.11	$8,277.41	
250	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$320.06	
250	cy	Haul stockpiled drain material, 12cy dump, 1mi r.t.	$4.33	$1,081.58	
250	cy	Place 6 in layer of drain material over GCL	$3.80	$949.14	
1500	sy	Install filter fabric over drain material	$1.38	$2,069.35	Assumes 20% extra to blend
1000	cy	Place and compact 24" soil cover in 8-inch lifts	$3.80	$3,796.57	
14	msf	Fertilizer, 800/lb/ac	$18.63	$252.71	
14	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,235.10	
14	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,010.53	
0.3	ac	Hydromulching, wood cellulose	$2,207.31	$687.37	
0.3	ac	Place wood slash back over cover	$763.73	$237.83	
		Repository Construction - Option 1 Engineered Cover Subtotal =		**$27,168.65**	
		Repository Construction - Option 2 Earthen Clay Cover:			
0.3	ac	Clear and grub repository footprint	$7,057.87	$2,117.36	
1000	cy	Excavate and stockpile topsoil, 300hp dozer, 150ft push	$2.28	$2,284.56	
500	cy	Compact bottom of repository, 6" lift, sheepsfoot	$1.16	$579.42	
1500	sy	Install 12 in clay liner	$18.61	$27,911.42	Assumes 20% extra for periphery
250	cy	Purchase clean drain material from off-site source	$8.72	$2,179.72	
250	cy	Haul drain material to staging area, 50 rt	$33.11	$8,277.41	
250	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$320.06	
250	cy	Haul stockpiled drain material, 12cy dump, 1mi r.t.	$4.33	$1,081.58	
250	cy	Place 6 in layer of drain material over clay	$3.80	$949.14	
1500	sy	Install filter fabric over drain material	$1.38	$2,069.35	Assumes 20% extra to blend
1000	cy	Place and compact 24" soil cover in 8-inch lifts	$3.80	$3,796.57	
14	msf	Fertilizer, 800/lb/ac	$18.63	$252.71	
14	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,235.10	
14	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,010.53	
0.3	ac	Hydromulching, wood cellulose	$2,207.31	$687.37	
0.3	ac	Place wood slash back over cover	$763.73	$237.83	
		Repository Construction - Option 2 Earthen Clay Cover Subtotal =		**$50,008.78**	
		Mine Waste Area Reclamation			
130	cy	Load stockpiled soil into truck, 2.25cy FE loader	$1.28	$166.43	Growth medium stockpiled at repository
130	cy	Haul stockpiled soil, 12cy dump, 3mi r.t.	$5.34	$694.42	
130	cy	Place 6 to 12" soil cover over excavated waste areas, FE loader	$4.90	$637.03	
1	ls	Reclaim seep areas	$4,000.00	$4,000.00	Mimic natural channel to Quartz Creek
20	msf	Fertilizer, 800/lb/ac	$18.63	$372.59	
20	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,821.03	
20	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,489.93	
0.4	ac	Hydromulching, wood cellulose	$2,207.31	$882.92	
1	LS	Plant tree seedlings in main area	$1,000.00	$1,000.00	Estimate
0.4	ac	Place wood slash back over areas	$763.73	$305.49	
		Mine Waste Area Reclamation Subtotal =		**$11,369.85**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
		Access Road Reclamation			
1	day	Ripped compacted surface	$1,184.22	$1,184.22	
10	day	Grade to blend with surrounding topography	$1,184.22	$11,842.21	
40	msf	Fertilizer, 800/lb/ac	$18.63	$745.19	
1	ls	Disassemble temporary bridge	$10,000.00	$10,000.00	
40	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$3,642.06	
40	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$2,979.87	
1	ac	Hydromulching, wood cellulose	$2,207.31	$2,207.31	
1	ac	Place wood slash back over areas	$763.73	$763.73	
		Access Road Reclamation Subtotal =		**$33,364.58**	
		Miscellaneous			
200	lf	Install earthen diversion channel above repository	$7.66	$1,531.87	
600	lf	Install temporary fence around repository	$2.95	$1,768.05	
1	ls	Staging area prep	$500.00	$500.00	
1	ls	Mobilization	$30,000.00	$30,000.00	
1	ls	Temporary erosion control BMPs	$4,000.00	$4,000.00	
		Miscellaneous Subtotal =		**$37,799.93**	
		Pos-removal Monitoring (3 year total)			Assumes 3 years of monitoring, 6 events, 3 aquatic sampling locations, limited analysis
1	ls	Biannual monitoring of aquatic habitat, 6 events total, annual reports	$49,472.00	$49,472.00	no baseline or pre-removal survey or sampling
		Post-removal Monitoring Subtotal =		**$49,472.00**	

SUMMARY

OPTION 1 - ENGINEERED COVER:		
Access Road Improvement Subtotal =	$5,000	
Bat Gate Installation Subtotal =	$5,500	
Debris Removal Subtotal =	$5,556	
Access Road Construction Subtotal =	$107,032	
Mine Waste Excavation and Disposal Subtotal =	$40,241	
Repository Construction - Option 1 Engineered Cover Subtotal =	$27,169	
Mine Waste Area Reclamation Subtotal =	$11,370	
Access Road Reclamation Subtotal =	$33,365	
Miscellaneous Subtotal =	$37,800	
Removal Action Total =	**$273,031**	
Design =	$40,954.72	Assumed 15% of removal action total
Removal Action Oversight =	$60,000	Assumed 30-day construction period
Post-removal Monitoring Subtotal =	$49,472	
Subtotal =	**$423,458**	
Contingency 20%	$84,692	
OPTION 1 - ENGINEERED COVER TOTAL =	**$508,150**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
		OPTION 2 - EARTHEN CLAY COVER:			
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate Installation Subtotal =		$5,500	
		Debris Removal Subtotal =		$5,556	
		Access Road Construction Subtotal =		$107,032	
		Mine Waste Excavation and Disposal Subtotal =		$40,241	
		Repository Construction - Option 2 Earthen Clay Cover Subtotal =		$50,009	
		Mine Waste Area Reclamation Subtotal =		$11,370	
		Access Road Reclamation Subtotal =		$33,365	
		Miscellaneous Subtotal =		$37,800	
		Removal Action Total =		**$295,872**	
		Design =		$44,380.74	Assumed 15% of removal action total
		Removal Action Oversight =		$60,000	Assumed 30-day construction period
		Post-removal Monitoring Subtotal =		$49,472	
		Subtotal =		**$449,724**	
		Contingency 20%		$89,945	
		OPTION 2 - EARTHEN CLAY COVER TOTAL =		**$539,669**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3b - Excavation and On–Site Disposal
Millsite

Qty	Unit	Description	Unit Cost	Cost	Comment
RAINY MINE - ALTERNATIVE 3B: EXCAVATION AND ON-SITE DISPOSAL, MILL SITE REPOSITORY LOCATION (OPTION 2)					
ACCESS ROAD IMPROVEMENT					
1	ls	**Access Road (FR 5640) Improvement**	$5,000.00	$5,000.00	Estimate based on minor improvements to FR 5640
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate Installation			
1	ea	Bat gate, installed at open adit	$5,500.00	$5,500.00	
		Bat Gate Installation Subtotal =		**$5,500.00**	
		Debris Removal			
1	ls	Collect miscellaneous debris and litter including mobillization	$5,000.00	$5,000.00	
20	cy	Load miscellaneous debris and litter, 1cy backhoe	$3.32	$66.44	Assumes equivalent to 1 truckload
6	hr	Haul mill debris to sanitary landfull, 12cy dump, 120mi r.t.	$81.62	$489.69	Assumes 3 hours per truckload
		Debris Removal Subtotal =		**$5,556.13**	
MINE WASTE REMOVAL:					
		Access Road Construction			
100	ea	Clear trees access route	$19.27	$1,926.98	Rough approximation
2000	cy	Excavate and cut road	$6.68	$13,354.22	Assumes riprable rock and soil, push with dozer, no hauling
1	ls	Install temporary bridge, 100-ft span	$70,000.00	$70,000.00	Bailey Bridges, Alabama, verbal estimate
800	lf	Benching	$1.43	$1,147.80	
230	sy	Compact and grade	$4.85	$1,114.36	
300	cy	Haul and spread 3in layer of gravel road base	$64.96	$19,488.33	Inc off-site material cost and delivery, handling, and spreading
		Access Road Construction Subtotal =		**$107,031.68**	
		Frecnh Drain Construction			
0.3	ac	Clear and grub repository footprint	$7,057.87	$2,394.74	Rough approximation
820	cy	Compact bottom of repository, 6" lift, sheepsfoot	$0.46	$380.10	
60	cy	Excavate french drain trench	$3.68	$220.51	
1500	sy	Install filter fabric over soil slope	$1.38	$2,069.35	
430	ft	Install 6" perforated drain pipe	$4.14	$1,779.64	
500	cy	Purchase clean drain material from off-site source	$6.93	$3,465.47	
500	cy	Haul drain material to staging area, 50 rt	$33.11	$16,554.81	
500	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$640.12	
500	cy	Haul stockpiled drain material, 12cy dump, 3mi r.t.	$5.34	$2,670.84	
500	cy	Place drain rock	$2.94	$1,470.62	
1500	sy	Install HDPE liner over drain rock	$14.10	$21,157.05	
		French Drain Construction Subtotal =		**$52,803.26**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3b - Excavation and On–Site Disposal
Millsite

Qty	Unit	Description	Unit Cost	Cost	Comment
		Mine Waste Excavation and Disposal			
0.4	ac	Clear trees/brush from waste rock piles	$1,018.81	$420.99	Rough approximation
2000	cy	Excavate waste rock from main area (WR-1); 1cy backhoe	$3.68	$7,350.34	
25	sy	Demolish concrete foundation	$182.60	$4,564.99	Assumes 7 to 24inch reinforced concrete
25	cy	Excavate contaminated soil/concrete from around mill foundation; 1cy backhoe	$3.68	$91.88	
150	cy	Backfill open shaft	$5.51	$826.91	
100	cy	Excavate contaminated sediment from two seeps; 1cy backhoe	$3.68	$367.52	
25	cy	Excavate waste rock from west zone (WR-2); 1cy backhoe	$3.68	$91.88	
25	cy	Transport waste rock to repository,12cy dump, 1 mi rt	$4.33	$108.16	
16	hr	Screen waste material and stockpile fines for repository cover	$389.40	$6,230.44	On-site screening plant, 125 ton/hr
2000	cy	Spread waste in 8in lifts and compact, FE loader	$6.06	$12,118.12	
3	wk	XRF rental	$2,530.00	$7,590.00	Ashtead Technology Rentals +10%
6	ea	Confirmation samples (selected metals)	$120.00	$720.00	4 from main area and 2 from secondary workings; SVL
		Mine Waste Excavation and Disposal Subtotal =		**$40,481.23**	
		Repository Construction - Option 1 Engineered Cover:			
450	cy	Excavate and stockpile topsoil, 300hp dozer, 150ft push	$2.28	$1,028.05	Soil for repository cap and to cover mine waste areas
1290	cy	Purchase topsoil from off-site source	$23.18	$29,897.99	Additional soil needed, import from local source <50miles
1290	cy	Haul topsoil to staging area, 50 rt	$33.11	$42,711.42	
1290	cy	Load stockpiled soil into truck, 2.25cy FE loader	$1.28	$1,651.51	
1290	cy	Haul stockpiled soil, 12cy dump, 3mi r.t.	$5.34	$6,890.78	
820	cy	Place and compact screened fines from waste material	$5.08	$4,162.98	
2450	sy	Install GCL	$1.69	$4,137.05	Assumes 20% extra for periphery
410	cy	Purchase clean drain material from off-site source	$8.72	$3,574.74	
410	cy	Haul drain material to staging area, 50 rt	$33.11	$13,574.95	
410	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$524.90	
410	cy	Haul stockpiled drain material, 12cy dump, 3mi r.t.	$4.33	$1,773.79	
410	cy	Place 6 in layer of drain material over GCL	$3.80	$1,556.59	
2450	sy	Install filter fabric over drain material	$1.38	$3,379.94	Assumes 20% extra to blend
1640	cy	Place and compact 24" soil cover in 8-inch lifts	$3.80	$6,226.38	
22	msf	Fertilizer, 800/lb/ac	$18.63	$410.96	
22	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$2,008.56	
22	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,643.37	
0.5	ac	Hydromulching, wood cellulose	$2,207.31	$1,117.82	
0.5	ac	Place wood slash back over cover	$763.73	$386.77	
		Repository Construction - Option 1 Engineered Cover Subtotal =		**$126,658.55**	
		Repository Construction - Option 2 Earthen Clay Cover:			
450	cy	Excavate and stockpile topsoil, 300hp dozer, 150ft push	$2.28	$1,028.05	Soil for repository cap and to cover mine waste areas
1290	cy	Purchase topsoil from off-site source	$33.11	$42,711.42	
1290	cy	Haul topsoil to staging area, 50 rt	$33.11	$42,711.42	
1290	cy	Load stockpiled soil into truck, 2.25cy FE loader	$1.28	$1,651.51	
1290	cy	Haul stockpiled soil, 12cy dump, 3mi r.t.	$5.08	$6,549.08	
820	sy	Install 12 in clay liner	$18.61	$15,258.24	Assumes 20% extra for periphery
410	cy	Purchase clean drain material from off-site source	$8.72	$3,574.74	
410	cy	Haul drain material to staging area, 50 rt	$33.11	$13,574.95	
410	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$524.90	
410	cy	Haul stockpiled drain material, 12cy dump, 3mi r.t.	$5.34	$2,190.09	
410	cy	Place 6 in layer of drain material over clay	$3.80	$1,556.59	
820	sy	Install filter fabric over drain material	$1.38	$1,131.25	Assumes 20% extra to blend

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3b - Excavation and On–Site Disposal
Millsite

Qty	Unit	Description	Unit Cost	Cost	Comment
1640	cy	Place and compact 24" soil cover in 8-inch lifts	$3.80	$6,226.38	
22	msf	Fertilizer, 800/lb/ac	$18.63	$410.96	
22	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$2,008.56	
22	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,643.37	
0.5	ac	Hydromulching, wood cellulose	$2,207.31	$1,117.82	
0.5	ac	Place wood slash back over cover	$763.73	$386.77	
		Repository Construction - Option 2 Earthen Clay Cover Subtotal =		**$144,256.09**	
		Mine Waste Area Reclamation (includes mill foundation footprint)			
2	cy	Load stockpiled soil into truck, 2.25cy FE loader	$1.28	$1.95	Material stockpiled at millsite, only need to haul for WR-2
2	cy	Haul stockpiled soil, 12cy dump, 1mi r.t. (west zone WR-2)	$4.33	$6.60	
100	cy	Push stockiled soil over WR-1 and Mill Site	$4.66	$464.73	Assumes 25% of area covered by repository
101	cy	Place 6 to 12" soil cover over excavated waste areas, 1cy backhoe	$2.45	$248.21	
1	ls	Reclaim seep areas	$4,000.00	$4,000.00	Mimic natural channel to Quartz Creek
15	msf	Fertilizer, 800/lb/ac	$18.63	$279.45	Assumes 25% of area covered by repository
15	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,365.77	
15	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,117.45	
0.3	ac	Hydromulching, wood cellulose	$2,207.31	$662.19	
1	ls	Plant tree seedlings in main area	$1,000.00	$1,000.00	Estimate
0.3	ac	Place wood slash back over areas	$763.73	$229.12	
		Mine Waste Area Reclamation Subtotal =		**$9,375.47**	
		Access Road Reclamation			
1	day	Ripped compacted surface	$1,184.22	$1,184.22	
10	day	Grade to blend with surrounding topography	$1,184.22	$11,842.21	
1	ls	Disassemble temporary bridge	$10,000.00	$10,000.00	
40	msf	Fertilizer, 800/lb/ac	$18.63	$745.19	
40	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$3,642.06	
40	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$2,979.87	
1	ac	Hydromulching, wood cellulose	$2,207.31	$2,207.31	
1	ac	Place wood slash back over areas	$763.73	$763.73	
		Access Road Reclamation Subtotal =		**$33,364.58**	
		Miscellaneous			
400	lf	Install riprap diversion channel above repository	$20.93	$8,370.11	
900	lf	Install temporary fence around repository	$2.95	$2,652.08	
1	ls	Staging area prep	$500.00	$500.00	
1	ls	Mobilization	$30,000.00	$30,000.00	
1	ls	Temporary erosion control BMPs	$5,000.00	$5,000.00	
		Miscellaneous Subtotal =		**$46,522.20**	
		Post-removal Monitoring (3 year total)			Assumes 3 years of monitoring, 6 events, 3 aquatic sampling locations
1	ls	Biannual monitoring of aquatic habitat, 6 events total, annual reports	$49,472.00	$49,472.00	no baseline or pre-removal survey or sampling
		Post-removal Monitoring Subtotal =		**$49,472.00**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3b - Excavation and On–Site Disposal
Millsite

Qty	Unit	Description	Unit Cost	Cost	Comment
SUMMARY					
		OPTION 1 - & ENGINEERED COVER:			
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate Installation Subtotal =		$5,500	
		Debris Removal Subtotal =		$5,556	
		Access Road Construction Subtotal =		$107,032	
		French Drain Construction Subtotal =		$52,803	
		Mine Waste Excavation and Disposal Subtotal =		$40,481	
		Repository Construction - Option 1 Engineered Cover Subtotal =		$126,659	
		Mine Waste Area Reclamation Subtotal =		$9,375	
		Access Road Reclamation Subtotal =		$33,365	
		Miscellaneous Subtotal =		$46,522	
		Removal Action Total =		**$432,293**	
		Design =		$64,844	Assumed 15% of removal action total
		Removal Action Oversight =		$60,000	Assumed 30-day construction period
		Post-removal Monitoring Subtotal =		$49,472	
		Subtotal =		**$606,609**	
		Contingency 20%		$121,322	
		OPTION 1 - ENGINEERED COVER TOTAL =		**$727,931**	
		OPTION 2 - EARTHEN CLAY COVER:			
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate Installation Subtotal =		$5,500	
		Debris Removal Subtotal =		$5,556	
		Access Road Construction Subtotal =		$107,032	
		French Drain Construction Subtotal =		$52,803	
		Mine Waste Excavation and Disposal Subtotal =		$40,481	
		Repository Construction - Option 2 Earthen Clay Cover Subtotal =		$144,256	
		Mine Waste Area Reclamation Subtotal =		$9,375	
		Access Road Reclamation Subtotal =		$33,365	
		Miscellaneous Subtotal =		$46,522	
		Removal Action Total =		**$449,891**	
		Design =		$67,484	Assumed 15% of removal action total
		Removal Action Oversight =		$60,000	Assumed 30-day construction period
		Post-removal Monitoring Subtotal =		$49,472	
		Subtotal =		**$626,846**	
		Contingency 20%		$125,369	
		OPTION 2 - EARTHEN CLAY COVER TOTAL =		**$752,215**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
RAINY MINE - RECOMMENDED ALTERNATIVE: EXCAVATION AND ON-SITE DISPOSAL IN RIDGE REPOSITORY WITH ENGINEERED COVER					
ACCESS ROAD IMPROVEMENT					
1	ls	**Access Road (FR 5640) Improvement**	$5,000.00	$5,000.00	Estimate based on minor improvements to FR 5640
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate Installation			
1	ea	Bat gate, installed at open adit	$5,500.00	$5,500.00	
		Bat Gate Installation Subtotal =		**$5,500.00**	
		Debris Removal			
1	ls	Collect miscellaneous debris and litter including mobillization	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
20	cy	Load miscellaneous debris and litter, 1cy backhoe	$3.32	$66.44	Assumes equivalent to 1 truckload
6	hr	Haul mill debris to sanitary landfull, 12cy dump, 120mi r.t.	$81.62	$489.69	Assumes 3 hours per truckload
		Debris Removal Subtotal =		**$5,556.13**	
MINE WASTE REMOVAL:					
		Access Road Construction			
100	ea	Clear trees, brush and downfall	$19.27	$1,926.98	Rough approximation
2000	cy	Cut and widen road	$6.68	$13,354.22	Assumes riprable rock and soil, push with dozer, no hauling
1	ls	Install temporary bridge, 100-ft span	$70,000.00	$70,000.00	Bailey Bridges, Alabama, verbal estimate
800	lf	Benching	$1.43	$1,147.80	
230	sy	Compact and grade	$4.85	$1,114.36	
300	cy	Haul and spread 3in layer of gravel road base	$64.96	$19,488.33	Inc off-site material cost and delivery, handling, and spreading
		Access Road Construction Subtotal =		**$107,031.68**	
		Mine Waste Excavation and Disposal			
0.4	ac	Clear trees/brush from waste rock piles	$1,018.81	$420.99	Rough approximation
2000	cy	Excavate waste rock from main area (WR-1); 1cy backhoe	$3.68	$7,350.34	Assumes no haulage
25	sy	Demolish concrete foundation	$182.60	$4,564.99	Assumes 7 to 24inch reinforced concrete
25	cy	Excavate contaminated soil/concrete from around mill foundation; 1cy backhoe	$3.68	$91.88	
100	cy	Excavate contaminated sediment from two seeps; 1cy backhoe	$3.68	$367.52	
150	cy	Backfill open shaft	$5.51	$826.91	
25	cy	Excavate waste rock from west zone (WR-2); 1cy backhoe	$3.68	$91.88	
2000	cy	Transport waste rock to repository,12cy dump, 2 mi rt	$4.83	$9,668.01	
16	hr	Screen waste material and stockpile fines for repository cover	$389.40	$6,230.44	On-site screening plant, 125 ton/hr
2000	cy	Compact waste material	$1.16	$2,317.67	Spread and compact, sheepsfoot, 8-inch lifts
3	wk	XRF rental	$2,530.00	$7,590.00	Ashtead Technology Rentals +10%
6	ea	Confirmation samples (selected metals)	$120.00	$720.00	4 from main area and 2 from west zone; SVL
		Mine Waste Excavation and Disposal Subtotal =		**$40,240.63**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
		Repository Cover Construction - Engineered Cover:			
0.3	ac	Clear and grub repository footprint	$7,057.87	$2,117.36	
2760	cy	Excavate and stockpile topsoil, 300hp dozer, 150ft push	$2.28	$6,305.40	
500	cy	Compact bottom of repository, 6" lift, sheepsfoot	$1.16	$579.42	
500	cy	Place and compact screened fines from waste material	$5.08	$2,538.40	
1500	sy	Install GCL	$1.69	$2,532.89	Assumes 20% extra for periphery
250	cy	Purchase clean drain material from off-site source	$8.72	$2,179.72	
250	cy	Haul drain material to staging area, 100 mi	$33.11	$8,277.41	
250	cy	Load stockpiled drain material into truck, 2.25cy FE loader	$1.28	$320.06	
250	cy	Haul stockpiled drain material, 12cy dump, 1mi r.t.	$4.33	$1,081.58	
250	cy	Place 6 in layer of drain material over GCL	$3.80	$949.14	
1500	sy	Install filter fabric over drain material	$1.38	$2,069.35	Assumes 20% extra to blend
1000	cy	Place and compact 24" soil cover in 8-inch lifts	$3.80	$3,796.57	
14	msf	Fertilizer, 800/lb/ac	$18.63	$252.71	
14	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,235.10	
14	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,010.53	
0.3	ac	Hydromulching, wood cellulose	$2,207.31	$687.37	
0.3	ac	Place wood slash back over cover	$763.73	$237.83	
		Repository Cover Construction - Engineered Cover Subtotal =		**$27,168.65**	
		Mine Waste Area Reclamation			
130	cy	Load stockpiled soil into truck, 2.25cy FE loader	$1.28	$166.43	Growth medium stockpiled at repository
130	cy	Haul stockpiled soil, 12cy dump, 3mi r.t.	$5.34	$694.42	
130	cy	Place 6 to 12" soil cover over excavated waste areas, FE loader	$4.90	$637.03	
1	ls	Reclaim seep areas	$4,000.00	$4,000.00	Mimic natural channel to Quartz Creek
20	msf	Fertilizer, 800/lb/ac	$18.63	$372.59	
20	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$1,821.03	
20	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$1,489.93	
0.4	ac	Hydromulching, wood cellulose	$2,207.31	$882.92	
1	LS	Plant tree seedlings in main area	$1,000.00	$1,000.00	Estimate
0.4	ac	Place wood slash back over areas	$763.73	$305.49	
		Mine Waste Area Reclamation Subtotal =		**$11,369.85**	
		Access Road Reclamation			
1	day	Ripped compacted surface	$1,184.22	$1,184.22	
10	day	Grade to blend with surrounding topography	$1,184.22	$11,842.21	
40	msf	Fertilizer, 800/lb/ac	$18.63	$745.19	
1	ls	Disassemble temporary bridge	$10,000.00	$10,000.00	
40	msf	Seeding, slope mix, 6lb/MSF, push spreader	$91.05	$3,642.06	
40	msf	Seeding, wildflowers, 0.6lb/MSF, push spreader	$74.50	$2,979.87	
1	ac	Hydromulching, wood cellulose	$2,207.31	$2,207.31	
1	ac	Place wood slash back over areas	$763.73	$763.73	
		Access Road Reclamation Subtotal =		**$33,364.58**	
		Miscellaneous			
200	lf	Install earthen diversion channel above repository	$7.66	$1,531.87	
600	lf	Install temporary fence around repository	$2.95	$1,768.05	
1	ls	Staging area prep	$500.00	$500.00	
1	ls	Mobilization	$30,000.00	$30,000.00	
1	ls	Temporary erosion control BMPs	$4,000.00	$4,000.00	
		Miscellaneous Subtotal =		**$37,799.93**	

Data from R.S. Means

Cost Estimate for Rainy Mine
Alternative 3a - Excavation and On–Site Ridge

Qty	Unit	Description	Unit Cost	Cost	Comment
		Post-removal Monitoring (3 year total)			Assumes 3 years of monitoring, 6 events, 3 aquatic sampling locations, limited analysis
1	ls	Biannual monitoring of aquatic habitat, 6 events total, annual reports	$49,472.00	$49,472.00	no baseline or pre-removal survey or sampling
		Post-removal Monitoring Subtotal =		**$49,472.00**	

SUMMARY

Access Road Improvement Subtotal =	$5,000	
Bat Gate Installation Subtotal =	$5,500	
Debris Removal Subtotal =	$5,556	
Access Road Construction Subtotal =	$107,032	
Mine Waste Excavation and Disposal Subtotal =	$40,241	
Repository Cover Construction - Engineered Cover Subtotal =	$27,169	
Mine Waste Area Reclamation Subtotal =	$11,370	
Access Road Reclamation Subtotal =	$33,365	
Miscellaneous Subtotal =	$37,800	
Removal Action Total =	**$273,031**	
Design =	$40,955	Assumed 15% of removal action total
Removal Action Oversight =	$60,000	Assumed 30-day construction period
Post-removal Monitoring Subtotal =	$49,472	
Subtotal =	**$423,458**	
Contingency 20%	$84,692	
RECOMMENDED ALTERNATIVE TOTAL =	**$508,150**	

Data from R.S. Means

Table 13. Estimated Removal Action Cost Summary
Rainy Mine EE/CA

TASK	Description	Alternative 2 Cost	Alternative 3 Cost		Recommended Alternative Cost
			Alt 3A	Alt 3B	
Access Road Improvement		$5,000	$5,000	$5,000	$5,000
	subtotal =	**$5,000**	**$5,000**	**$5,000**	**$5,000**
Physical Hazards Mitigation	Bat Gate Installation	$5,500	$5,500	$5,500	$5,500
	Debris Removal	$5,556	$5,556	$5,556	$5,556
	subtotal =	**$11,056**	**$11,056**	**$11,056**	**$11,056**
Mine Waste Removal	Access Road Construction	$107,032	$107,032	$107,032	$107,032
	Mine Waste Excavation and Disposal	$195,267	$40,241	$40,481	$40,241
	French Drain Construction			$52,803	
	Repository Construction[a]		$27,169	$126,659	$27,169
	Mine Waste Area Reclamation	$18,651	$11,370	$9,375	$11,370
	Access Road Reclamation	$27,075	$33,365	$33,365	$33,365
	subtotal =	**$348,025**	**$219,175**	**$369,715**	**$219,175**
Miscellaneous	Staging Area Preparation	$2,000	$500	$500	$500
	Mobilization	$20,000	$30,000	$30,000	$30,000
	Temporary Erosion Control BMPs	$5,000	$4,000	$5,000	$4,000
	Install Diversion Channel Above Repository		$1,532	$8,370	$1,532
	Install Temporary Fence Around Repository		$1,768	$2,652	$1,768
	subtotal =	**$27,000**	**$37,800**	**$46,522**	**$37,800**
	Removal Action Subtotal =	**$391,081**	**$273,031**	**$432,293**	**$273,031**
Design and Oversight	Design	$39,108	$40,955	$64,844	$40,955
	Removal Action Oversight	$40,000	$60,000	$60,000	$60,000
	subtotal =	**$79,108**	**$100,955**	**$124,844**	**$100,955**
Post-removal Monitoring	Post-removal Monitoring for 3 years	$49,472	$49,472	$49,472	$49,472
	subtotal =	**$49,472**	**$49,472**	**$49,472**	**$49,472**
	SUBTOTAL =	**$519,662**	**$423,458**	**$606,609**	**$423,458**
Contingency	20% Contingency	$103,932	$84,692	$121,322	$84,692
	TOTAL COST =	**$ 623,594**	**$ 508,150**	**$ 727,931**	**$ 508,150**

Notes:

[a]Cost based on repository cover option 1 - engineered cover; cover option 2 - earthen clay cover would increase cost from $25,000 to $31,000 based on options selected