LONGSHOT MINE AND MILL

Colville National Forest
Stevens County, Washington

Engineering Evaluation/Cost Analysis

November 12, 2008

Prepared For:
U.S. Forest Service, Region 6
10600 NE 51st Circle
Vancouver, Washington 98682

MSE
Millennium Science & Engineering, Inc.

ENGINEERING EVALUATION/COST ANALYSIS

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Prepared For:

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10600 NE 51st Circle
Vancouver, WA 98682

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ACRONYMS AND ABBREVIATIONS

bcy	Bank cubic yard
gpm	Gallon per minute
lcy	Loose cubic yard
µg/L	Microgram per liter
mg/kg	Milligram per kilogram
sf	Square foot
sy	Square yard
$CaCO_3$	Calcium carbonate
ABA	Acid base accounting
AGP	Acid generating potential
AMSL	Above mean sea level
ANP	Acid neutralizing potential
APA	Abbreviated Preliminary Assessment
ARAR	Applicable or Relevant and Appropriate Requirements
BGS	Below ground surface
BMP	Best management practice
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CFR	Code of Federal Regulations
COI	Contaminant of interest
COPC	Contaminant of potential concern
CPEC	Contaminant of potential ecological concern
CTE	Central tendency exposure
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
FP S&Gs	Forest Plan Standards and Guidelines
GCL	Geosynthetic clay liner
HDPE	High density polyethylene
HHRA	Human Health Risk Assessment
HI	Hazard index
INFISH	Inland Native Fish Strategy
LRMP	Land and Resource Management Plan
MDC	Maximum detected concentration
MDL	Method detection limit
MSE	Millennium Science and Engineering, Inc.
MTCA	Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NF	National Forest
NFS	National Forest System
NNP	Net neutralization potential
O&M	Operations and maintenance
PRG	Preliminary Remediation Goal
RAO	Removal action objective
RfD	Reference dose
RME	Reasonable maximum exposure
RTE	Rare, threatened or endangered
SFMC	South Fork Mill Creek

ACRONYMS AND ABBREVIATIONS (continued)

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
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 Longshot Mine and Mill in eastern Washington. This inactive lead-zinc mine is located on the Colville National Forest, about 11 miles northeast of the town of Colville, Washington (Figure 1). The Site is in the South Fork Mill Creek (SFMC) drainage, which is a tributary to Mill Creek and the Colville River. Sensitive ecosystems within 2 miles of the Site include jurisdictional wetlands along SFMC. In addition, sensitive or threatened animal 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 mine waste for all receptors;
(2) Reducing or eliminating the migration of contaminants to the environment; and
(3) Mitigating physical hazards at the Site.

MSE completed a Site Inspection (SI) of the Longshot Mine and Mill in 2005. The Site consists of a partially collapsed mill and other collapsed wooden structures, two open adits, an open stope, an unprocessed ore bin, six waste rock piles, three tailings impoundments, and two ponds. Public site use is moderate and physical hazards at the Site pose a significant public risk. The Site is located along a hillside adjacent to an unnamed ephemeral tributary to SFMC and tailings from the mill were deposited in a series of three impoundments in the drainage bottom. Water discharges from the lower adit and flows through a small pond before disappearing beneath wood and metal debris surrounding the mill structure. The tributary was dry upstream of the Site and along the tailings impoundments during the SI. However, downstream of the last tailings impoundment, there is a large pond followed by a small riparian habitat and stream flow in the tributary. The stream flows only short distance before infiltrating and disappearing. The ephemeral drainage continues for about 1 mile with intermittent flow and joins several other small ephemeral drainages before draining to SFMC.

A streamlined risk evaluation completed during the SI indicated potential risk to both human and ecological receptors at the Site from exposure to high concentrations of metals, particularly lead, in the mine waste. Maximum concentrations of lead in the mine waste (30,000 milligrams per kilogram [mg/kg]) exceeded human and ecological screening criteria by 30 and 600 times. While arsenic in mine waste also poses a slight human health risk at the Site, the maximum detected arsenic concentration is below a risk-based cleanup level that was calculated to be 52 mg/kg. Two areas were identified as hotspots: (1) unprocessed ore in the ore bin, and (2) waste rock pile WR3. Mine waste samples from these two areas contained the highest detected concentrations of several metals, including antimony, cadmium, copper, lead and zinc. Removal of these two hotspots and any additional unprocessed ore that may be present under the wood and metal debris around the mill would significantly decrease the overall human health and ecological risk at the Site.

Mine waste at the Site is the primary contaminant source at the Site. Fine-grained materials (i.e., sediment) that may have been deposited in, or migrated to the ponds and ephemeral tributary are considered a secondary contaminant source. The ephemeral drainage is heavily vegetated and the large pond and surrounding area form a sensitive riparian habitat. Removal of sediment from these areas would result in significant collateral damage to the riparian habitat; therefore, sediment was eliminated from the scope of this removal action. Surface and groundwater were also eliminated from the scope of this removal action because surface water at the Site is not impaired and groundwater is not used for drinking water at the Site, nor is future use as a drinking source anticipated. If future water quality monitoring indicates a risk from surface water or sediment, additional removal actions may be necessary.

Four removal action alternatives were evaluated for the Longshot Mine and Mill:

- Alternative 1 – No Action
- Alternative 2 – Excavation and Off-site Disposal of Hotspots
- Alternative 3 – Excavation and On-site Containment of Hotspots
- Alternative 4 – In-place Capping of Hotspots

Alternative 3 is recommended. Approximately 213 bank cubic yards (bcy) of unprocessed ore and mine waste rock would be excavated, placed in the open stope, and covered with soil 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 bat gates in the open upper and lower adits, and a cable net over the partially filled stope. The partially collapsed wooden mill structure would be demolished and approximately 20 loose cubic yards (lcy) of wood and metal debris would be removed and hauled to the Stevens County Landfill for disposal.

The total estimated cost for the recommended alternative is **$172,320.**

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 Longshot Mine and Mill ("the Site") on the Colville 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 the 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 Site Inspection (SI) report prepared by MSE (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 (MSE 2005) and will not be reiterated here; 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. The site is located along a heavily vegetated southwest-facing slope at an elevation of about 3,600 feet above mean sea level (amsl). According to the SI, the entire Site encompasses about 5 acres (MSE 2005). Mine waste at the Site consists of unprocessed ore, waste rock, and tailings. Site features include:

- Remnants of a mill and other wooden structures
- Two open adits, including one with discharge
- One open stope
- Two ponds
- An unprocessed ore bin
- Six waste rock piles
- Three tailings impoundments

Access to the Site is via Forest Service Spur Road 150 by turning off County Road 4954 and traveling north for about 1 mile (Figure 1). Spur Road 150 leads to a turnaround at the mill and lower adit (Figure 2). A wet, marshy area leads to the adit, and water was observed flowing from the portal during the SI at approximately 6.7 gallons per minute (gpm). The water flows along the road and through a small settling

pond (PD1) before crossing the road just above the mill and disappearing under wood and metal debris surrounding the mill. There are three waste rock piles (WR1, WR2, WR3) and remnants of several wooden structures and piles of wood debris around the lower adit and mill area.

The road continues about 700 feet up the hill to the upper adit and stope but vehicular access is blocked by dense vegetation and large rocks (Figure 2). Both adits are open and unframed, and there are visible trails leading into them. The upper adit was dry during the SI and there was no visible sign of historic or episodic flows from the portal. The road forks near the upper adit with one road leading to the stope, and another road traveling around the adit and up the hill to the highwall above the stope. The stope is located about 200 feet uphill above the upper adit and extends vertically about 50 feet down into the adit. A large exposed vertical rock face about 30 feet high borders the stope to the north side. Three waste rock piles (WR4, WR5, and WR6) are located along the road between the upper adit and stope.

The Forest Service investigated and mapped the upper and lower underground workings on October 7, 2008 (Lentz 2008). It was determined that most of the water discharging from the lower adit originates from a drill hole located near the northeast end of the lower workings. The upper workings were dry except for ponded water in an isolated winze/stope at the northeast end of the workings. Two plugged ore chutes were identified; however, there were no open passages between upper and lower workings. While several Townsend bats were observed roosting in both the upper and lower workings, it was determined that the physical separation between the upper and lower workings limits the upper workings potential for use as hibernacula. It was estimated that the open stope could accommodate up to 500 loose cubic yards (lcy) of material. The approximate extent of the underground workings is shown on Figures 3 and 4.

The mill is located along a hillside across the road from the lower adit that slopes down into an ephemeral drainage. The wooden mill structure is partially collapsed and structurally unstable. Unprocessed ore is piled near the top of the mill and in an ore bin in the bottom of the mill structure. Wood and metal debris covers the hillside below the mill and extends into the bottom of the ephemeral drainage. It's likely that there is additional unprocessed ore beneath the wood and metal debris around the mill foundation. No flow was observed in the drainage below the mill during the SI and there was little evidence of concentrated flow in the drainage upstream of the Site. However, flow was observed in the drainage downstream of the Site and the drainage is considered to be an unnamed ephemeral tributary to SFMC, which is about 1 mile downstream of the Site.

There are three tailings impoundments in the ephemeral drainage below the mill. The impoundments are relatively thin (0 to about 5.5 feet), covered in detritus, heavily vegetated, and not well defined in areas. The impoundments were generally dry on the surface during the SI but subsurface flow was evidenced by isolated, wet boggy areas, and hand borings indicated saturation at about 3 to 4 feet below ground surface (bgs). The first impoundment (TA1) is about 200 feet from the mill and covers about 1,700 square feet (sf). The second tailings impoundment (TA2) is immediately downstream of the first and covers about 5,000 sf. A third tailings impoundment (TA3) is located along the hillside near the second impoundment and covers about 4,200 sf. A small earthen embankment separates TA1 and TA2, and a larger earthen embankment separates the TA2 from a wet marshy area that leads to a large pond (PD2). The pond is approximately 50 feet in diameter and appears to be up to 8 feet deep. Wood and metal debris are scattered on the pond bottom and there appears to be a structural foundation with a vertical opening in the pond bottom. Below the pond embankment is a wet, marshy area (ET3) that extends about 100 feet to a road crossing. The road crossing is slightly elevated (about 2 feet) above the drainage and there is a 12-inch diameter culvert under the road. The culvert was dry during the SI and all flow infiltrated before reaching the road. Surface water features at the Site do not support a viable fish habitat.

Immediately downstream of the road crossing, the drainage widens and the stream channel gradually disappears. The ephemeral drainage combines with other drainages and continues for approximately 1

mile where it crosses under County Road 4954 and enters SFMC. At the confluence, SFMC is several hundred feet wide and consists of unconfined meadow pool habitat with several beaver dams and widely dispersed flow. The point of confluence of the two channels is not well defined and the flows merge over a large marshy area.

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, camping, fishing, and hunting. Public use of the Site is moderate. The town of Colville is about 11 miles southwest of the Site and has approximately 5,049 inhabitants (U.S. Census Bureau 2006). There are no known residences within a 4-mile radius of the Site.

2.2 Data Gap Investigation

Additional data collected during preparation of this EE/CA was limited to climate data for the Site obtained from the Western Regional Climate Center (WRCC 2008). The nearest climate station is located in Colville, about 11 miles southwest of the Site at an elevation of about 1,600 feet amsl.

- The Site, located approximately 2,000 feet higher in elevation than the monitoring station, likely receives more total precipitation and has lower 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, cobalt, chromium, copper, lead, manganese, mercury, nickel, silver, vanadium and zinc. Analytical results of samples collected during the SI indicated concentrations of several COIs were above screening levels, particularly in the mine waste. The highest concentrations were found in the unprocessed ore and waste rock. The analytical results are summarized in Tables 2 through 6 and a summary of the estimated mine waste volumes is provided in Table 7.

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

Surface Water

- A total of 10 surface water samples were collected during the SI: 1 from the lower adit discharge, 1 from the small settling pond, 2 from the large pond, 2 from the ephemeral tributary, 1 from a pool in the ephemeral tributary upstream of the confluence with SFMC, 2 from SFMC, and 1 background sample.
- The single background sample was collected from a seep in an adjacent drainage that flows into the ephemeral tributary upstream of the confluence with SFMC. The ephemeral tributary was dry upstream of the Site. Therefore, because only one sample was used to characterize background conditions at the Site, the reported background concentrations should be considered representative of "apparent background" conditions.
- Only three COIs were detected in the water samples: barium, manganese, and zinc. Barium was the only COI detected in the background water sample.
- The surface water samples had pH values ranging from 7.6 to 8.7, and hardness values ranging from 201 to 226 milligrams per liter (mg/L) calcium carbonate ($CaCO_3$). Surface water samples from SFMC had pH values ranging from 8.2 to 8.3, and a hardness value of 116 mg/L $CaCO_3$. The single background sample had a pH value of 7.7 and hardness value of 185 mg/L $CaCO_3$.
- No COIs exceeded human health screening criteria.

- One COI exceeded ecological screening criteria in 8 of the 10 surface water samples, including the single background sample: barium.
- The results for several COIs were reported as analyzed for but not detected; however, the method detection limits (MDL) for antimony, arsenic, beryllium, cadmium, chromium, mercury, silver and thallium were above one or more screening criteria.
- In the two samples collected from SFMC, only barium and manganese were detected. There was a slight increase in manganese concentrations in the downstream sample compared to the upstream sample.
- Flow from the lower adit was measured to be 6.7 gpm. The ephemeral tributary was dry upstream of the Site and flow ranged from 4.9 to 94.9 gpm downstream of the Site. Flow in the SFMC could not be measured during the SI because the flow is widely dispersed over a large marshy area.

Sediment and Pore Water

- Ten sediment and two pore water and samples were collected during the SI.
- Sediment samples were co-located with the 10 surface water samples.
  - A single background sample was collected from a seep in an adjacent drainage; therefore, the reported background concentrations should be considered representative of "apparent background" conditions. No COIs in the background sample exceeded human health or ecological screening criteria.
  - Two COIs exceeded human health screening criteria: arsenic and cadmium. The highest concentrations were in the sediment samples from the lower adit discharge and two ponds.
  - Four COIs exceeded one or more ecological screening criteria: cadmium, copper, lead and zinc. The most notable exceedances were cadmium and zinc.
  - The results for antimony were reported as analyzed for but not detected; however, the MDL was above ecological screening criteria.
  - In general, COI concentrations in the downstream sediment sample from SFMC were consistent with, or only slightly above, the upstream sample.
- Pore water samples were collected from two locations on SFMC: upstream and downstream of the confluence with the ephemeral tributary.
  - Two COIs in pore water exceeded ecological screening criteria: barium and manganese.
  - The results for beryllium, cadmium, mercury, and silver were reported as analyzed for but not detected; however, the MDLs were above one or more screening criteria.
  - pH values ranged from 8.3 to 8.5 and hardness values ranged from 108 to 120 mg/L $CaCO_3$.
  - In general, most COI concentrations in the downstream sample were consistent with the upstream sample except for manganese, which was significantly higher in the upstream sample.

Groundwater

- Groundwater conditions at the Site are not well documented and no groundwater samples were collected during the SI.
- According to the SI, only one drinking water well is located within 1 mile of the Site; however, the location is uncertain because of conflicting information in the water well report (MSE 2005). If present, the well location is in a separate drainage and should not be hydraulically connected to the Site.
- Groundwater pathway is considered incomplete.
- Groundwater will be addressed indirectly in the consideration of the mine waste.

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 mine waste.
- COI concentrations in the mine waste were all below EPA's soil screening level for inhalation of particulates (EPA 2004).
- Air pathway is considered complete but insignificant.

Background Soil

- Five background soil samples were collected during the SI.
  - pH values ranged from 6.78 to 7.53.
  - Three COIs exceeded human health screening criteria: arsenic, cadmium and chromium.
  - 10 COIs exceeded one or more ecological screening criteria: aluminum, barium, cadmium, chromium, lead, manganese, nickel, silver, vanadium, and zinc. The most notable exceedances were aluminum and vanadium.
  - The results for antimony were reported as analyzed for but not detected; however, the MDL was above screening criteria.

Mine Waste

- Six waste rock piles and three tailings impoundments were identified during the SI: WR1 through WR6, and TA1 through TA3. There is also an ore bin containing unprocessed ore inside the partially collapsed mill structure.
- According to the SI, the estimated mine waste volumes include:
  - ~50 bank cubic yards (bcy) of unprocessed ore,
  - ~2,188 bcy of waste rock, and
  - ~1,155 bcy of tailings.
  - Although not identified during the SI, additional unprocessed ore (~100 bcy) may be present beneath the wood and metal debris around the mill foundation.
- A Niton X-ray fluorescence meter (XRF) was used to screen for COIs and assist in identifying waste rock piles and delineating the extent of the tailings impoundments. Background readings were also taken to assist in assessing background concentrations.
  - A total of 21 XFR readings were taken.
  - Four COIs were identified: arsenic, lead, iron, and zinc.
  - The unprocessed ore contained the highest readings for arsenic (304 milligram per kilogram [mg/kg]), lead (9,040 mg/kg), and zinc (2,270 mg/kg).
- A total of 15 mine waste samples were collected during the SI.
  - pH values ranged from 7.53 to 8.37
  - Four COIs exceeded human health screening criteria: arsenic, cadmium, chromium, and lead.
  - Fourteen COIs exceeded one or more ecological screening criteria: silver, aluminum, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, manganese, nickel, antimony, vanadium, and zinc. The most notable exceedances were aluminum, arsenic, cadmium, lead, selenium, and zinc.
  - The results for selenium were reported as analyzed for but not detected; however, the MDL was above the ecological screening criteria.
- Acid-base accounting (ABA) tests were conducted on: (1) one background sample composited from the five background locations, (2) the two unprocessed ore samples, (3) two waste rock composite samples (from WR1 and WR2, and from WR5 and WR6), and (4) two tailings composite samples from TA1 and TA2.
  - Net neutralization potentials (NNP) ranged from 11.5 for the background sample to 932 in the mine waste.

- Acid neutralization potential (ANP) to acid generating potential (AGP) ratios (ANP/AGP) ranged from 18 for the background sample to 3,107 in the mine waste.
- The background soil and mine waste have a very low potential for acid generation.

Structures and Debris

- The wooden mill structure surrounding the ore bin is partially collapsed and structurally unstable.
- Wood and metal debris surround the mill structure and extend into the ephemeral drainage below the mill.
- There are four collapsed wooden structures and several piles of wood and metal debris along the road leading from the lower adit to the upper adit.

2.4 Risk Assessment Conclusion

MSE completed a streamlined human health and ecological risk assessment of the Longshot Mine and Mill as part of the SI to evaluate risks associated with exposure to mining-related contaminants at the Site (MSE 2005). Analytical data and other information collected during the SI were used in the risk calculations. Results of the streamlined risk assessment indicated 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 very low non-carcinogenic hazard and low carcinogenic risk from exposure to metals in mine waste at the Site.

- Two human health contaminants of potential concern (COPC) were identified: arsenic and lead.
- Non-carcinogenic Hazard Indices (HI) were below 1 for adult and child receptors for all media under both central tendency exposure (CTE) and reasonable maximum exposure (RME) scenarios. 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.
- Carcinogenic risks ranged from 6.E-08 to 9.E-07 for the adult recreationalist, and from 4.E-07 to 4.E-06 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).
- Human health risks resulting from exposure to lead at the Site were not quantified because (1) the EPA has not established quantitative toxicological reference data for lead, and (2) the current lead exposure models are based on chronic long-term exposures and are not intended for assessing risk from occasional short-term exposures. The models were developed to assess exposures under chronic, steady-state conditions such as a working environment or residence and they are not intended to be used for acute, short-term exposures such as those associated with occasional recreational use of a remote site (EPA 2004 and 2005). Therefore, the potential risks were qualitatively evaluated by comparing lead concentrations to Washington State and federal screening values.
  - The maximum detected lead concentration (30,000 mg/kg) in the mine waste exceeded Washington Department of Ecology's (WDOE) Model Toxics Control Act (MTCA) Method A Industrial Soil Cleanup Level of 1,000 mg/kg by a factor of 30, and EPA's Industrial Soil Preliminary Remediation Goal (PRG = 800 mg/kg) by a factor of nearly 40 (EPA 2004). However, these screening values are based on a worker scenario with 250 days of exposure, which is much greater than expected for a recreational use scenario.

    - Two areas were identified as hotspots based on lead concentrations ranging from 16,000 to 30,000 mg/kg: (1) unprocessed ore in the ore bin, and (2) waste rock pile WR3.
    - The maximum detected lead concentration (90.4 mg/kg) in sediment is well below human health screening levels.
    - Lead was not detected in any of the surface water or pore water samples.
- The most significant exposure pathway is ingestion of and dermal contact with the mine waste.
- Inhalation of particulates from the mine waste, and dermal contact with and ingestion of sediment and surface water contribute minimal risk and are insignificant pathways.
- Removal of the two hotspots would significantly reduce potential human health risks at the Site.

2.4.2 Ecological Risk Assessment

Results of the streamlined ecological risk assessment (ERA) indicated 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 in mine waste and sediment at the Site, most notably aluminum, cadmium, lead, silver and zinc.
- No CPECs were identified in surface water or pore water.
- The highest risk ratios to terrestrial receptors were from exposure to the mine waste, particularly from lead and zinc. There is also risk to aquatic receptors from exposure to cadmium and zinc in sediment.
- 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 waste 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.

2.4.3 Physical Hazards

Physical hazards at the Site include:

- Two open adits
- An open stope
- A partially collapsed, structurally unstable, wooden mill structure
- Four collapsed wooden structures and several piles of wood and metal debris
- A large pond with wood and metal debris

Open Adits

- Both adits are easily accessible and have visible trails leading into the openings.
- The lower adit is located near the main road at the turnaround, along the southwest facing hillside above the mill (Figure 2).
    - The opening is unsupported in competent rock and is large enough for entry (approximately 6 feet in diameter).
    - Water discharges from the adit and forms a small marshy area that extends to the access road.
- The upper adit is located about 700 feet uphill from the lower adit (Figure 2). The adit is deeply cut into the hillside and the surrounding area is densely vegetated.
    - The opening is unsupported in competent rock and is large enough for entry (approximately 8 feet in diameter).

Stope

- The stope is located approximately 200 feet uphill from the upper adit. The stope drops vertically approximately 50 feet into the underground workings and is bordered by a 30-foot high vertical highwall on the north side.
- There are scattered remains of a protective wooden fence around the opening. The stope and surrounding highwall pose a significant fall hazard.

Collapsed Mill and Other Structures

- There is a large, partially collapsed wooden mill structure at the Site, about 200 feet from the lower adit. The mill structure is structurally unstable and poses a significant physical hazard.
- There is miscellaneous wood and metal debris scattered around mill, particularly along the hillside and into the ephemeral drainage below the mill.
  - The debris consists primarily of scattered wooden timbers, mining debris, sheet metal, and other general litter.
  - The concrete mill foundation is exposed and covers an area of about 75 sf.
- There are four collapsed wooden structures and several piles of wood and metal debris along the road leading from the lower adit to the upper adit.

Large Pond

- There is a large pond about 50 feet in diameter and 4 to 8 feet deep in the ephemeral drainage below tailings area TA3.
- There appears to be a concrete foundation under the water with a large vertical opening near the middle of the pond.
- Wood and metal debris are scattered along the pond bottom.

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. A risk-based cleanup level of 52 mg/kg was developed for arsenic in the mine waste at the Longshot Mine as part of the streamlined HHRA (MSE 2005); however, all mine waste samples were below the cleanup level.

The ARARs and 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 Longshot Mine include, respectively:

- **Chemical-specific Water, Soil, and Sediment Quality Standards:**
    - Washington State Water Quality Standards for Surface Water (Washington Administrative Code [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 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)

- **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):**
  - Colville National Forest Land and Resource Management Plan (LRMP; Forest Service 1988) as amended by Inland Native Fish Strategy (INFISH; Forest Service 1995).

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 185 in the single background sample.

- No COIs in surface water exceeded human health water quality ARARs and only barium exceeded the ecological water quality ARAR of 4 micrograms per liter (μg/L):
  - Single background sample (11.8 μg/L);
  - Two samples from SFMC (12.5 to 12.6 μg/L);
  - Two samples from the large pond (13.2 to 13.4 μg/L); and
  - Three samples from the ephemeral tributary (12.4 to 15.3 μg/L).
- 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 mine waste at the Site exceeded soil quality ARARs:

- Several COIs in background soil exceeded human health or ecological ARARs:
  - Arsenic, cadmium and chromium exceeded human health ARARs.
  - Silver, aluminum, cadmium, cobalt, chromium, manganese, nickel, lead, vanadium, and zinc exceeded ecological ARARs.
- Several COIs in mine waste at the Site exceeded human health or ecological ARARs:
  - Arsenic, cadmium, chromium, and lead exceeded human health ARARs.
  - Silver, aluminum, arsenic, cadmium, cobalt, chromium, copper, mercury, manganese, nickel, lead, antimony, vanadium and zinc exceeded ecological ARARs.

[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.

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 sediment quality ARARs:

- Arsenic and cadmium exceeded human health ARARs.
- Cadmium, copper, lead, and zinc exceeded ecological ARARs.
- With the exception of a single arsenic exceedance in the ephemeral tributary, all exceedances occurred in samples from the lower adit discharge and pond sediments.
- Future sampling may 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. Two COIs in pore water samples from SFMC exceeded pore water quality ARARs: barium and manganese.

- Barium exceeded the pore water quality ARAR in both samples.
- Manganese exceeded the pore water quality ARAR in the upstream sample only.
- Future sampling may 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 piles and tailings impoundments 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 Colville National Forest LRMP (1988), as amended by INFISH (1995), are potentially applicable or relevant and appropriate for assessing Site remedial alternatives. The LRMP and INFISH 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 the ephemeral tributary. These standards and guidelines include RF-2 through RF-5, 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 Aquatic Conservation Strategy objectives.

3.2 Risk–based Cleanup Concentrations

Risk-based cleanup levels can be computed using site-specific exposure factors for comparison to ARARs criteria in the event the latter is not practicable considering the exigencies of the circumstances (MSE 2005). Typically risk-based criteria calculated for remote areas, such as the Longshot 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 10 days for a recreational scenario at the Longshot Mine under the RME.

A risk-based cleanup level was developed for arsenic in the mine waste at the Site as part of the SI. The arsenic cleanup level was developed using the human health risk equations for the most sensitive receptor (child recreationalist) under the RME scenario, site-specific exposure factors, and an acceptable non-carcinogenic HI of 1.E+00 and a carcinogenic risk of 1.E-05 (EPA 1991)[2]. The risk-based arsenic cleanup level was calculated to be 52 mg/kg, which is well above the highest detected arsenic concentration in mine waste at the Site (41 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 streamlined risk assessment, there appears to be a significant human health risk from exposure to lead at the Site. The maximum detected lead concentration in soil at the Site (30,000 mg/kg) exceeds WDOE's MTCA Method A Industrial Soil Cleanup Level of 1,000 mg/kg by a factor of 30, and EPA Region 9's Industrial Soil PRG of 800 mg/kg by a factor of nearly 40. However, removal of mine waste from the two hotspots would decrease the average lead concentration at the Site from 5,371 to 1,278 mg/kg, and significantly decrease the overall Site risk.

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 Longshot Mine, the following time-critical removal action objectives (RAO) were developed for the Site:

- Reduce human and wildlife exposure to metals in mine waste at the Site;
- Improve public safety by addressing physical hazards at the Site; and
- 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 and sediment.

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

- The MDC of lead (30,000 mg/kg) in the unprocessed ore exceeds WDOE's MTCA Method A Industrial Soil cleanup level of 1,000 mg/kg by a factor of 30.
- The MDC of four metals in the mine waste exceeds WDOE's MTCA Method A Industrial Soil cleanup levels: arsenic, cadmium, chromium, and lead.
- The MDC of 15 metals in the mine waste exceed WDOE's MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Plant and Animals: aluminum, antimony, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, vanadium and zinc.

o Land uses in areas surrounding the Site include minerals prospecting, timber harvesting, firewood cutting, and recreational activities such as hiking, camping, fishing, and hunting.
- Because 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 and lead.
- The area is open to recreational use and the public is not restricted from entering the area or coming into contact with mine waste at the Site.

- **Actual or potential contamination of drinking water supplies or sensitive ecosystems:**
  - Water discharging from the lower adit flows into an ephemeral drainage that eventually drains to SFMC.
  - There are no public water supplies at the Site; however, recreationists may occasionally use water from the ephemeral tributary and SFMC for cooking and as a drinking source.
  - The MDC of barium (15.3 μg/L) in surface water exceeds WDOE's Ambient Water Quality Criteria for Protection of Aquatic Life (4 μg/L).
- **High levels of hazardous substances, pollutants, or contaminants in soils, at or near the surface that may migrate:**
  - During the SI, approximately 50 bcy of unprocessed ore was observed in the ore bin; however, there could also be up to 100 bcy of additional unprocessed ore beneath the wood and metal debris around the mill structure.
    - The unprocessed ore contains high concentrations of several metals.
    - The unprocessed ore is subject to erosion and fines eroding from the pile may migrate to the ephemeral tributary, which drains to SFMC.
  - The six waste rock piles on the Site contain a total of approximately 2,187 bcy.
    - The waste rock contains high concentrations of several metals.
    - The waste rock piles are subject to erosion and fines eroding from the piles may migrate to the ephemeral tributary, which drains to SFMC.
  - The three tailings impoundments contain a total of approximately 942 bcy.
    - The tailings are in an ephemeral drainage and may be subject to seasonal and episodic flows and erosion.
- **Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released:**
  - The mine waste is subject to erosion during rain events and snowmelt.
  - The Site is estimated to receive more than 18 inches of rain and 40 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 two open adits and an open vertical stope.

4.2 Scope of Removal Action

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

1) Eliminating direct contact with high concentrations of COIs in the mine waste;
2) Reducing or eliminating the migration of contaminants to the environment; and
3) Mitigating physical hazards at the Site.

The primary source of contaminants at the Site and focus of this removal action is the mine waste. Fine-grained material (i.e., sediment) that may have been deposited in, or migrated to, the ponds and ephemeral tributary is considered a secondary contaminant source. Sediment that has migrated to the ponds and ephemeral tributary is well covered with vegetation and removal would result in significant collateral damage to the riparian habitat; therefore, sediment was eliminated from the scope of this removal action. Surface water at the Site is not impaired and groundwater is not used for drinking water at the Site and future use as a drinking source is not anticipated; therefore, treatment of surface water and groundwater were also eliminated from the scope of this removal action. If future water quality monitoring indicates that a significant risk from surface water or sediment in the ponds and ephemeral tributary remains, additional removal actions may be necessary.

Two mine waste areas were identified in the SI as potential hotspots, i.e. areas that are highly contaminated and contribute to a large percentage of the overall exposure risk at the Site: (1) the unprocessed ore bin, and (2) waste rock pile WR3. Mine waste samples from these two areas contained the highest detected concentrations of several metals, including antimony, cadmium, copper, lead and zinc. Lead concentrations in these two hotspots were significantly higher than any other area and ranged from 16,000 to 30,000 mg/kg. Removal of these two hotspots would significantly decrease the overall human health risk at the Site. Human health risks from recreational exposures to the remaining mine waste should be minimal because: (1) the Site is relatively isolated, (2) the waste rock and tailings are well vegetated and covered with debris and detritus, and (3) recreational activities at the Site are unlikely to result in significant soil ingestion or dermal contact.

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 removal, and post-removal monitoring of the aquatic habitat in the ephemeral tributary 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 could 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 technologies not screened out were retained as potential alternatives that could be implemented at the Site.

The technologies were grouped into similar categories (i.e. engineering controls, treatment, etc.) and assessed relative to others in the same 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 5 through 7) 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 mine waste quantities are presented in bcy; all other bulk material quantities are presented in lcy. The referenced figures are conceptual only.

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

- **ALTERNATIVE 1 – NO ACTION**
- **ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL OF HOTSPOTS**
- **ALTERNATIVE 3 – EXCAVATION AND ON-SITE CONTAINMENT OF HOTSPOTS**
- **ALTERNATIVE 4 – IN-PLACE CAPPING OF HOTSPOTS**

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 Spur Road 150 is relatively narrow and minor widening and filling may be needed to accommodate heavy equipment; however, access does not require a high-clearance, 4-wheel drive vehicle.

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 BMPs and proposed actions for each hazard are discussed below:

- **Site Access.** Minimally improving Spur Road 150 by removing obstructions, widening the road, and placing road base material (total of ~10 lcy of 2-inch minus material) in selected areas to minimize hazards.

- **Physical Hazards.** Physical hazards at the Site are minimal. Each hazard is described below:
  - **Lower and Upper Adits.** Installing bat gates, shown in Figure 7, to prevent public access while maintaining potential bat habitat.
  - **Open Stope.** Covering the stope opening with a pre-fabricated cable net to prevent public access.
  - **Partially Collapsed Mill Structure.** Removal of the unprocessed ore from the ore bin and around the mill structure will require demolishing the wooden structure and transporting the wood and metals debris to the Stevens County Landfill for disposal. The concrete foundation located downhill from the mill structure will not be disturbed and left as is.
  - **Miscellaneous Debris.** Removing miscellaneous debris and litter from the mill site and surrounding hillside and transporting to the Stevens County Landfill for disposal.
- **Best Management Practices.** During removal activities, BMPs will be employed to contain run-off, minimize erosion, and prevent sedimentation of the ephemeral tributary 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:

- Unprocessed ore, waste rock and tailings would remain in their current locations; and
- Site safety issues (i.e. open adits, open stope, debris, etc.) would remain as they are.

ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL OF HOTSPOTS

This alternative involves excavating the two mine waste hotspots (ore bin and WR3), and transporting to an off-site facility for disposal. Any additional unprocessed ore under the wood and metal debris around the mill foundation would also be removed. This alternative also includes demolition of the partially collapsed wooden mill structure and off-site disposal of the wood and metal debris. Disposal options will depend on whether the mine waste and debris is considered a hazardous waste under Washington Dangerous Waste Rules (WAC Chapter 173-303). The material is not a listed discarded chemical product or dangerous waste source, nor does it exhibit the characteristics of a hazardous waste; however, the mine waste samples collected during the SI were not analyzed for synthetic precipitation leaching procedure (SPLP) or toxicity characteristic leaching procedure (TCLP) metals. This analysis will be required prior to disposal of the mine waste and debris to determine whether the leachate is below RCRA TCLP disposal limits. The mine waste may also be considered a special waste because it poses a relatively low hazard to human health and the environment.

For the purposes of estimating the costs associated with this alternative, it was assumed that the wood and metal debris can be disposed of at the Stevens County Landfill, approximately 15 miles from the Site. The landfill will reportedly also accept the mine waste if the material passes the TCLP disposal limits; however, if the mine waste or debris exceeds the TCLP disposal limits, it will need to be transported to the RCRA-C landfill near Arlington, Oregon, approximately 300 miles from the Site.

- Removing the two hotspots.
  - Excavating the unprocessed ore and waste rock.
    - ~50 bcy of unprocessed ore from the ore bin at the mill site.
    - ~100 bcy of additional unprocessed ore beneath the wood and metal debris around the mill foundation (assumed).
    - ~63 bcy of waste rock from pile WR3 near the lower adit.

- Loading the mine waste (~213 bcy total) in 12-cy dump trucks and transporting to a temporary staging area.
- 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.
- Loading and transporting the staged waste to: (1) the Stevens County Landfill (~15 miles), or (2) the RCRA-C landfill in Arlington, Oregon (~300 miles) for disposal.
- Using heavy equipment to demolish the partially collapsed mill structure, loading the wood and metal debris (~20 cy) in 12-cy dump trucks and transporting to Stevens County Landfill for disposal.
- Grading the mill site and the area from which waste rock was excavated (~0.2 acre) to blend with the surrounding topography and promote drainage.
- Applying 6 to 12 inches of growth media (~220 lcy), applying fertilizer, seeding with a Forest Service-approved seed mix, and hydromulching.

ALTERNATIVE 3 – EXCAVATION AND ON-SITE CONTAINMENT OF HOTSPOTS

This alternative involves excavating the two mine waste hotspots (ore bin and WR3), and containing them on-site. Any additional unprocessed ore under the wood and metal debris around the mill foundation would also be removed. Two containment options and two cover configurations were evaluated for this alternative. Both options area discussed below. Removal action activities common to both containment options include:

- Using heavy equipment to demolish the mill structure, loading the wood and metal debris (~20 cy) in 12-cy dump trucks and transporting to the Stevens County Landfill (~15 miles) for disposal.
- Excavating and containing the two hotspots onsite.
  - ~50 bcy of unprocessed ore from the ore bin at the mill site.
  - ~100 bcy of additional unprocessed ore beneath the wood and metal debris around the mill foundation (assumed).
  - ~63 bcy of waste rock from pile WR3 near the lower adit.
  - Loading the unprocessed ore and waste rock (~213 bcy total) in 12-cy dump trucks and transporting to an on-site repository. Two disposal options 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 mill site and areas from which the waste rock was excavated (~0.2 acre) to blend with the surrounding topography and promote drainage.
  - Applying 6 to 12 inches of growth media (~220 lcy), applying fertilizer, seeding with a Forest Service-approved seed mix, and hydromulching.
- **Containment Option 1 – Stope:**
  Under this option, the mine waste would be disposed of in the open stope (Figure 5). The stope is located along the hillside above the upper adit and is relatively close to the mill site and waste rock pile WR3. Based on field estimates by the Forest Service, the stope can accommodate up to 500 lcy of material (Lentz 2008).
  - Clearing and widening the existing access road from the mill site to the stope (~900 feet).
  - Compacting and placing ~20 lcy of coarse road base in select areas as needed.
  - Excavating a diversion channel along the uphill edge of the stope 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 150 feet. Riprap protection (~2 lcy) would be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened onsite.
    - Placing ~213 bcy of unprocessed ore and waste rock in the stope using methods to prevent bridging of the material.
    - Placing ~10 lcy of clean, well-graded soil in the stope over the waste material to provide an earthen cover.
    - Based on the estimated available volume in the stope, the waste material will not completely fill the stope and a cable net will be required to secure the opening.
    - The proposed design is conceptual and the actual engineered designs may differ considerably based on site-specific conditions and constraints.
    - Reclaiming 900 feet of access road by ripping compacted surfaces, seeding ~0.3 acre with a Forest Service-approved seed mix, and hydromulching.
- **Containment Option 2 – Repository:**
  Under this option, the mine waste would be disposed of in a repository located at an old homestead along Spur Road 150 about 0.5 mile from the mill site. The repository would have a minimum available storage capacity of 300 lcy (includes >30 percent swell).
    - Clearing and grubbing the repository site (~0.1 ac) and stockpiling the woody debris. The area appears to be relatively clear of old growth trees.
    - Excavating topsoil (volume depends on cover alternative selected) 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 with 1H:1V side slopes. For cost estimation purposes, the assumed channel length is 150 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 onsite.
    - Excavating a shallow area for the repository base and stockpiling the excavated material for use in the cap.
    - Placing and compacting the unprocessed ore and waste rock in the repository in 12-inch-thick lifts to the approximate configuration shown on Figure 6.
    - 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.
- **Cover Options**
  Two cover options were evaluated for the mine waste repository. The cover soil for both options, as well as for the excavated waste areas, was assumed to come from a borrow source at the homestead site or other nearby source along Spur Road 150. The borrow soil will also be screened to provide the fine bedding layer for the engineered cover, if selected; however, the drainage layer will be purchased and imported from an off-site source within 20 miles of the Site.

- **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 6). The cover material quantities will vary depending on the actual repository location and final configuration.
  - Generating ~110 lcy of fine bedding material on site by screening the borrow soil. Placing and compacting the screened fines over the waste material in one 12-inch lift.
  - Installing ~330 square yards (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 (~60 lcy) over the GCL in one loose lift.
  - Placing a single layer of filter fabric (~330 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 (~220 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 (~0.1 ac).
  - Placing woody debris generated during the removal action over the final cover surface to prevent erosion and provide natural habitat.
- **Option 2 – Earthen Cover:**
  Consists of a 12-inch-thick well-graded soil cover (Figure 6).
  - Placing a single layer of filter fabric (~330 sy) over the compacted mine waste to prevent piping of fines from the mine waste into the cover soil.
  - Placing a 12-inch-thick, well-graded soil cover (~110 lcy) over the filter fabric in one lightly compacted 12-inch lift. Adding soil amendments and seeding the cover with a Forest Service-approved seed mix and hydromulching (~0.1 ac).
  - Placing woody debris generated during the removal action over the final cover surface to prevent erosion and provide natural habitat.

ALTERNATIVE 4 – IN-PLACE CAPPING OF HOTSPOTS

This alternative involves capping the unprocessed ore and waste rock in place.

- Under this option, a 12-inch thick soil cover would be installed over two areas to eliminate the surface exposure: (1) the unprocessed ore at the mill, and (2) waste rock pile WR3. This option assumes that additional unprocessed ore will be removed from beneath the wood and metal debris around the mill foundation
  - Preparing the two areas for installation of the soil cap.
    - Demolishing the partially collapsed mill structure surrounding the ore bin and transporting the wood and metal debris (~20 cy) to the Stevens County Landfill (~15 miles) for disposal.
    - Clearing and grubbing waste rock pile WR3.
    - Lightly grading and compacting the waste in place to remove major surface irregularities.
  - Excavating and loading ~300 lcy of soil from a borrow source to be located at the homestead site or other location along Spur Road 150 and transporting to the mine and mill (~4,000 feet).
  - Placing a single layer of filter fabric (~860 sy) over the compacted mine waste at each area to prevent piping of fines from the mine waste into the cover soil.
  - Placing a 12-inch-thick, well-graded soil cover (~300 lcy) over the filter fabric in one lightly compacted 12-inch lift.
  - Adding soil amendments and seeding the cover with a Forest Service-approved seed mix and hydromulching (~0.2 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).

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.

[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.

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 1 mile) source along Spur Road 150.
- The coarse drainage material soil will be available and purchased from a nearby (within 20 miles) off-site source and transported to the Site.
- A temporary staging area can be established at the intersection of County Road 4954 and Spur Road 150 for offloading equipment and materials.
- Improvements to Spur Road 150 will be minimal to accommodate site access.
- The borrow soil will be screened on site to provide the fine bedding materials needed in the repository engineered cover.
- The proposed locations for the repository are suitable and accessible, and will not require significant modification.
- The mill structure and other wood and metal debris at the Site are non-hazardous and can be disposed of at the Stevens County Landfill.
- The Forest Service and State Historic Preservation Officer (SHPO) will approve demolition of the partially collapsed mill structure and the Forest Service will confirm approval for backfilling the open stope and upper adit.
- 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 annual site visits for a 3-year period following completion of removal action.
- Post-removal monitoring will be limited to general visual assessment of the Site and surface water sampling at two locations: (1) the lower adit discharge (AD1), and (2) the ephemeral tributary immediately downstream of the Site at ET3.
- 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 $15,106 to $21,151 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 $22,736 to $27,480.
- 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 TCLP analysis on mine waste samples;
- Lack of sufficient background surface water, sediment, and pore water samples to develop reasonably accurate average background COI concentrations;
- Quantity (if any) of additional unprocessed ore beneath the wood and metal debris around the mill foundation;
- Wood and metal debris not characterized; and

- Potential repository locations and borrow sources not well characterized.

The data gaps, potential issues, recommended actions, and estimated costs are summarized in Table 14. 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.

Effectiveness

- 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 sediment would continue to pose a threat to ecological receptors.
  - 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 – Surface water quality at the Site currently meets all ARARs. Post-removal monitoring would determine continued compliance.
    - Soil Quality ARARs – The two hotspots would be removed. Some remaining mine waste may exceed MTCA human health or ecological criteria for silver, aluminum, arsenic, cadmium, chromium, cobalt, copper, mercury, manganese, nickel, lead, antimony, vanadium and zinc (Table 9).
    - Sediment Quality ARARs – Sediment at the Site will not be removed to avoid excessive collateral environmental impacts (see Section 4.2). Sediment in the two ponds contain metals concentrations that may slightly exceed WDOE's Freshwater Sediment Quality Standards for arsenic, cadmium, copper, lead and zinc (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.
  - 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 Containment 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 at the Site currently meets all ARARs. Post-removal monitoring would determine continued compliance.
    - Soil Quality ARARs – The two hotspots would be contained and covered. Some remaining mine waste may exceed MTCA human health or ecological criteria for silver, aluminum, arsenic, cadmium, chromium, cobalt, copper, mercury, manganese, nickel, lead, antimony, vanadium and zinc (Table 9).
    - Sediment Quality ARARs – Sediment at the Site will not be removed to avoid excessive collateral environmental impacts (see Section 4.2). Sediment in the two ponds contain metals concentrations that may slightly exceed WDOE's Freshwater Sediment Quality Standards for arsenic, cadmium, copper, lead and zinc (Table 10).
  - Compliance with Solids Disposal ARARs – Key action-specific ARARs would be attained. Hotspot mine waste would be isolated from the environment in underground mine workings or an earthen repository.
    - Option 1 (stope) would provide a more effective and stable configuration than option 2 (repository).
    - The repository may be subject to more potential vandalism and require more maintenance because it would be visible from Spur Road 150.
    - The stope would require improving the existing access road but the mine waste would be in a more secure location.
    - Cover option 1 (engineered cover) would be more effective than option 2 (earthen cover) in reducing infiltration through the waste material. The engineered cover meets the substantive Solids Disposal ARARs by capping them in accordance with state landfill standards (WAC 173-350-400). The engineered cover would consist of 2 feet of soil and a geomembrane (the presumptive cover prescribed by state regulations). The earthen cover 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 stored outside a Riparian Reserve; roads and disturbance in a Riparian Reserve would not be required.
  - 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.
- Alternative 4 – In-place Capping is moderately protective of the human health and environment.
  - Most RAOs would be achieved under this alternative by capping the mine waste in place.
  - Most key chemical-specific ARARs will be attained:
    - Surface water quality at the Site currently meets all ARARs. Post-removal monitoring would determine continued compliance.
    - Soil Quality ARARs – The two hotspots would be capped in place. Some remaining mine waste may exceed MTCA human health or ecological criteria for silver, aluminum, arsenic, cadmium, chromium, cobalt, copper, mercury, manganese, nickel, lead, antimony, vanadium and zinc (Table 9).

- Sediment Quality ARARs – Sediment at the Site will not be removed to avoid excessive collateral environmental impacts (see Section 4.2). Sediment in the two ponds contain metals concentrations that may slightly exceed WDOE's Freshwater Sediment Quality Standards for arsenic, cadmium, copper, lead and zinc (Table 10).

  - Compliance with Solids Disposal ARARs – Key action-specific ARARs would be attained. Hotspot mine waste would be isolated from the environment by a soil cap.
  - Compliance with FP S&G ARARs – Key location-specific ARARs would be attained. Wastes are not in a Riparian Reserve; roads and disturbance in a Riparian Reserve would not be required.
  - Moderate short-term effectiveness and moderate long-term effectiveness and permanence (see Table 15).
  - No reduction in toxicity or volume through treatment, but moderate to high reduction in toxicity through 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 Containment is moderately to highly implementable.
  - The availability of service and materials is high.
  - All options are implementable using standard construction equipment and methods.
  - Option 1 (stope) would be slightly more difficult to implement than option 2 because of the additional access road improvements; however, option 2 (repository) would require hauling the waste material a greater distance.
  - Both cover options are easily implementable.
  - Agency and community acceptance will likely be higher for cover option 1 (engineered cover).
- Alternative 4 – In-place Capping is highly implementable.
  - The availability of service and materials is high.
  - Implementable using standard construction equipment and methods.
  - Community acceptance may be moderate; agency acceptance will likely be low.

Cost

- Alternative 1 – No Action is the least expensive alternative.
- Alternative 2 – Off-site Disposal is the most expensive alternative.
- Alternative 3 – On-site Containment is moderately expensive.
  - Both containment options are very similar in cost and depend on the repository cover option selected; the engineered cover (Option 1) is about 8 percent more expensive than the earthen cover (Option 2). With an earthen cover, Containment Option 1 (stope) is more expensive than Containment Option 2 (repository); however, with an engineered covered, Containment Option 2 becomes more expensive than. Containment Option 1
- Alternative 4 – In-place Capping is the least expensive action alternative.

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 5 through 7. The recommendation expressed here is based on the analysis discussed in Sections 6.3 and 7.0, and summarized in Table 15. Alternative 3 is recommended with the options listed below:

- **Alternative 3 – Excavation and On-site Containment of Hotspots**
  - Containment Option 1: Stope

Containment Option 1 (stope) was selected over the Option 2 (repository) because of the more secure containment offered by the underground workings. The existing road from the mill site to the stope would be minimally widened to remove obstructions and accommodate heavy equipment. Physical hazards would be mitigated as described in Section 5.1 under Removal Action Elements Common to All Removal Action Alternatives. The partially collapsed mill structure would be demolished and the wood and metal debris would be hauled to the Stevens County Landfill for disposal. The two mine waste hotspots would be contained in the open stope. Surface and groundwater at the Site were excluded from the scope of this removal action because surface water is not impacted and groundwater is not used as a drinking water source. Sediment was also excluded from the removal action scope because removal would result in significant collateral damage to the ephemeral drainage and riparian habitat.

Specifics of the recommended removal action alternative are described below:

- Clearing and widening the existing access road from the mill site to the stope (~900 feet).
  - Compacting and placing ~20 lcy of coarse road base in select areas as needed.
- Using heavy equipment to demolish the partially collapsed mill structure, loading the wood and metal debris (~20 cy) in 12-cy dump trucks and transporting to the Stevens County Landfill for disposal.
- Excavating the two hotspots.
  - ~50 bcy of unprocessed ore from the ore bin at the mill site.
  - ~100 bcy of additional unprocessed ore from beneath the wood and metal debris around the mill foundation (assumed).
  - ~63 bcy of waste rock from pile WR3 near the lower adit.
  - Loading the unprocessed ore and waste rock (~213 bcy total) in 12-cy dump trucks and transporting to the stope.
    - Placing and compacting the unprocessed ore and waste rock in the stope using methods to prevent bridging of the material.
  - 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.
- Placing ~10 lcy of clean, well-graded soil in the stope over the waste material to establish an earthen cover.
- Installing a cable net over the partially filled stope to prevent public access.
- Installing bat gates in the upper and lower adits to prevent public access.
- Excavating a diversion channel along the uphill edge of the stope 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 total channel length is 150 feet. Riprap protection (~2 lcy) would be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened onsite.
- Reclaiming the waste excavation areas.
  - Grading the mill site and areas (~0.2 acre) from which the waste rock was excavated to blend with the surrounding topography and promote drainage.

- Applying 6 to 12 inches of growth media (~220 lcy), applying fertilizer, seeding with a Forest Service-approved seed mix, and hydromulching.
- Reclaiming 900 feet of access road by ripping compacted surfaces, seeding ~0.3 acre with a Forest Service-approved seed mix, and hydromulching.

The recommended alternative would dispose of a total of ~213 bcy of mine waste. The removal action would achieve RAOs and attain ARARs to the extent practical by eliminating the surface exposure pathway to mine waste and mitigating physical hazards at the Site. The recommended alternative would eliminate human health risk from exposure to the mine waste by removing the two mine waste hotspots.

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 the hotspots will be eliminated by removing and containing the source.	Yes
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	There are no impacts to surface water quality at the Site.	Yes
(3) Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release	None.	Yes
(4) High levels of hazardous substances, pollutants, or contaminants in soils largely at, or near, the surface that may migrate	Mine waste hotspots will be removed.	Yes
(5) Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released	Mine waste hotspots 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 **$172,320.**

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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REFERENCES

Lentz, R.T. 2008. Personal communication and . U.S. Department of Agriculture, Forest Service (Forest Service).

Millennium Science and Engineering, Inc. (MSE) 2005. "Site Inspection Report, Longshot Mine and Mill, Colville National Forest." Prepared for the Forest Service. November.

National Oceanic and Atmospheric Administration (NOAA) 1999. Screening Quick Reference Tables for Organics. Updated September.

R.S. Means 2005. *Environmental Remediation Cost Data – Unit Price.* Reed Construction Data, Kingston, Mass. 11th Annual Edition.

U.S. Census Bureau 2006. 2006 Population Estimate for Colville, Washington. Online address: http://factfinder.census.gov/servlet/SAFFPopulation?

Forest Service 1988. Land and Resource Management Plan (LRMP). Colville National Forest. U.S. Government Printing Office.

Forest Service 1995. Inland Native Fish Strategy (INFISH). Decision Notice/Finding of No Significant Impact, Environmental Assessment, INFISH, Interim Strategies for Managing Fish-producing Watershed in Eastern Oregon, Washington, Idaho, Western Montana, and Portions of Nevada. March.

Forest Service 2003. "Abbreviated Preliminary Assessment, Longshot Mine and Mill Site, Colville National Forest." September.

U.S. Environmental Protection Agency (EPA) 1991. "Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)." Interim. EPA Publication 9285.7-01B. EPA Office of Emergency and Remedial Response. Washington, DC.

EPA 1993. "Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA." EPA/540/F-94-009. Washington, D.C.

EPA 2000. "Mine Waste Technology Program Annual Report 2000." EPA Office of Research and Development, Cincinnati, Ohio.

EPA.2004. "Region 9 Preliminary Remediation Goals, Intercalc Tables." Online address: http://www.epa.gov/region09/waste/sfund/prg/

EPA.2006. "National Recommended Water Quality Criteria." EPA Office of water. Online address: http://www.epa.gov/waterscience/criteria/wqcriteria.html

EPA 2007. "Aquatic Life Ambient Freshwater Quality Criteria – Copper." EPA-822R-07-001. February.

EPA.2008. "Ecological Soil Screening Levels (ECO-SSL)." Online address: http://www.epa.gov/ecotox/ecossl/

Washington Department of Ecology (WDOE 2001a). "Model Toxics Control Act Cleanup (MTCA) Regulation." WAC Chapter 173-340-900, Table 745-1, Method A Soil Cleanup Levels for Industrial Properties. Amended February.

WDOE 2001b. "MTCA Regulation." WAC Chapter 173-340-900, Table 749-3, Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals. Amended February.

WDOE 2003. "Water Quality Standards for Surface Waters of the State of Washington." Chapter 173-201A WAC. Amended July 1, 2003. Online address: http://www.ecy.wa.gov/pubs/wac173201a.pdf.

WDOE 2004. "Freshwater Sediment Quality Standards." WAC Chapter 173-204.

Washington State Department of Health (WSDH) 2006. "Drinking Water Maximum Contaminant Levels," WAC 246-290-310. Online address: http://apps.leg.wa.gov/WAC/default.aspx?cite=246-290-310

Western Regional Climate Center (WRCC) 2008. Washington Climate Summaries. http://www.wrcc.dri.edu/summary/climsmwa.html (and linked pages), Desert Research Institute, Reno, Nevada.

Tables

Table 1. Monthly Climatic Averages for Colville, Washington WSO
Longshot Mine EE/CA

Parameter	Month												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average Maximum Temperature (°F)	31.1	39.1	48.6	59.5	68.6	75.8	85.1	83.9	73.8	58.5	40.8	32.8	58.1
Average Minimum Temperature (°F)	17.7	22.9	27.7	34.0	41.1	47.5	51.0	49.9	42.7	34.2	26.9	21.3	34.7
Average Total Precipitation (in)	2.00	1.55	1.33	1.1	1.65	1.67	0.82	0.96	0.99	1.34	2.24	2.27	17.9
Average Total Snowfall (in)	13.9	6.3	2.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	6.6	13.6	43.1
Average Snow Depth (in)	7	6	1	0	0	0	0	0	0	0	1	4	2

Notes:
Source: National Weather Service, Period of Record 3/01/37 to 10/31/87
Percent of possible observations for period of record: maximum temperature = 97.9%, minimum temperature = 98.1%, precipitation = 98.6%, snowfall = 84%, snow depth = 93.9%
°F = Degrees Fahrenheit
in = inches

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

Sample ID	Area	Date Collected	pH	Analyte Concentration (mg/kg)																					
				Ca	K	Mg	Na	CN	Ag	Al	As_T	Ba	Be	Cd	Co	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
MW-OB1-G-02	Ore Bin	6/21/2005	7.94	156000	800	15700	*125*	*0.025*	147	5400	26.4	12.6	*0.5*	122	15.8	20.5	63.7	32500	0.165	1560	38.2	16000	43.0	*1.5*	*1.0*	9.59	23100
MW-OB1-G-01		6/21/2005	8.37	178000	*125*	99300	*125*	*0.025*	3.96	1330	9.01	23.3	*0.5*	14.8	1.50	6.90	21.9	8040	0.994	442	5.10	30000	*5*	*1.5*	*1.0*	48.7	2040
MW-WR1-G-01	WR1	6/21/2005	8.02	80800	1430	16200	206	*0.025*	15.6	12500	15.4	22.2	NA	16.7	15.8	20.3	124	38400	*0.01665*	1510	24.1	1760	5.8	NA	NA	43.5	2610
MW-WR1-2-C-01	WR1&2	6/22/2005	7.71	52400	3220	11400	340	*0.025*	0.62	23700	5.61	43.7	NA	2.05	14.5	37.6	40.2	27300	*0.01665*	515	31.3	34.8	*1*	NA	NA	39.3	136
MW-WR2-G-01	WR2	6/21/2005	7.84	110000	4150	7550	256	*0.025*	*0.25*	32700	3.50	17.0	NA	1.96	15.2	49.1	20.1	22700	*0.01665*	496	44.7	17.0	*1*	NA	NA	24.6	167
MW-WR3-G-01	WR3	6/21/2005	7.55	139000	823	18900	57	*0.025*	176	5140	27.1	12.4	NA	191	15.4	10.3	158	31400	0.285	1730	21.1	23200	88.5	NA	NA	9.89	39100
MW-WR4-G-01	WR4	6/21/2005	7.87	17500	3570	9110	582	*0.025*	2.57	30600	6.05	83.0	NA	4.71	16.8	46.4	22.4	32400	*0.01665*	724	37.5	299	*1*	NA	NA	39.8	677
MW-WR5-G-01	WR5	6/23/2005	7.8	22700	1820	13200	255	*0.025*	20.2	25400	20.9	46.3	NA	10.6	26.3	31.1	61.0	45500	*0.01665*	1320	38.2	1430	8.60	NA	NA	96.3	1980
MW-WR5-6-01	WR5&6	6/22/2005	7.53	18500	2060	12000	299	*0.025*	12.8	25500	36.9	47.7	NA	6.87	25.0	33.7	58.1	51000	*0.01665*	1220	44.4	1040	*1*	NA	NA	103	1630
MW-WR6-G-01	WR6	6/21/2005	7.84	13200	1090	13000	130	*0.025*	7.01	20200	41.0	26.3	NA	11.8	29.3	22.8	52.0	68100	*0.01665*	1620	34.3	1120	6.30	NA	NA	135	1640
MW-TA1-C-01	TA1	6/23/2005	7.73	127000	715	19600	*125*	*0.025*	19.7	4250	11.5	14.8	*0.5*	7.10	6.80	20.2	48.5	37100	0.0750	1670	32.9	3810	*5*	*1.5*	*1.0*	13.2	1470
MW-TA1-G-01		6/23/2005	7.68	189000	758	11200	*25*	*0.025*	8.37	2560	9.20	11.4	NA	9.04	4.28	9.70	77.9	15300	*0.01665*	908	10.1	892	3.40	NA	NA	4.88	1240
MW-TA1-G-02		6/23/2005	7.76	151000	693	18100	*25*	*0.025*	30.9	2710	13.8	7.70	NA	11.5	6.74	14.0	58.1	31400	*0.01665*	1640	17.0	1460	8.40	NA	NA	7.10	1120
MW-TA2-C-01	TA2	6/23/2005	8.17	151000	682	18200	*125*	1.42	30.9	2110	13.30	8.10	*0.5*	14.5	6.90	11.9	57.1	34700	0.0350	1680	23.2	1120	15.0	*1.5*	*1.0*	6.52	2080
MW-TA2-G-01		6/23/2005	7.80	128000	485	21600	*25*	*0.025*	15.6	1700	12.3	4.92	NA	11.5	7.87	8.87	85.1	45200	*0.01665*	2170	17.9	415	4.80	NA	NA	6.26	1390
MW-TA3-G-01	TA3	6/23/2005	7.86	342000	847	14000	*25*	*0.025*	7.27	2270	11.4	9.52	NA	5.96	4.62	8.94	25.1	22500	*0.01665*	1280	12.4	513	3.30	NA	NA	5.71	790
SD-ET3-C-01	ET3	6/22/2005	7.62	68900	558	24100	*25*	*0.025*	7.40	1930	5.60	11.2	NA	3.42	2.13	6.64	14.3	12000	0.132	782	5.30	4000	4.60	NA	NA	9.05	650
		minimum =	7.53	13200	*125*	7550	*25*	*0.025*	*0.25*	1330	3.5	4.92	*0.5*	1.96	*1.5*	6.64	14.3	8040	*0.01665*	442	5.1	17	*1*	*1.5*	*1*	4.88	136
		MDC =	**8.37**	**342000**	**4150**	**99300**	**582**	**1.42**	**176**	**32700**	**41.0**	**83**	***0.5***	**191**	**29.3**	**49.1**	**158**	**68100**	**0.994**	**2170**	**44.7**	**30000**	**88.5**	***1.5***	***1***	**135**	**39100**
		average =	7.83	114412	1402	20186	162	0.11	29.8	11765	15.8	23.7	0.5	26.2	12.6	21.1	58.1	32679	0.11	1251	25.7	5124	12.1	*1.5*	*1.0*	35.4	4813
		95% UCL =	NC	166069	2125	43925	264	NC	61.1	20607	22.2	35.2	NC	157	16.9	29.4	78.0	39780	0.69	1476	32.2	13194	28	NC	NC	62	10860
		# of samples = 17; Standard Deviation =	NC	80830	1147	20247	145	NC	49.2	11323	11	20	NC	49.2	8.3	13.4	36.8	14430	0.23	501	12.7	8713	21	NC	NC	39	10005
		Frequency detected =	NC	100%	94%	100%	47%	6%	94%	100%	100%	100%	0%	100%	94%	100%	100%	100%	35%	100%	100%	100%	65%	0%	0%	100%	100%
Human Health Screening Criteria																											
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)				NS	NS	NS	20	NS	NS	2	NS	19	NS	NS	2	NS	NS	1000	NS	NS	NS	NS	NS				
EPA Region IX Industrial Soil PRGs (EPA 2004)				1200	5100	100000	1.6	67000	1900	450	1900	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, lowest value (WDOE 2001b)					2	50	7	102	10	4	20	42	50	NS	0.1	1100	30	50	5	0.3	1	2	86				
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2008)					4.2	NS	18	330	21	0.36	13	28	NS	NS	NS	220	38	11	0.27	0.52	NS	7.8	46				

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit
Screening criteria exceeded
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
MTCA = Model Toxics Control Act
NA = Not analyzed for
NC = Not calculated
NS = No standard
PRG = Preliminary remediation goal
UCL = Upper confidence level
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

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

Sample ID	Date Collected	pH	Analyte Concentration (mg/kg)																			
			Ca	CN	K	Mg	Na	Ag	Al	As_T	Ba	Cd	Co	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	V	Zn
BS-BG1-G-01	6/21/2005	7.37	3650	*0.25*	2120	3060	256	*0.25*	22400	4.30	249	0.83	6.63	20.8	13.2	17400	*0.0165*	1370	17.5	11.9	*1.0*	19.5	96.3
BS-BG3-G-01	6/21/2005	6.78	5570	*0.25*	1070	4370	202	*0.25*	27500	3.87	80.7	1.38	14.7	30.9	19.8	23700	*0.0165*	386	40.6	16.9	*1.0*	22.6	87.5
BS-BG2-G-01	6/21/2005	7.53	29100	*0.25*	2720	12300	359	3.43	25100	6.93	60.3	4.05	13.1	41.0	23.1	28300	*0.0165*	701	34.3	268	*1.0*	30.4	651
BS-BG4-G-01	6/23/2005	6.90	4530	*0.25*	2300	4280	382	*0.25*	26800	2.33	136	1.05	8.94	27.6	19.5	21400	*0.0165*	492	20.1	11.5	*1.0*	30.6	66.3
BS-BG5-G-01	6/23/2005	6.88	2990	*0.25*	3240	4760	152	*0.25*	22500	4.29	138	1.26	10.2	31.2	19.2	25200	*0.0165*	631	26.3	16.0	*1.0*	30.8	81.1
minimum =		6.78	2990	*0.25*	1070	3060	152	*0.25*	22400	2.33	60.3	0.83	6.63	20.8	13.2	17400	*0.0165*	386	17.5	11.5	*1.0*	19.5	66.3
MDC =		**7.53**	**29100**	***0.25***	**3240**	**12300**	**382**	**3.43**	**27500**	**6.93**	**249**	**4.05**	**14.7**	**41**	**23.1**	**28300**	***0.0165***	**1370**	**40.6**	**268**	***1.0***	**30.8**	**651**
average =		7.09	9168	*0.25*	2290	5754	270	1.29	24860	4.34	133	1.71	10.7	30.3	19.0	23200	*0.0165*	716	27.8	64.9	*1.0*	26.8	196
95% UCL =			71278	NC	3059	12819	365	7.20	27117	5.92	203	3.74	13.8	37.3	22.4	27106	NC	1083	37.0	570	NC	692	538
# of samples = 5; Standard Deviation =			10004	NC	722	3322	89	1.27	2117	1.48	66	1.18	2.9	6.5	3.2	3664	NC	345	8.6	102	NC	4.8	227
Frequency detected =			100%	0%	100%	100%	100%	20%	100%	100%	100%	100%	100%	100%	100%	100%	0%	100%	100%	100%	0%	100%	100%
Human Health Screening Criteria																							
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)			NS	NS	20	NS	2	NS	19	NS	NS	2	NS	NS	1000	NS	NS	NS					
EPA Region IX Industrial Soil PRGs (EPA 2004)			5100	100000	1.6	67000	450	1900	450	41000	100000	310	19000	20000	800	410	1000	100000					
Ecological Screening Criteria																							
WDOE MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals (WDOE 2001b)			2	50	7	102	4	20	42	50	NS	0.1	1100	30	50	5	2	86					
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2008)			4.2	NS	18	330	0.36	13	28	NS	NS	NS	220	38	11	0.27	7.8	46					

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit
Screening criteria exceeded
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
MTCA = Model Toxics Control Act
NC = Not calculated
NS = No standard
PRG = Preliminary remediation goal
UCL = Upper confidence limit
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

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

Sample ID	Date Collected	Analyte Concentration (µg/L)[a]																				
		CN	Ag	Al	As_3	As_5	As_T	Ba	Be	Cd	Co	Cr_6	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
Background:																								
SW-BG1-F-01	6/22/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	11.8	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
South Fork Mill Creek:																								
SW-MC1	6/20/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	12.6	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	4.6	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
SW-MC2	6/21/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	12.5	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	10.2	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
Site:																								
SW-AD1-01/02	6/23/2005	*5*	*2.5*	*15*	*1.5*	*1.5*	*1.5*	2.7	*1*	*1*	*3*	*5*	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	66
SW-PD1	6/22/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	3.1	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	38
SW-PD2-01	6/23/2005	*5*	*2.5*	*15*	*NA*	*NA*	*1.5*	13.4	*1*	*1*	*3*	*5*	*3*	*5*	*30*	*0.1*	13.3	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
SW-PD2-02	6/23/2005	*5*	*2.5*	*15*	*1.5*	*1.5*	*1.5*	13.2	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	15.7	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
Ephemeral Tributary:																								
SW-ET3	6/22/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	13.4	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
SW-ET2	6/22/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	12.4	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
SW-ET4	6/22/2005	*5*	*2.5*	*15*	NA	NA	*1.5*	15.3	*1*	*1*	*3*	NA	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
minimum (excluding BG) =		*5*	*2.5*	*15*	*1.5*	*1.5*	*1.5*	2.7	*1*	*1*	*3*	*5*	*3*	*5*	*30*	*0.1*	*2*	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
MDC (excluding BG) =		***5***	***2.5***	***15***	***1.5***	***1.5***	***1.5***	**15.3**	***1***	***1***	***3***	***5***	***3***	***5***	***30***	***0.1***	**15.7**	***5***	***1.5***	***10***	***1.5***	***1***	***2.5***	**66**
average (excluding BG) =		*5*	*2.5*	*15*	*1.5*	*1.5*	*1.5*	11.0	*1*	*1*	*3*	*5*	*3*	*5*	*30*	*0.1*	5.6	*5*	*1.5*	*10*	*1.5*	*1.0*	*2.5*	14.4
95% UCL =		NC	NC	NC	NC	NC	NC	17.7	NC	NC	NC	NC	NC	NC	NC	NC	14.1	NC	NC	NC	NC	NC	NC	8.8
# of samples = 10; Standard Deviation =		NC	NC	NC	NC	NC	NC	4.166	NC	NC	NC	NC	NC	NC	NC	NC	1.0	NC	NC	NC	NC	NC	NC	19.8
Frequency detected =		0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	40%	0%	0%	0%	0%	0%	0%	20%
Human Health Screening Criteria[b]																								
1 - Washington HH AQWC		NS	NS	NS	NS	NS	0.018	NS	NS	NS	NS	NS	NS	NS	NS	0.14	NS	610	NS	14	170	1.7	NS	NS
2 - Washington DWS		NS	100	NS	NS	NS	10	2000	4	5	NS	NS	100	1300	300	2	50	100	15	6	NS	2	NS	50000
3 - EPA AWQC		140	NS	NS	NS	NS	0.018	1000	NS	NS	NS	NS	NS	1300	300	NS	50	610	NS	5.6	170	0.24	NS	7400
Ecological Screening Criteria[b]																								
4 - Washington Eco AWQC		5.2	NS	NS	NS	NS	190	NS	NS	1.75	NS	10	NS	21.0	NS	0.012	NS	289	5.4	NS	5	NS	NS	192
5 - EPA FW AWQC		5.2	0.36	NS	NS	3.1	150d	4	0.66	0.40	23	0.11d	NS	16.5	1000	0.77d	120	95	5.4	30	5	12	20	217

Sample ID	Flow (gpm)	pH	Hardness (mg $CaCO_3$/L)	Eh (mV)	Analyte Concentration (mg/L)[a]				
					Sulfate	Ca	K	Mg	Na
SW-BG1-F-01	<1.0	7.7	185	214	9.75	68.2	1.63	3.65	4.89
SW-MC1	NM	8.3	116	205	4.50	41.1	1.65	3.36	3.36
SW-MC2	NM	8.2	116	200	4.57	41.1	1.65	3.34	3.34
SW-AD1-01/02	<1.0	8.7	218	218	30.5	81	1.55	3.75	3.51
SW-PD1	NM	7.6	217	224	29.8	80.6	1.5	3.77	3.45
SW-PD2-01	NM	7.6	225	230	23.4	80.2	1.54	6.05	3.42
SW-PD2-02	NM	7.6	226	217	23.7	80.6	1.56	6.03	3.38
SW-ET3	4.9	7.6	222	207	1.4	78.8	1.59	6.00	3.37
SW-ET2	14.8	7.6	201	235	1.4	73.0	1.94	4.46	4.46
SW-ET4	94.9	8.0	201	399	47.4	66.9	1.78	8.28	3.64
minimum (excluding BG) =	NC	7.6	116	200	1.4	41.1	1.5	3.34	3.34
MDC (excluding BG) =	**NC**	**8.7**	**226**	**399**	**47.4**	**81.1**	**1.94**	**8.28**	**4.89**
average (excluding BG) =	NC	7.9	193	235	17.6	69.2	1.64	4.87	3.7
Frequency detected =	NC	NC	NC	NC	100%	100%	100%	100%	100%

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit

Screening criteria exceeded

[a]Results are dissolved concentrations except for As, Hg, CN, and S.

[b]Screening criteria for hardness dependent metals are based on a apparent background hardness of 185 and were converted to total concentrations where applicable.

AWQC = Ambient water quality criteria
BG = Background
DWS = Drinking water standards
eH = Reduction potential
EPA = U.S. Environmental Protection Agency
FW = Freshwater
gpm = Gallon per minute
HH = Human health
MDC = Maximum detected concentration
NC = Not calculated
NM = No measurement
NS = No standard
UCL = Upper confidence limit
WSDH = Washington State Department of Health
µg/L = Microgram per liter
mg/L = Milligram per liter
mg $CaCO_3$/L = Milligram calcium carbonate per liter
mV = Millivolt

1-State of Washington ambient water quality criteria for protection of human health (WDOE 2003)
2-State of Washington drinking water standards, WAC 246-290-310 (WSDH 2006)
3-EPA recommended chronic ambient water quality criteria for human consumption of water and fish (EPA 2006)
4-State of Washington ambient water quality criteria for protection of aquatic life, chronic criterion (WDOE 2003)
5-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
Longshot Mine EE/CA

Sample ID	Date Collected	TOC (%)	TOT C (%)	pH	Analyte Concentration (mg/kg) Ca	K	Mg	Na	CN	Ag	Al	As_T	Ba	Cd	Co	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	V	Zn
Background:																									
SD-BG1-C-01	6/22/2005	3.83	4.16	6.96	5780	1260	2810	395	*0.25*	*0.25*	9010	0.84	30.2	0.34	3.47	13.6	10	8950	*0.01665*	237	9.5	5.01	*1.0*	12.9	18.1
South Fork Mill Creek:																									
SD-MC1-C-01	6/20/2005	NM	NM	6.69	3020	851	1910	158	*0.25*	*0.25*	6930	0.61	38.8	0.29	2.87	8	5.6	7630	*0.0165*	89.2	5.0	3.32	*1.0*	11.8	20.3
SD-MC2-C-01	6/21/2005	NM	NM	6.67	2870	867	1920	146	*0.25*	*0.25*	7960	1.29	51.1	0.30	3.04	9.56	7.3	7680	*0.0165*	93.6	6.6	5.21	*1.0*	12.2	25.0
Site:																									
SD-AD1-C-01	6/22/2005	1.63	5.47	7.03	34700	1450	2220	166	*0.25*	*0.25*	9290	1.98	22.9	7.41	4.09	16.0	17.6	8360	*0.01665*	67.7	11.0	37.5	*1.0*	15.8	442
SD-PD1-C-01	6/22/2005	3.02	5.32	7.05	17900	1500	2290	126	*0.25*	*0.25*	9140	1.54	24.9	2.87	4.53	15	14.9	8360	*0.01665*	55.2	10.6	32.6	*1.0*	16.3	251
SD-PD2-C-01	6/22/2005	5.68	6.79	6.82	9680	1090	2850	166	*0.25*	0.95	7500	2.71	30.4	1.71	5.22	12.2	26.2	10500	*0.0165*	263	10.4	90.4	*1.0*	20.8	243
SD-PD2-C-02	6/22/2005	3.04	3.29	7.05	3710	907	1760	149	*0.25*	*0.25*	8280	1.39	32.9	0.51	4.06	9.74	22.8	7320	*0.01665*	55	7.7	12.4	*1.0*	14.8	59
Ephemeral Tributary:																									
SD-ET2-C-01	6/22/2005	6.94	7.24	7.33	3320	932	2190	158	*0.25*	*0.25*	6460	0.82	25.5	0.38	2.85	12	12.8	8930	*0.01665*	143	9.4	4.39	*1.0*	12.7	20.1
SD-ET4-C-01	6/22/2005	2.69	3.26	7.23	3560	1610	2560	207	*0.25*	*0.25*	8690	2.27	58.1	0.49	4.84	12.1	10.7	10900	*0.01665*	218	10.9	8.4	*1.0*	13.4	39.3
minimum (excluding BG) =		1.63	3.26	6.67	2870	851	1760	126	*0.25*	*0.25*	6460	0.61	22.9	0.29	2.85	7.94	5.6	7320	*0.0165*	55	5.0	3.32	*1.0*	11.8	18.1
MDC (excluding BG) =		**6.94**	**7.24**	**7.33**	**34700**	**1610**	**2850**	**395**	***0.25***	**0.95**	**9290**	**2.71**	**58.1**	**7.41**	**5.22**	**16.0**	**26.2**	**10900**	***0.01665***	**263**	**11.0**	**90.4**	***1.0***	**20.8**	**442**
average (excluding BG) =		3.83	5.08	6.98	9393	1163	2279	186	*0.25*	0.33	8140	1.49	35.0	1.59	3.89	11.9	14.2	8737	*0.0166*	136	9.0	22.1	*1.0*	14.5	124
95% UCL =		NC	NC	NC	27296	1363	2455	175	NC	NC	8714	2.05	44.2	4.50	4.56	13.5	19.6	9603	NC	176	10.5	59.0	NC	16.7	345
# of samples = 9; Standard Deviation =		NC	NC	NC	10068	282	370	77	NC	NC	950	0.67	11.5	2.22	0.83	2.5	6.5	1179	NC	78	2.0	27.0	NC	2.7	144
Frequency detected =		100%	100%	100%	100%	100%	100%	100%	0%	11%	100%	100%	100%	100%	100%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%
Human Health Screening Criteria																									
WDOE MTCA Method A Industrial Soil Cleanup Levels – Human Receptors (WDOE 2001a)					NS	NS	NS	20	NS	2	NS	19	NS	NS	2	NS	NS	1000	NS	NS	NS				
EPA Region IX Industrial Soil PRGs (EPA 2004)					NS	5100	100000	1.6	67000	450	1900	450	41000	100000	310	19000	20000	800	410	1000	100000				
Ecological Screening Criteria																									
State of Washington Development of Freshwater Sediment Quality Values (WDOE 2004) - recommended only					NS	2.0	NS	20.0	NS	0.6	NS	95.0	80.0	NS	0.5	NS	60.0	335	0.4	NS	140				
State of Washington Development of Freshwater Sediment Quality Values (WDOE 2004) - in development					NS	3.9	NS	5.9	NS	0.6	NS	26.0	16.0	NS	0.17	NS	16.0	31	35.0	NS	110				
EPA Threshold Effects Level (NOAA 1999)					NS	NS	NS	5.9	NS	0.596	NS	37.3	35.7	NS	0.174	NS	18	35	NS	NS	123				
EPA Freshwater Probable Effects Level (NOAA 1999)					NS	NS	NS	17	NS	3.53	NS	90	197	NS	0.486	NS	35.9	91.3	NS	NS	315				

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit
Screening criteria exceeded
BG = Background
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
MTCA = Model Toxics Control Act
NA = Not analyzed for
NC = Not calculated
NM = Not measured
NOAA = National Oceanic and Atmospheric Administration
NS = No standard
PRG = Preliminary remediation goal
UCL = Upper confidence limit
WDOE = Washington Department of Ecology
mg/kg = Milligram per kilogram

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

Sample ID	Date Collected	Analyte Concentration (µg/L)[a] CN	Ag	Al	As_T	Ba	Be	Cd	Co	Cr_T	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	V	Zn
PW-MC1-01	6/20/2005	*5*	*2.5*	*15*	*2*	27	*1*	*1*	*3*	*3*	*5*	75	*0.1*	123	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
PW-MC2-01	6/21/2005	*5*	*2.5*	*15*	*2*	13	*1*	*1*	*3*	*3*	*5*	*30*	*0.1*	7	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
minimum (excluding BG) =		*5*	*2.5*	*15*	*2*	13	*1*	*1*	*3*	*3*	*5*	*30*	*0.1*	7	*5*	*1.5*	*10*	*1.5*	*1*	*2.5*	*5*
MDC (excluding BG) =		***5***	***2.5***	***15***	***2***	**27**	***1***	***1***	***3***	***3***	***5***	**75**	***0.1***	**123**	***5***	***1.5***	***10***	***1.5***	***1***	***2.5***	***5***
average (excluding BG) =		*5*	*2.5*	*15*	*2*	20	*1*	*1*	*3*	*3*	*5*	52.5	*0.1*	65	*5*	*1.5*	*10*	*1.5*	*1.0*	*2.5*	*5*
95% UCL[c] =		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
# of samples = 2; Standard Deviation =		NC	NC	NC	NC	7	NC	NC	NC	NC	NC	22.5	NC	58	NC	NC	NC	NC	NC	NC	NC
Frequency detected =		0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	50%	0%	100%	0%	0%	0%	0%	0%	0%	0%
Ecological Screening Criteria																					
1- Washington Eco AWQC		5.2	NS	NS	190	NS	NS	1.8	NS	NS	21	NS	0.012	NS	289	5	NS	5	NS	NS	190
2- EPA Eco AWQC		5.2	0.36	NS	150d	4	0.66	0.4	23	NS	17	1000	0.7d	120.000	96	5	30	5	12	20	220

Sample ID	Ph	Hardness (mg $CaCO_3$/L)	Eh (mV)	Analyte Concentration (mg/L)[a] Sulfate	Ca	K	Mg	Na
PW-MC1-01	8.5	108	212	0.65	37.2	2.23	3.61	3.54
PW-MC2-01	8.3	120	198	4.74	42.1	1.67	3.51	3.33
minimum (excluding BG) =	8.3	108	198	0.65	37.2	1.67	3.51	3.33
MDC (excluding BG) =	**8.5**	**120**	**212**	**4.74**	**42.1**	**2.23**	**3.61**	**3.54**
average (excluding BG) =	8.4	114	205	2.70	39.7	1.95	3.56	3.44
95% UCL[c] =	**NC**	**NC**	NC	NC	NC	NC	NC	NC
Frequency Detected =	NC	NC	NC	100%	100%	100%	100%	100%

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).
µg/L = Microgram per liter
mg/L = Milligram per liter
mg $CaCO_3$/L = Milligram calcium carbonate per liter
mV = Millivolt

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit
Screening criteria exceeded
[a]Dissolved concentrations
[b]Screening criteria for hardness dependent metals are based on a average hardness of 205.
[c]95 Percent upper confidence levels not computed because fewer than four samples.
BG = Background
Eh = Reduction potential
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
NA = Not analyzed for
NC = Not calculated
NOAA = National Oceanic and Atmospheric Administration
NS = No standard
UCL = Upper confidence limit
WDOE = Washington Department of Ecology

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

Area	Description	Estimated Volume (bcy)	Maximum Detected Concentration (mg/kg)		
			Arsenic	Lead	Zinc
BG	Background soil	NA	6.93	268	651
OB	Unprocessed ore in ore bin	50	26.4	30000	23100
Mill	Unprocessed ore beneath the wood and metal debris around the mill[a]	100	NM	NM	NM
WR1	Waste rock pile 1	852	15.4	1760	2610
WR2	Waste rock pile 2	248	3.5	17	167
WR3	Waste rock pile 3	63	27.1	23200	39100
WR4	Waste rock pile 4	382	6.1	299	677
WR5	Waste rock pile 5	187	20.9	1430	1980
WR6	Waste rock pile 6	456	41	1120	1640
TA1	Tailings impoundment 1	160	13.8	3810	1470
TA2	Tailings impoundment 2	535	13.3	1120	2080
TA3	Tailings impoundment 3	247	11.4	513	1390
ET3	Tailings below the large pond	213	5.60	4000	650
Total estimated waste volume =		**3,493**	**bcy**		

Notes:
[a]Assumed and unconfirmed.
Data in this table represent analytical results of samples collected during the Site Inspection (MSE 2005).
NA = Not applicable
NM = Not measured
bcy = Bank cubic yard
mg/kg = Milligram per kilogram

Table 8. Surface Water Quality ARARs (total recoverable µg/L)

Longshot Mine EE/CA

Analyte	Apparent Background Concentration[a]	Maximum Detected Concentration	State of Washington		Federal			
			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]
Barium	11.8	15.3	NS	2000	1000	NS	NS	NS
Manganese	*2*	15.7	NS	50	50	NS	NS	NS
Zinc	*5*	66	NS	50000	7400	192	NS	192

Notes:

Italics - Result below method detection limit, reported at 1/2 reporting limit

µg/L = Microgram per liter

[a]Based on a single background sample.

[b]Hardness dependent criteria adjusted based on an apparent background hardness of 185; 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.

ARAR = Applicable or relevant and appropriate requirement

CFR = Code of Federal Regulations

NS = No screening criteria

WAC = Washington Administrative Code

Table 9. Soil Quality ARARs (mg/kg)
Longshot Mine EE/CA

Analyte	Average Background Concentration[a]	Maximum Detected Concentration	State of Washington			Federal
			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	24860	32700	NS	NS	50p	100000
Antimony	*1.0*	88.5	NS	NS	5p	410
Arsenic	4.34	41	20	20	10p (As^5)	1.6
Cadmium	1.71	191	2	2	4p	450
Chromium	30.3	49.1	19	19	42p,s	450
Cobalt	10.71	29.3	NS	NS	20p	1900
Copper	19.0	158	NS	NS	50s	41000
Lead	64.9	30000	1000	250	50p	800
Manganese	716	2170	NS	NS	1100p	19000
Mercury	*0.0165*	0.994	2	2	0.1s	310
Nickel	27.8	44.7	NS	NS	30p	20000
Silver	1.29	176	NS	NS	2p	5100
Vanadium	26.8	135	NS	NS	2p	1000
Zinc	196	39100	NS	NS	86p	100000

Notes:
Italics - Result below method detection limit, reported at 1/2 reporting limit
mg/kg = Milligram per kilogram
[a]Based on five background soil samples.
[b]Lowest value selected from plant(p), soil biota(s), and wildlife(w) receptors
ARAR = Applicable or relevant and appropriate requirement
EPA = U.S. Environmental Protection Agency
MTCA = Model Toxics Control Act
NS = No screening criteria
PRG = Preliminary Remediation Goal
WAC = Washington Administrative Code

Table 10. Sediment Quality ARARs (mg/kg)
Longshot Mine EE/CA

Analyte	Apparent Background Concentration[a]	Maximum Detected Concentration	State of Washington		Federal	
			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	0.84	2.71	20	57	5.9	17
Cadmium	0.34	7.41	0.6	5.1	0.596	3.53
Copper	10.0	26.2	80	390	35.7	197
Lead	5.01	90.4	335	450	35	91.3
Zinc	18.1	442	140	410	123	315

Notes:
mg/kg = Milligram per kilogram
[a]Based on a single background sample.
[b]For reference only - not applicable.
ARAR = Applicable or relevant and appropriate requirement
EPA = U.S. Environmental Protection Agency
NOAA = National Oceanic and Atmospheric Administration
PRG = Preliminary Remediation Goal
WAC = Washington Administrative Code
WDOE = Washington Department of Ecology

Table 11. Hotspot Summary
Longshot Mine EE/CA

Area	Maximum Detected Lead Concentration (mg/kg)	Average Detected Lead Concentration (mg/kg)	Estimated Volume (bcy)
Ore Bin	30000	23000	50
Waste rock pile WR3	23200	23200	63

Notes:

bcy = Bank cubic yard

mg/kg = Milligram per kilogram

Table 12. Removal Action Technology Screening Matrix
Longshot 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 stope	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 stope	Medium	Low	High	Medium–subject to vandalism	Visual contrast	Simple, more effective than barbed-wire	Unsightly, subject to vandalism	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	Subject to vandalism, easy to ignore	**Yes**
	Road closure	Add locked gate on Spur Road 150	Medium	High	Low	Medium–subject to vandalism	None	Cheap, easy	Prevents access to other areas, Site hazards still accessible by foot	No
Physical Hazards										
Access restriction	**Bat gate**	Install bat gates in open adits	High	High	Low	Medium—subject to vandalism	None	Reduces ecoreceptor exposure & physical hazard; maintains bat habitat	Potential vandalism	**Yes**
	Cable net	Install cable net over open stope	High	High	Low	Medium—subject to vandalism	None	Reduces physical hazard	Potential vandalism, less bat compatible than a cupola	**Yes**
	Backfill stope	Backfill stope	High	Medium	High	Low–subject to further subsidence	Moderate-requires tree felling and construction of access road	Eliminates physical hazard; may be able to use waste rock for fill material	Potential for future collapse; removes potential bat habitat; insufficient material to completely fill stope	**Yes**
	Plug open adits and stope	Install polyurethane foam 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 stope	Install concrete cap over open stope	High	Medium	Medium	Low–inspect for sloughing around cap	Minimal	Eliminates physical hazard; not as prone to collapse or vandalism	Not natural looking; eliminates potential bat habitat	No
	Remove or bury debris	Remove scattered debris or bury on site	High	High	Low	None	Minimal	Cheap and easy, landfill within 15 miles	Requires waste characterization	**Yes**

Table 12. Removal Action Technology Screening Matrix
Longshot 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	**Yes**
Solids containment	**Soil cover**	Soil cover designed to eliminate surface exposure	Low	Low	Low	Low–inspect for erosion	<0.3 ac repository and topsoil stockpile	Simple design/installation	Requires soil borrow source	**Yes**
	Engineered 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)	No
	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 mine waste/unprocessed ore and place in on–site repository	High	High	Medium	Medium—inspect cap and analyze leachate; inspect reclaimed areas	<0.3 ac (reclaimed)	Eliminates or reduces direct exposure	Waste remains on Site; potential for re-exposure	**Yes**
Off-site disposal	**RCRA landfill**	Excavate mine waste/unprocessed ore and dispose in RCRA–C 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
Longshot 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 mine waste 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	Expensive	No
Vitrification	Vitrification	Heat mine waste >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 mine waste 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

Notes:
ac = Acre
ft = Foot
yr = Year
GCL = Geosynthetic clay liner
HDPE = High density polyethylene
O&M = Operation and maintenance

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

TASK	Description	Alternative 2 Cost	Alternative 3 Cost		Alternative 4 Cost
			Option 1 Stope	Option 2 Repository	
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/Cable Net Installation	$14,500	$14,500	$14,500	$14,500
	Mill Structure Demolition and Debris Removal	$10,393	$10,393	$10,393	$10,393
	subtotal =	**$24,893**	**$24,893**	**$24,893**	**$24,893**
Mine Waste Removal	Access Road Construction	$0	$6,231	$0	$0
	Mine Waste Excavation	$6,934	$7,106	$7,258	$0
	Transportation and Disposal	$79,446			
	Cap Construction[(a)]	$0	$0	$3,153	$10,047
	Mine Waste Area Reclamation	$4,920	$5,783	$4,542	$0
	Access Road Reclamation	$2,000	$5,082	$2,000	$2,000
	subtotal =	**$93,301**	**$24,202**	**$16,954**	**$12,047**
Miscellaneous	Staging Area Preparation	$500	$500	$500	$500
	Mobilization	$20,000	$20,000	$20,000	$15,000
	Temporary Erosion Control BMPs	$1,000	$2,000	$2,000	$1,000
	Install Diversion Channel	$0	$1,149	$1,149	$0
	Install Temporary Fence Around Repository	$0	$0	$589	$0
	subtotal =	**$21,500**	**$23,649**	**$24,238**	**$16,500**
	Removal Action Subtotal =	**$144,694**	**$77,743**	**$71,085**	**$58,440**
Design and Oversight	Design	$15,106	$21,151	$21,151	$15,863
	Removal Action Oversight	$22,736	$25,108	$27,480	$25,108
	subtotal =	**$37,842**	**$46,259**	**$48,631**	**$40,971**
Post-removal Monitoring	Post-removal Monitoring for 3 years	$19,598	$19,598	$19,598	$19,598
	subtotal =	**$19,598**	**$19,598**	**$19,598**	**$19,598**
	SUBTOTAL =	**$202,134**	**$143,600**	**$139,314**	**$119,009**
Contingency	20% Contingency	$40,427	$28,720	$27,863	$23,802
	TOTAL COST WITH EARTHEN COVER=	**$ 242,560**	**$ 172,320**	**$ 167,177**	**$ 142,811**
	TOTAL COST WITH ENGINEERED COVER=	**NA**	**NA**	**$ 180,346**	**NA**

Notes:
[(a)]Cost based on cover option 2 (earthen cover).

Table 14. Data Gap Summary
Longshot Mine EE/CA

Data Gap	Potential Issues	Recommended Action	Estimated Cost
Lack of TCLP analysis on mine waste samples: • Mine waste samples collected during the SI were not analyzed for TCLP metals.	• Mine waste hazardous waste characterization and disposal options depend on TCLP metals leachate concentrations.	A minimum of one mine waste sample should be collected from each of the two hotspots (ore bin and waste rock pile WR3) and submitted to a laboratory for analysis of TCLP metals.	$2,000
Lack of sufficient background samples: • Minimal background data for surface water, sediment, and pore water quality.	• Background surface water and sediment data limited to a single site in an adjacent drainage. • Background pore water data from a single site on SFMC. • Prevents establishing statistically representative background concentrations for the site. • 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. However, there is no available background surface water source near the Site and there does not appear to be any surface water impairment. Therefore, no action recommended.	$0
Wood and metal debris not characterized: • No samples of the wood and metal debris have been collected.	• Debris may contain elevated leachable concentrations of metals. • May be considered a hazardous waste.	Samples from the wood and metal debris should be collected and analyzed to determine whether the material can be disposed of in a sanitary landfill.	$2,000
Potential presence of unprocessed ore under the wood and metal debris around the mill: • The soil under the wood and metal debris around the mill has not been characterized.	• Unprocessed ore that may be present under the wood and metal debris may contain high concentrations of metals. • Removal of the wood and metal debris will expose the underlying material.	During removal of the wood and metal debris from around the ore bin and mill, an XRF should be used to screen the underlying soil for metals concentrations. If metals concentrations in the soil/unprocessed ore exceed the cleanup levels, the material should be removed and disposed of.	$0[b]
Potential repository locations and soil borrow sources not well identified: • Potential locations for repository and soil borrow sources were not identified during the SI.	• Difficult to prepare an engineered design for removal actions involving a repository. • Difficult to estimate costs for borrow soil.	The Site should be inspected to identify and characterize potential repository locations and borrow soil sources.	$2,000
		Total Estimated Cost =	**$6,000[a]**

Notes:
[a]Estimated costs are based on a site visit for each data gap. Significant cost savings could be recognized by addressing all data gaps in a single site visit.
[b]To be addressed during the removal action and will not require a separate site visit or significant resources.
ARAR = Applicable or relevant and appropriate requirement
SI = Site Inspection
TCLP = Toxicity Characteristic Leaching Procedure

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

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Containment	Alternative 4 In-place Capping
Compliance with Removal Action Goals and Objectives				
Attributes:	Does not comply	Waste material removed from Site and physical hazards mitigated.	Waste material contained on Site and physical hazards mitigated.	Waste material covered in place and physical hazards mitigated.
Advantages:	None	+Eliminates potential exposure at Site	+Reduces exposure potential at Site	+Reduce exposure potential at Site
Overall Protectiveness of Public Health, Safety and Welfare				
Attributes:	No protection	Mine waste hotspots removed from Site.	Mine waste hotspots contained on Site.	Mine waste hotspots covered in place.
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	+Moderate level of human protection +Eliminates risk to community from long-distance transport of waste
Environmental Protectiveness				
Attributes:	No protection	Mine waste hotspots removed from Site.	Mine waste hotspots contained on Site.	Mine waste hotspots covered in place.
Advantages:	None	+Higher level of ecological protection +Eliminates potential for future releases at the Site	+High level of ecological protection	+Moderate 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	Moderate compliance with Soil Quality ARARs Moderate compliance with Solids Disposal ARARs High compliance with FP S&G ARARs
Advantages:	None	+Eliminates potential for future non-compliances from waste material	+Containment option 1 (stope) would be more compliant with Soil Quality ARARs and would better comply with FP S&Gs +Cover option 1 (engineered cover) meets substantive Solids Disposal ARARs +Cover option 2 (earthen cover) may meet Solids Disposal ARARs	+May be more minimally compliant with Soil Quality ARARs and FP S&Gs +May meet Solids Disposal ARARs
Long-term Effectiveness and Permanence				
Attributes:	No action	Waste source removed from Site. Bat gates/cable net may be subject to vandalism.	Waste source contained on Site. Effectiveness dependent on containment and cover options selected. Bat gates/cable net may be subject to vandalism.	Waste source covered on Site. Bat gates/cable net may be subject to vandalism.
Advantages:	None	+Most effective and permanent long term	+Effective and provides long-term permanence '+Contianment option 1 (stope) would be more secure	+Moderately Effective and provides long-term permanence

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

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Containment	Alternative 4 In-place Capping
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 contained.	No reduction in toxicity or mobility, but waste is covered.
Advantages:	None	+Complete reduction of waste hotspot volume +Most likely for reduction of mobility	+Reduction in mobility dependent on cover option selected; option 1(engineered cover) will be more effective at minimizing mobility.	+Reduces contaminant migration from erosion
Short-Term Effectiveness				
Attributes:	No action	Waste removed from the Site within one field season.	Waste contained on Site within one field season. Short-term effectiveness will depend on containment option selected.	Waste covered on Site within one field season.
Advantages:	None	+Most easily constructed +Minimal risk to community and workers	+Easily constructed +Containment option 1 (stope) more effective in short-term +Minimal risk to community and workers +Does not require off-site transport of waste	+Easily constructed +Does not require transporting the waste and disturbing another area of the Site +Quickly effective
Implementability				
Attributes:	Not applicable	Waste removal, transport, and Site reclamation accomplished using standard construction equipment and methods.	Waste containment using standard construction equipment and methods.	Waste covered using standard construction equipment and methods.
Advantages:	None	+Easiest to implement; technically and administratively feasible.	+Easily implemented; technically and administratively feasible.	+Implementable; technically and administratively feasible
State and Federal Agency, and Community Acceptance				
Attributes:	Not acceptable	Waste removed from Site and physical hazards mitigated.	Waste contained on Site and physical hazards mitigated.	Waste covered on Site and physical hazards mitigated.
Advantages:	None	+Most acceptable	+Acceptable	+Least acceptable

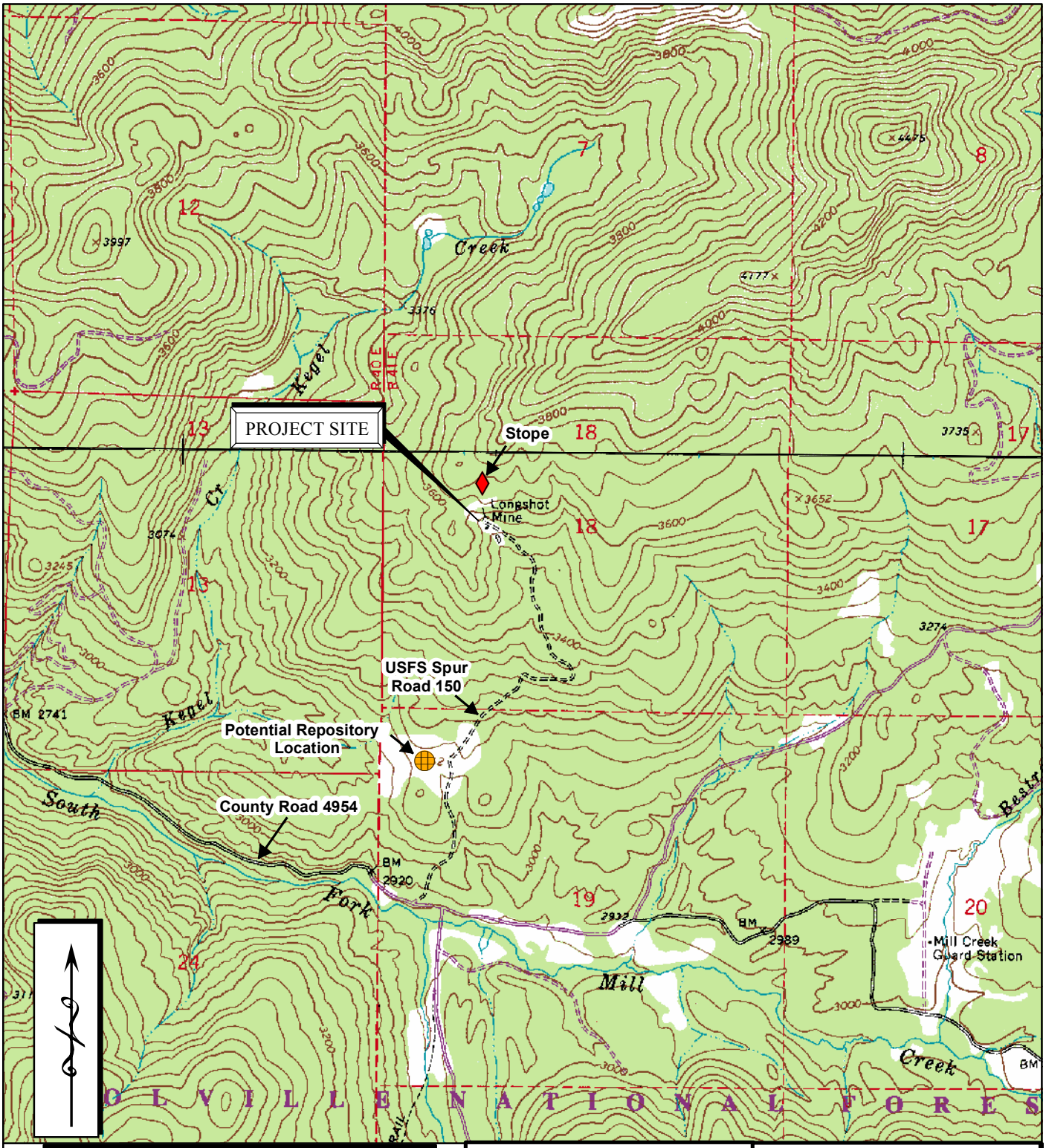
Table 15. Comparative Analysis of Removal Action Alternatives
Longshot Mine EE/CA

Assessment Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-site Disposal	Alternative 3 Excavation and On-site Containment	Alternative 4 In-place Capping
Estimated Total Present Worth Cost				
Attributes:	$0	$242,204	Containment Option 1 - Stope[a] = $171,964 Containment Option 2 - Repository[a] = $166,820	$142,455
Advantages (= cost savings over most expensive option):	+$242,204	+$0	Containment Option 1 - Stope[a] = +$70,240 Containment Option 2 - Repository[a] = +$75,384	+$99,749

Notes:

[a]Costs based on earthen cover option; an engineered cover would increase the cost approximately $13,000.
ARAR = Applicable or Relevant and Appropriate Requirement
FP S&Gs = Forest Plan Standard and Guidelines

Figures



Legend

REFERENCE: U.S.G.S. 7.5 MINUTE QUADRANGLE, PARK RAPIDS, WASHINGTON 1967 (PHOTOREVISED 1986)

SCALE

0 0.125 0.25 0.5 0.75 1
Miles

0 500 1,000 2,000 3,000 4,000
Feet

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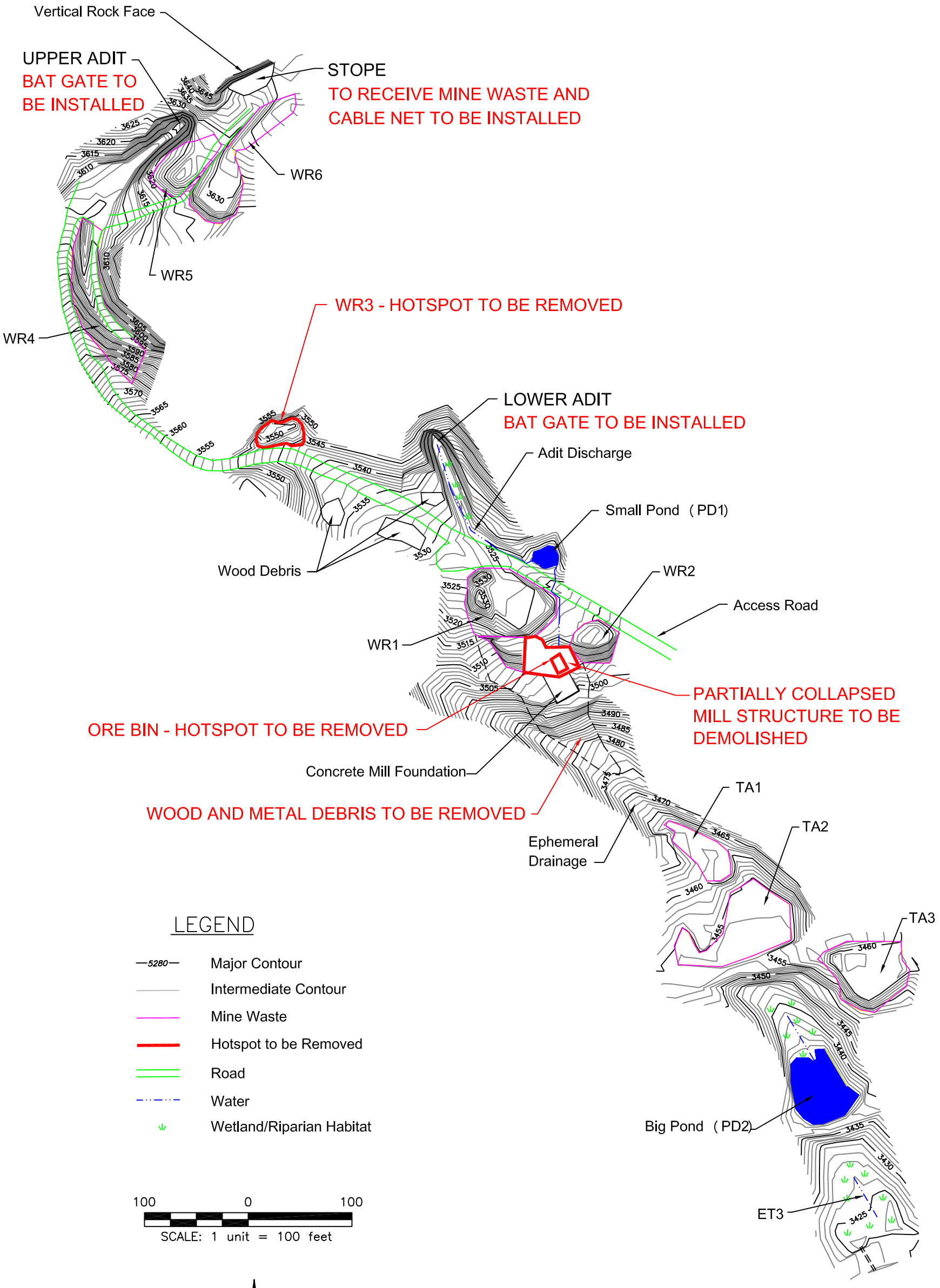
VICINITY MAP

LONGSHOT MINE
COLVILLE NATIONAL FOREST
WASHINGTON

B2473G	11-12-08	MSE	FIGURE 1

:MSE\2473\2473B_F2_07_08 07.28.08



Base Map Source: RFK Land Surveying, 2004

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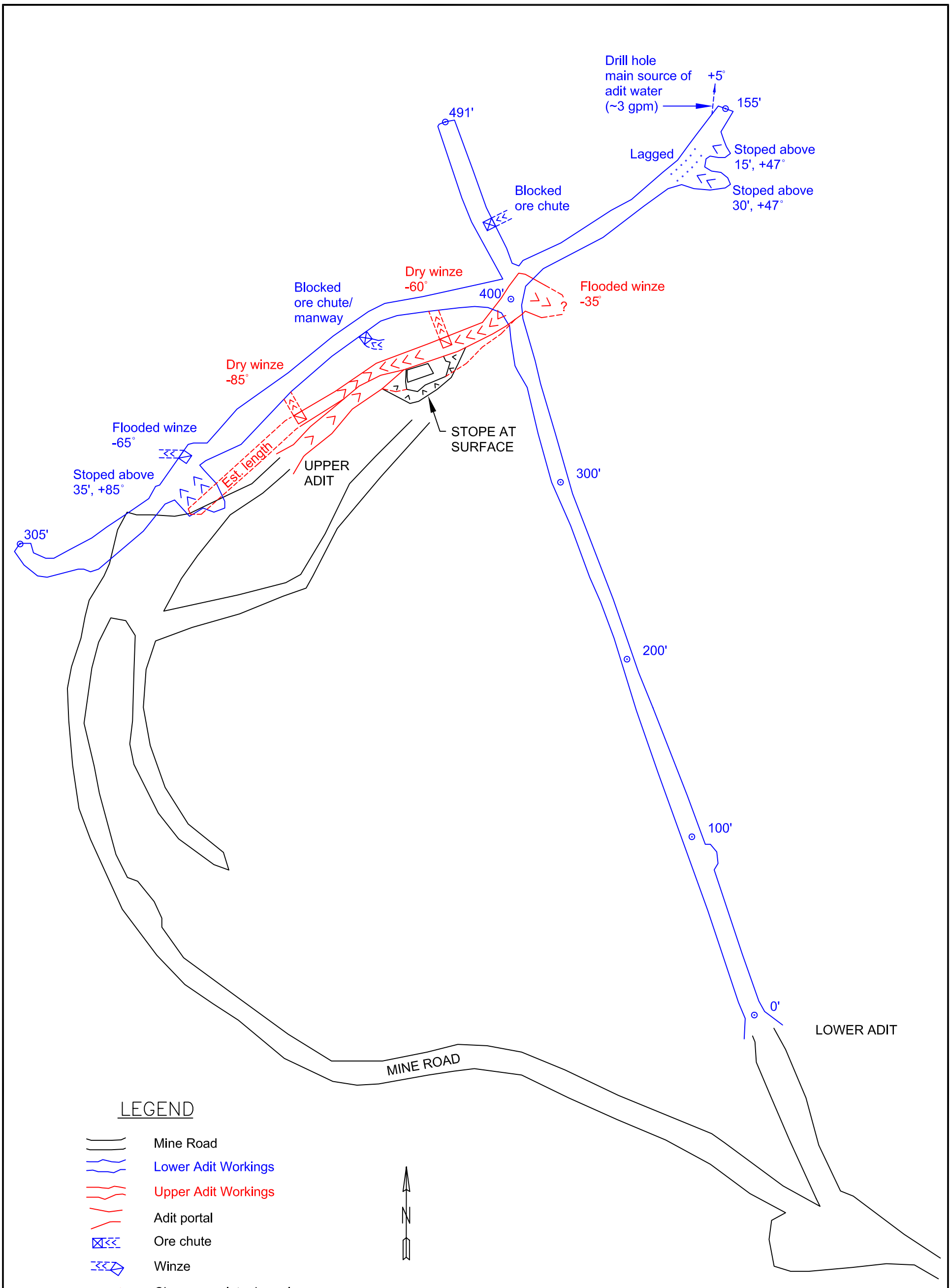
Longshot Mine and Mill Primary Site Features

B2473G	Figure2.dwg	11-12-08	Figure 2



Brunton and tape survey by USDA Forest Service, R.T. Lentz and G. Graham, 2008

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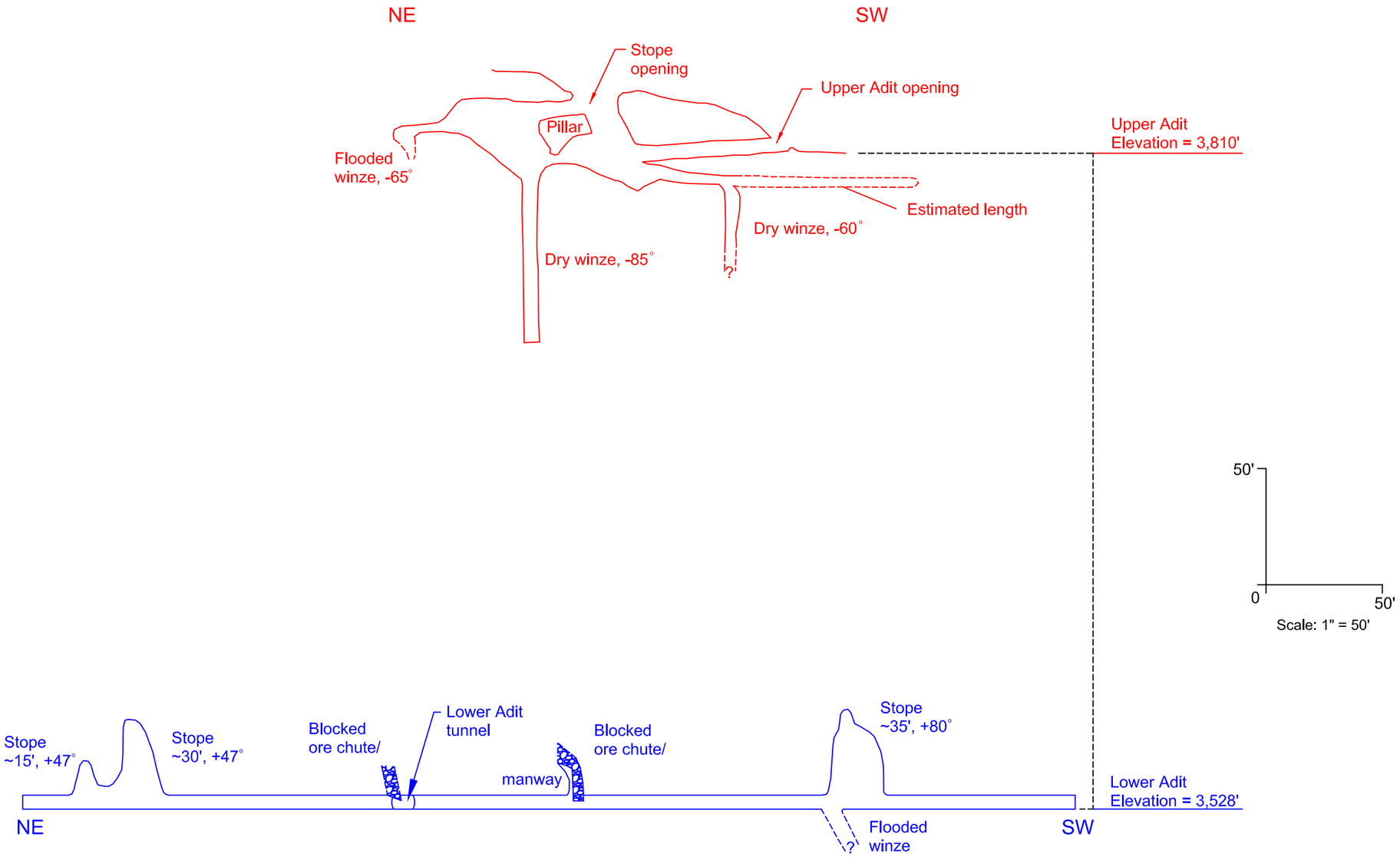
Longshot Mine
Map of
Underground Workings

B2473G	Figure 3.dwg	11/12/08	Figure 3



CROSS-SECTION ALONG STRIKE OF ORE ZONE - UPPER AND LOWER WORKINGS

Scale: 1" = 50'

Brunton and tape survey by USDA Forest Service, R.T. Lentz and G. Graham, 2008

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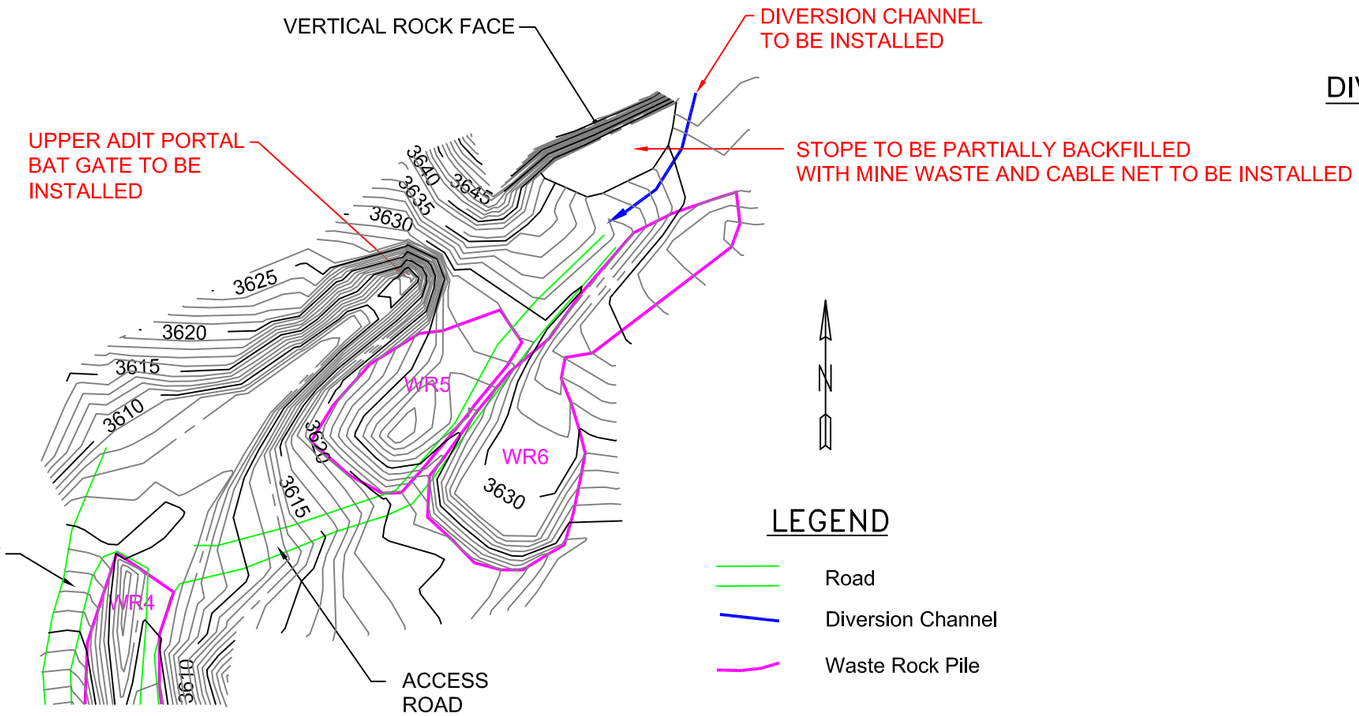
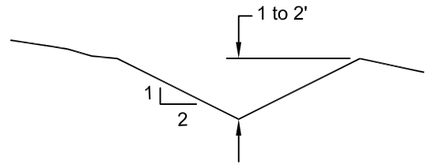
Longshot Mine Underground Workings Cross Section

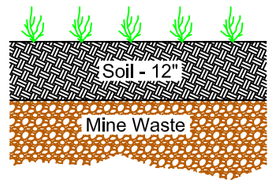
B2473G	Figure 4.dwg	11-12-08	Figure 4



STOPE PLAN VIEW
Scale: 1" = 50'



DIVERSION CHANNEL CROSS SECTION
Not to Scale



EARTHEN COVER
Not to Scale

Base Map Source: RFK Land Surveying, 2004

CONCEPTUAL DESIGN DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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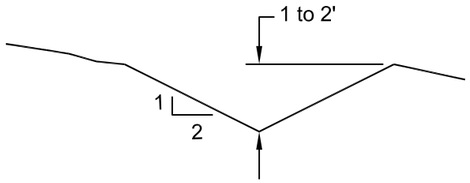
Longshot Mine Containment Option 1

B2473G	figure5.dwg	11-12-08	Figure 5



DIVERSION CHANNEL CROSS SECTION
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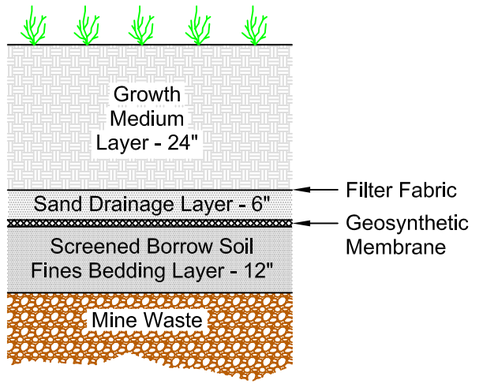
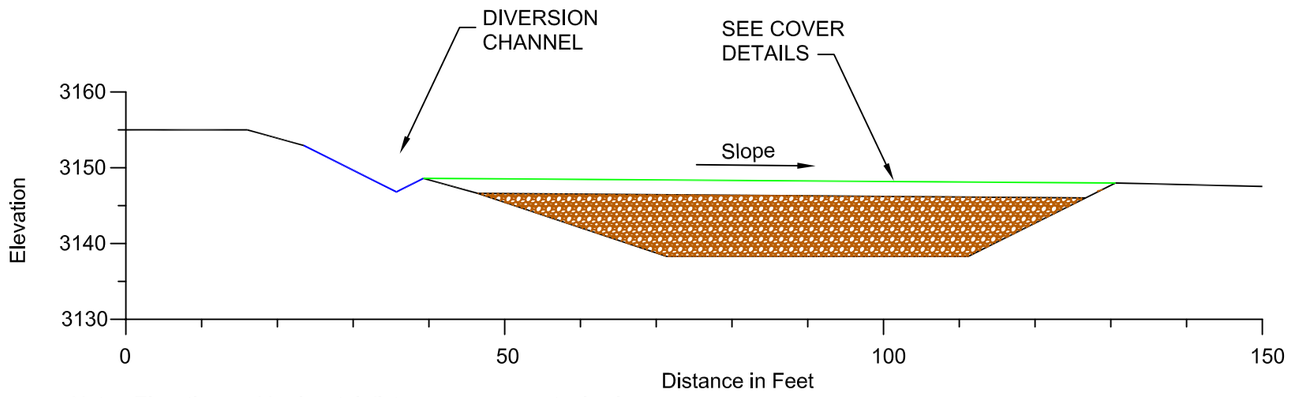
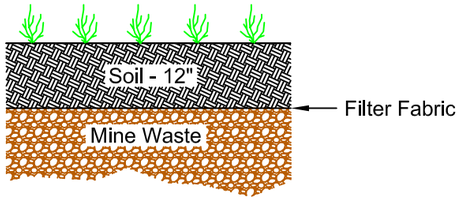


COVER OPTION 1 - ENGINEERED COVER
Not to Scale



Note: Elevation and horizontal distance are conceptual only.

CONCEPTUAL REPOSITORY CROSS SECTION
Not to Scale



COVER OPTION 2 - EARTHEN COVER
Not to Scale

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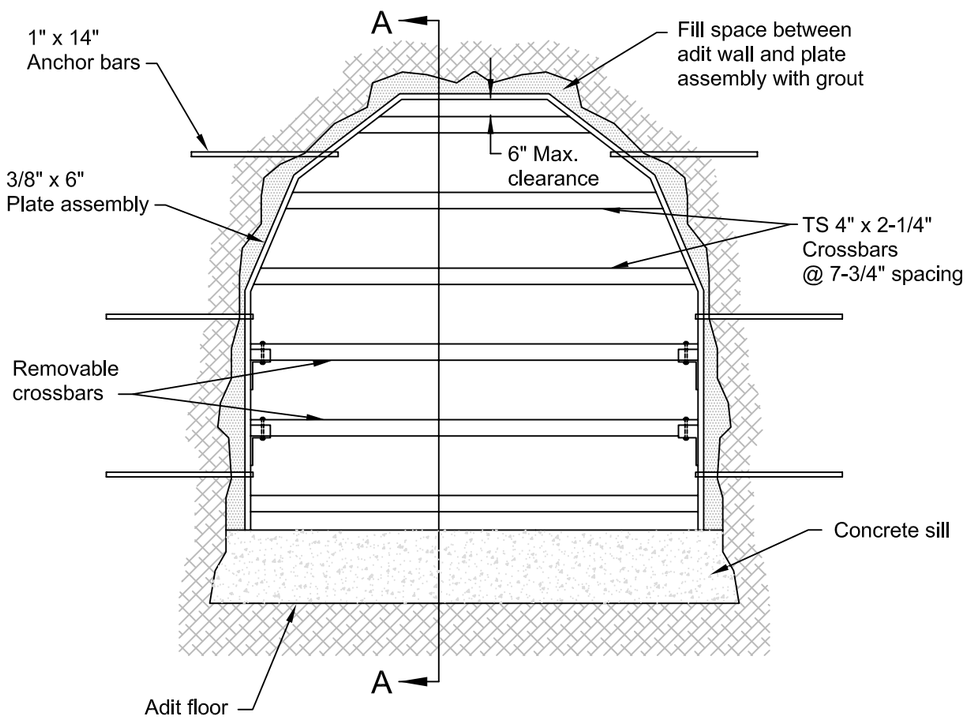
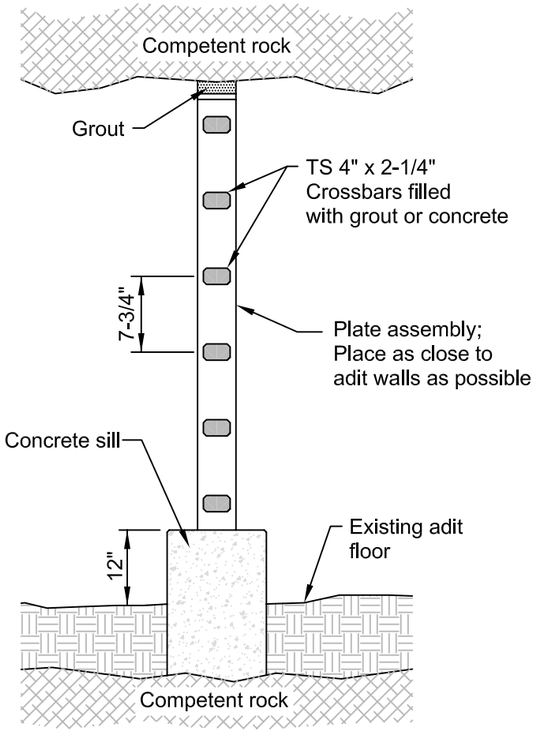
Longshot Mine Containment Option 2

B2473G	figure6.dwg	11-12-08	Figure 6



BAT GATE ELEVATION

Not to scale



SECTION A-A

Not to scale

CONCEPTUAL DESIGN DRAWINGS ONLY - NOT INTENDED FOR CONSTRUCTION

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Longshot Mine
Bat Gate Details

B2473G	figure7.dwg	11-12-08	Figure 7

APPENDIX A

SITE PHOTOGRAPHS

Photo 1. Lower adit

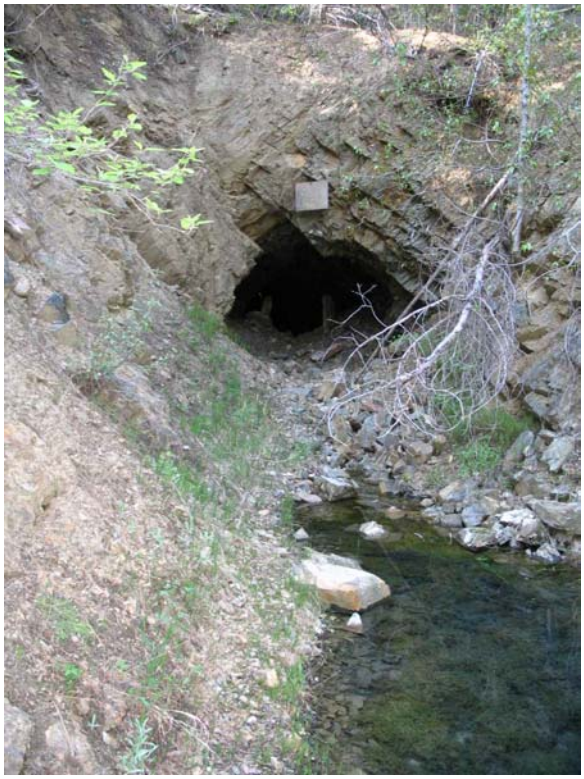

Photo 2. Discharge from lower adit

Photo 3. Partially collapsed mill structure

Photo 4. Mill foundation and ore bin in background

Photo 5. Mine waste hotspot - unprocessed ore in and around ore bin

Photo 6. Mine waste hotspot - waste rock pile WR3

Photo 7. Upper adit

Photo 8. Stope and vertical rock face

Photo 9. Tailings impoundment TA1

Photo 10. Tailings impoundment TA2

Photo 11. Tailings impoundment TA3

Photo 12. Large pond (PD2) below TA3

Photo 13. Surface water sample location (ET3) in the ephemeral tributary

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
Colville National Forest Land and Resource Management Plan (LRMP 1989), as amended by the Inland Native Fish Strategy (INFISH 1995)	16 USC §§ 1600-1614	Requires land management based on multiple-use, sustained-use yields. The LRMP and INFISH establish guidelines and standards for design, construction, and use of various actions on Forest Service 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
Longshot 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
Longshot 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
Longshot 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
Longshot 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
Longshot 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 Longshot Mine Removal Action
Alternative 2 - Excavation of Hotspots and Off–Site Disposal

Qty	Unit	Description	Unit Cost	Cost	Comment
LONGSHOT MINE - ALTERNATIVE 2: EXCAVATION OF HOTSPOTS AND OFF-SITE DISPOSAL					
ACCESS ROAD IMPROVEMENT					
1	LS	**Access Road (Spur Road 150) Improvement**	$5,000.00	$5,000.00	Estimate based on minor improvements to Spur Road 150
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate/Cable Net Installation			
2	ea	Bat gates installed in upper and lower adits	$5,500.00	$11,000.00	
1	ea	Cable net installed over open stope	$3,500.00	$3,500.00	
		Bat Gate/Cable Net Installation Subtotal =		**$14,500.00**	
		Mill Structure Demolition and Debris Removal			
1	LS	Demolish wooden mill structure	$5,000.00	$5,000.00	Assumes benching required to access mill and debris
20	lcy	Load structure debris, 1-cy backhoe	$3.32	$66.44	
1	LS	Collect and load other wood and metal debris	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
4	hr	Haul mill debris to sanitary landfull, 12-cy dump, 30-mi rt	$81.62	$326.46	Assumes 2 hours per load, 2 loads
		Mill Structure Demolition and Debris Removal Subtotal =		**$10,392.90**	
MINE WASTE REMOVAL:					
		Mine Waste Excavation			
0.2	ac	Clear trees/brush from mill area and WR3	$7,057.87	$1,251.17	Assumed medium brush, medium trees, clear, grub, haul 2 mi
63	bcy	Excavate/load waste rock from WR3; 1-cy backhoe	$3.68	$231.54	Assumes no stockpiling at site
50	bcy	Excavate/load unprocessed ore from ore bin; 1-cy backhoe	$3.68	$183.76	
100	bcy	Excavate/load unprocessed ore from underneath debris around the mill; 1-cy backhoe	$3.68	$367.52	Assumed up to 100 bcy of unprocessed ore or contaminated soil under debris around m
213	bcy	Transport mine waste to staging area, 12-cy dump, 3-mi rt	$5.34	$1,137.78	
213	bcy	Load mine waste from staging area for transport to landfill, 2.25-cy FE loader	$1.28	$272.69	
1	wk	XRF rental	$2,530.00	$2,530.00	
8	ea	Confirmation samples (selected metals)	$120.00	$960.00	2 from each area; SVL Analytical
		Mine Waste Excavation Subtotal =		**$6,934.45**	
TRANSPORTATION AND DISPOSAL (Option 1 - Arlington RCRA-C Landfill):					
		Transportation and Disposal			
213	bcy	Haul mine waste to Arlington RCRA-C Landfill, 18-cy belly dump, 300 mi	$297.99	$63,471.16	Depends on fuel costs, assumed $3/gal
213	bcy	TSDF tipping fee	$75.00	$15,975.00	
		Transportation and Disposal Subtotal =		**$79,446.16**	
		Mine Waste Area Reclamation (includes mill structure footprint)			
220	lcy	Excavate, load, haul, and place borrow soil over areas	$8.42	$1,852.59	Assumes grading performed as part of removal
8	msf	Fertilizer, 800 lb/ac	$18.63	$149.04	
8	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$728.41	Means+50% for USDA-FS seed mix
8	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$595.97	Means+50% for USDA-FS seed mix
0.2	ac	Hydromulching, wood cellulose	$2,207.31	$441.46	
1	LS	Plant tree seedlings in main area	$1,000.00	$1,000.00	Estimate
0.2	ac	Place wood slash back over areas	$763.73	$152.75	
		Mine Waste Area Reclamation Subtotal =		**$4,920.22**	

Data from R.S. Means, Dynamac, USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 2 - Excavation of Hotspots and Off–Site Disposal

Qty	Unit	Description	Unit Cost	Cost	Comment
		Access Road Reclamation (Spur Road 150)			
1	LS	Rough grade to return to original condition	$2,000.00	$2,000.00	Assumed duration
		Access Road Reclamation Subtotal =		**$2,000.00**	
		Miscellaneous			
1	LS	Staging area prep	$500.00	$500.00	
1	LS	Mobilization	$20,000.00	$20,000.00	
1	LS	Temporary erosion control BMPs	$1,000.00	$1,000.00	
		Miscellaneous Subtotal =		**$21,500.00**	
		Post-removal Monitoring (3 year total)			
1	LS	Annual surface water monitoring, 2 locations and 3 events total, annual reports	$19,598.04	$19,598.04	Assumes limited analysis and no baseline sampling event
		Post-removal Monitoring Subtotal =		**$19,598.04**	

SUMMARY

Access Road Improvement Subtotal =	$5,000	
Bat Gate/Cable Net Installation Subtotal =	$14,500	
Mill Structure Demolition and Debris Removal Subtotal =	$10,393	
Mine Waste Excavation Subtotal =	$6,934	
Transportation and Disposal Subtotal =	$79,446	
Mine Waste Area Reclamation Subtotal =	$4,623	
Access Road Reclamation Subtotal =	$2,000	
Miscellaneous Subtotal =	$21,500	
Removal Action Total =	**$144,397**	
Design =	$15,106	Design minimal because hauling waste off site
Removal Action Oversight and Final Report =	$22,736	Assumes 8-day construction period
Post-removal Monitoring Subtotal =	$19,598	
Subtotal =	**$201,837**	
Contingency 20%	$40,367	
ALTERNATIVE 2 TOTAL =	**$242,204**	

Notes:

ac = Acre
bcy = Bank cubic yard
BMP = Best management practice
cy = Cubic yard
ea = Each
gal = Gallon
hp = Horsepower
hr = Hour
lb/ac = Pound per acre
lb/MSF = Pound per thousand square feet
lcy = Loose cubic yard
LS = Lump sum
mi = Mile
msf = Thousand square feet
rt = Roundtrip
TSDF = Treatment, Storage, and Disposal Facility
USDA-FS = U.S. Department of Agriculture Forest Service
wk = Week
XRF = X-ray fluorescence

Data from R.S. Means, Dynamac, USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 3 - Excavation of Hotspots and On–Site Containment
Option 1 - Stope

Qty	Unit	Description	Unit Cost	Cost	Comment
LONGSHOT MINE - ALTERNATIVE 3: EXCAVATION OF HOTSPOTS AND ON-SITE CONTAINMENT (OPTION 1 - STOPE)					
ACCESS ROAD IMPROVEMENT					
1	LS	**Access Road (Spur Road 150) Improvement**	$5,000.00	$5,000.00	Estimate based on widening and minor improvements to Spur Road 150
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate/Cable Net Installation			
2	ea	Bat gates installed in upper and lower adits	$5,500.00	$11,000.00	
1	ea	Cable net installed over open stope	$3,500.00	$3,500.00	
		Bat Gate/Cable Net Installation Subtotal =		**$14,500.00**	
		Mill Structure Demolition and Debris Removal			
1	LS	Demolish wooden mill structure	$5,000.00	$5,000.00	Assumes benching required to access mill and debris
20	lcy	Load structure debris, 1-cy backhoe	$3.32	$66.44	
1	LS	Collect and load other wood and metal debris	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
4	hr	Haul mill debris to sanitary landfull, 12-cy dump, 30-mi rt	$81.62	$326.46	Assumes 2 hours per load, 2 loads
		Mil Structure Demolition and Debris Removal Subtotal =		**$10,392.90**	
MINE WASTE REMOVAL:					
		Access Road Construction (from mill site to stope)			
100	ea	Clear trees, brush and downfall	$19.27	$1,926.98	Assumed 24-in tree removal with D8 Cat
450	bcy	Cut, widen and rough grade/compact road	$6.68	$3,004.70	Assumes ripable rock and soil, push with dozer, no hauling
20	lcy	Haul and spread 3-in layer of gravel road base in select areas	$64.96	$1,299.22	Inc off-site material cost and delivery, handling, and spreading
		Access Road Construction Subtotal =		**$6,230.90**	
		Mine Waste Excavation and Disposal			
0.1	ac	Clear trees/brush from mill area and WR3	$7,057.87	$557.29	Assumed medium brush, medium trees, clear, grub, haul 2 mi
63	bcy	Excavate/load waste rock from WR3; 1-cy backhoe	$3.68	$231.54	Assumes no stockpiling at site or material transfer
50	bcy	Excavate/load unprocessed ore from ore bin; 1-cy backhoe	$3.68	$183.76	
100	bcy	Excavate/load unprocessed ore from beneath debris around mill; 1-cy backhoe	$3.68	$367.52	Assumed up to 100 bcy of unprocessed ore under debris around mill
213	bcy	Transport mine waste to stope and upper adit cut,12-cy dump, 1-mi rt	$4.33	$921.51	
213	bcy	Dump material into stope	$4.90	$1,043.75	
213	bcy	Compact waste material	$1.16	$246.83	
10	lcy	Load and haul clean borrow cover soil to stope, 1 mi	$6.35	$63.46	
1	wk	XRF rental	$2,530.00	$2,530.00	Ashtead Technology Rentals +10%
8	ea	Confirmation samples (selected metals)	$120.00	$960.00	2 from each area; SVL Analytical
		Mine Waste Excavation and Disposal Subtotal =		**$7,105.65**	
		Mine Waste Area Reclamation			
0.1	ac	Clear and grub soil borrow source	$7,057.87	$705.79	Assumed heavy brush with average grub, medium to heavy trees
230	lcy	Excavate and stockpile soil, 75-hp dozer, 50-ft push	$2.33	$535.60	Includes borrow soil to cover waste in stope
220	lcy	Load and haul borrow material to Site, 1 mi	$6.35	$1,396.12	Soil stockpiled at borrow source
220	lcy	Place 6 to 12-in soil cover over excavated waste areas, FE loader	$4.90	$1,078.05	
8	msf	Fertilizer, 800 lb/ac	$18.63	$149.04	
8	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$728.41	Means+50% for USDA-FS seed mix
8	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$595.97	Means+50% for USDA-FS seed mix
0.2	ac	Hydromulching, wood cellulose	$2,207.31	$441.46	
0.2	ac	Place wood slash back over areas	$763.73	$152.75	
		Mine Waste Area Reclamation Subtotal =		**$5,783.19**	

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 3 - Excavation of Hotspots and On–Site Containment
Option 1 - Stope

Qty	Unit	Description	Unit Cost	Cost	Comment
		Access Road Reclamation (from mill site to stope & Spur Road 150)			
0.25	day	Ripped compacted surface	$1,184.22	$296.06	Road to stope only
15	msf	Fertilizer, 800 lb/ac	$18.63	$279.45	Road to stope only
15	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$1,365.77	Road to stope only
15	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$1,117.45	Road to stope only
0.3	ac	Hydromulching, wood cellulose	$2,207.31	$760.09	Road to stope only
0.3	ac	Place wood slash back over areas	$763.73	$262.99	Road to stope only
1	LS	Rough grade to return to original condition	$1,000.00	$1,000.00	Spur Road 150 only
		Access Road Reclamation Subtotal =		**$5,081.81**	
		Miscellaneous			
150	lf	Install earthen diversion channel above stope	$7.66	$1,148.90	
1	LS	Staging area prep	$500.00	$500.00	
1	LS	Mobilization	$20,000.00	$20,000.00	
1	LS	Temporary erosion control BMPs	$2,000.00	$2,000.00	
		Miscellaneous Subtotal =		**$23,648.90**	
		Post-removal Monitoring (3 year total)			
1	LS	Annual surface water monitoring, 2 locations and 3 events total, annual reports	$19,598.04	$19,598.04	Assumes limited analysis and no baseline sampling event
		Post-removal Monitoring Subtotal =		**$19,598.04**	

SUMMARY

Access Road Improvement Subtotal =	$5,000	
Bat Gate/Cable Net Installation Subtotal =	$14,500	
Mil Structure Demolition and Debris Removal Subtotal =	$10,393	
Access Road Construction Subtotal =	$6,231	
Mine Waste Excavation and Disposal Subtotal =	$7,106	
Mine Waste Area Reclamation Subtotal =	$5,486	
Access Road Reclamation Subtotal =	$5,082	
Miscellaneous Subtotal =	$23,649	
Removal Action Total =	**$77,446**	
Design =	$21,151	
Removal Action Oversight =	$25,108	Assumed 10-day construction period
Post-removal Monitoring Subtotal =	$19,598	
Subtotal =	**$143,303**	
Contingency 20%	$28,661	
ALTERNATIVE 3 - CONTAINMENT OPTION 1 (STOPE) TOTAL =	**$171,964**	

Notes:

ac = Acre
bcy = Bank cubic yard
BMP = Best management practice
cy = Cubic yard
ea = Each
ft = Feet
hp = Horespower
hr = Hour
in = Inch
lb/ac = Pound per acre
lb/MSF = Pound per thousand square feet
lcy = Loose cubic yard
lf = Lineal feet
LS = Lump sum
mi = Mile
msf = Thousand square feet
rt = Roundtrip
USDA-FS = U.S. Department of Agriculture Forest Service
wk = Week
XRF = X-ray fluorescence

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 3 - Excavation of Hotspots and On–Site Containment
Option 2 - Repository

Qty	Unit	Description	Unit Cost	Cost	Comment
LONGSHOT MINE - ALTERNATIVE 3: EXCAVATION OF HOTSPOTS AND ON-SITE CONTAINMENT (OPTION 2 - REPOSITORY)					
ACCESS ROAD IMPROVEMENT					
1	LS	**Access Road (Spur Road 150) Improvement**	$5,000.00	$5,000.00	Estimate based on widening and minor improvements to Spur Road 150
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate/Cable Net Installation			
2	ea	Bat gates installed in upper and lower adits	$5,500.00	$11,000.00	
1	ea	Cable net installed over open stope	$3,500.00	$3,500.00	
		Bat Gate/Cable Net Installation Subtotal =		**$14,500.00**	
		Mill Structure Demolition and Debris Removal			
1	LS	Demolish wooden mill structure	$5,000.00	$5,000.00	Assumes benching required to access mill and debris
20	lcy	Load structure debris, 1-cy backhoe	$3.32	$66.44	
1	LS	Collect and load other wood and metal debris	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
4	hr	Haul mill debris to sanitary landfull, 12-cy dump, 120-mi rt	$81.62	$326.46	Assumes 2 hours per load, 2 loads
		Mil Structure Demolition and Debris Removal Subtotal =		**$10,392.90**	
MINE WASTE REMOVAL:					
		Mine Waste Excavation and Disposal			
0.1	ac	Clear trees/brush from mill area and WR3	$7,057.87	$557.29	Assumed medium brush, medium trees, clear, grub, haul 2 mi
63	bcy	Excavate/load waste rock from WR3; 1-cy backhoe	$3.68	$231.54	Assumes no stockpiling at site
50	bcy	Excavate/load unprocessed ore from ore bin; 1-cy backhoe	$3.68	$183.76	
100	bcy	Excavate/load unprocessed ore from beneath debris around mill; 1-cy backhoe	$3.68	$367.52	Assumed up to 100 bcy of unprocessed ore or contaminated soil under debris around mil
213	bcy	Transport mine waste to repository,12-cy dump, 2-mi rt	$5.34	$1,137.78	
213	bcy	Dump and spread material in repository	$4.90	$1,043.75	
213	bcy	Compact waste material	$1.16	$246.83	Spread and compact
1	wk	XRF rental	$2,530.00	$2,530.00	Ashtead Technology Rentals +10%
8	ea	Confirmation samples (selected metals)	$120.00	$960.00	2 from each area; SVL Analytical
		Mine Waste Excavation and Disposal Subtotal =		**$7,258.46**	
		Repository Construction - Option 1 Engineered Cover:			
0.1	ac	Clear and grub repository footprint	$7,057.87	$705.79	Assumed medium brush, medium trees, clear, grub, haul 2 mi
550	lcy	Excavate and stockpile soil, 75-hp dozer, 50-ft push	$2.33	$1,280.79	Includes soil to cover excavated waste areas
110	lcy	Screen fines from borrow soil	$3.12	$342.67	
55	lcy	Compact bottom of repository, 6-in lift, sheepsfoot	$1.16	$63.17	
110	lcy	Place and compact screened fines	$5.08	$558.45	
330	sy	Install GCL	$1.69	$557.24	Assumes extra for periphery
60	lcy	Purchase clean drain material from off-site source	$8.72	$523.13	
60	lcy	Haul drain material to staging area, 20 mi	$13.24	$794.63	
60	lcy	Load stockpiled drain material into truck, 2.25-cy FE loader	$1.28	$76.81	
60	lcy	Haul stockpiled drain material, 12-cy dump, 1-mi rt	$4.33	$259.58	
60	lcy	Place - in layer of drain material over GCL	$3.80	$227.79	
330	sy	Install filter fabric over drain material	$1.38	$455.26	Assumes extra to blend
220	lcy	Place and compact 24-in soil cover in 12-in lifts	$3.80	$835.25	
3	msf	Fertilizer, 800 lb/ac	$18.63	$54.84	
3	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$268.03	Means+50% for USDA-FS seed mix
3	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$219.30	Means+50% for USDA-FS seed mix
0.1	ac	Hydromulching, wood cellulose	$2,207.31	$149.17	
0.1	ac	Place wood slash back over cover	$763.73	$51.61	
		Repository Construction - Option 1 Engineered Cover Subtotal =		**$7,423.52**	

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 3 - Excavation of Hotspots and On–Site Containment
Option 2 - Repository

Qty	Unit	Description	Unit Cost	Cost	Comment
		Repository Construction - Option 2 Earthen Cover:			
0.1	ac	Clear and grub repository footprint	$7,057.87	$705.79	Assumed medium brush, medium trees, clear, grub, haul 2 mi
330	lcy	Excavate and stockpile topsoil, 75-hp dozer, 50-ft push	$2.33	$768.47	Includes soil to cover excavated waste areas
55	lcy	Compact bottom of repository, 6-in lift, sheepsfoot	$1.16	$63.17	
330	sy	Install filter fabric over waste material	$1.38	$455.26	Assumes extra to blend
110	lcy	Place and lightly compact 12-in soil cover in one lift	$3.80	$417.62	
3	msf	Fertilizer, 800 lb/ac	$18.63	$54.84	
3	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$268.03	Means+50% for USDA-FS seed mix
3	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$219.30	Means+50% for USDA-FS seed mix
0.1	ac	Hydromulching, wood cellulose	$2,207.31	$149.17	
0.1	ac	Place wood slash back over cover	$763.73	$51.61	
		Repository Construction - Option 2 Earthen Cover Subtotal =		**$3,153.27**	
		Mine Waste Area Reclamation			
220	lcy	Load and haul borrow material to Site, 1 mi	$6.35	$1,396.12	Soil stockpiled at repository
220	lcy	Place 6 to 12-in soil cover over excavated waste areas, FE loader	$4.90	$1,078.05	
8	msf	Fertilizer, 800 lb/ac	$18.63	$149.04	
8	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$728.41	Means+50% for USDA-FS seed mix
8	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$595.97	Means+50% for USDA-FS seed mix
0.1	ac	Hydromulching, wood cellulose	$2,207.31	$220.73	
0.1	ac	Place wood slash back over areas	$763.73	$76.37	
		Mine Waste Area Reclamation Subtotal =		**$4,244.70**	
		Access Road Reclamation (Spur Road 150)			
1	LS	Rough grade to return to original condition	$2,000.00	$2,000.00	
		Access Road Reclamation Subtotal =		**$2,000.00**	
		Miscellaneous			
150	lf	Install earthen diversion channel above repository	$7.66	$1,148.90	
200	lf	Install temporary fence around repository	$2.95	$589.35	
1	LS	Staging area prep	$500.00	$500.00	
1	LS	Mobilization	$20,000.00	$20,000.00	
1	LS	Temporary erosion control BMPs	$2,000.00	$2,000.00	
		Miscellaneous Subtotal =		**$24,238.26**	
		Post-removal Monitoring (3 year total)			
1	LS	Annual surface water monitoring, 2 locations and 3 events total, annual reports	$19,598.04	$19,598.04	Assumes limited analysis and no baseline sampling event
		Post-removal Monitoring Subtotal =		**$19,598.04**	

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 3 - Excavation of Hotspots and On–Site Containment
Option 2 - Repository

Qty	Unit	Description	Unit Cost	Cost	Comment
SUMMARY					
		OPTION 1 - ENGINEERED COVER:			
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate/Cable Net Installation Subtotal =		$14,500	
		Mil Structure Demolition and Debris Removal Subtotal =		$10,393	
		Mine Waste Excavation and Disposal Subtotal =		$7,258	
		Repository Construction - Option 1 Engineered Cover Subtotal =		$7,424	
		Mine Waste Area Reclamation Subtotal =		$4,245	
		Access Road Reclamation Subtotal =		$2,000	
		Miscellaneous Subtotal =		$24,238	
		Removal Action Total =		**$75,058**	
		Design =		$23,266	
		Removal Action Oversight =		$32,069	Assumed 14-day construction period
		Post-removal Monitoring Subtotal =		$19,598	
		Subtotal =		**$149,991**	
		Contingency 20%		$29,998	
		ALTERNATIVE 3 - CONTAINMENT OPTION 2 (REPOSITORY) ENGINEERED COVER TOTAL =		**$179,989**	
		OPTION 2 - EARTHEN COVER:			
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate/Cable Net Installation Subtotal =		$14,500	
		Mil Structure Demolition and Debris Removal Subtotal =		$10,393	
		Mine Waste Excavation and Disposal Subtotal =		$7,258	
		Repository Construction - Option 2 Earthen Cover Subtotal =		$3,153	
		Mine Waste Area Reclamation Subtotal =		$4,245	
		Access Road Reclamation Subtotal =		$2,000	
		Miscellaneous Subtotal =		$24,238	
		Removal Action Total =		**$70,788**	
		Design =		$21,151	
		Removal Action Oversight =		$27,480	Assumed 12-day construction period
		Post-removal Monitoring Subtotal =		$19,598	
		Subtotal =		**$139,017**	
		Contingency 20%		$27,803	
		ALTERNATIVE 3 - CONTAINMENT OPTION 2 (REPOSITORY) EARTHEN COVER TOTAL =		**$166,820**	

Notes:

ac = Acre
bcy = Bank cubic yard
BMP = Best management practice
cy = Cubic yard
ea = Each
ft = Feet
hp = Horespower
hr = Hour
in = Inch
lb/ac = Pound per acre
lb/MSF = Pound per thousand square feet
lcy = Loose cubic yard
lf = Lineal feet
LS = Lump sum
mi = Mile
msf = Thousand square feet
rt = Roundtrip
sy = Square yard
USDA-FS = U.S. Department of Agriculture Forest Service
wk = Week
XRF = X-ray fluorescence

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 4 - Excavation of Hotspots and In-place Capping

Qty	Unit	Description	Unit Cost	Cost	Comment
LONGSHOT MINE - ALTERNATIVE 4: IN-PLACE CAPPING OF THE HOTSPOTS					
ACCESS ROAD IMPROVEMENT					
1	LS	**Access Road (Spur Road 150) Improvement**	$5,000.00	$5,000.00	Estimate based on widening and minor improvements to Spur Road 150
		Access Road Improvement Subtotal =		**$5,000.00**	
PHYSICAL HAZARDS MITIGATION:					
		Bat Gate/Cable Net Installation			
2	ea	Bat gates installed in upper and lower adits	$5,500.00	$11,000.00	
1	ea	Cable net installed over open stope	$3,500.00	$3,500.00	
		Bat Gate/Cable Net Installation Subtotal =		**$14,500.00**	
		Mill Structure Demolition and Debris Removal			
1	LS	Demolish wooden mill structure	$5,000.00	$5,000.00	Assumes benching required to access mill and debris
20	lcy	Load structure debris, 1-cy backhoe	$3.32	$66.44	
1	LS	Collect and load other wood and metal debris	$5,000.00	$5,000.00	Based on crew of 6 employees with no overnight stay
4	hr	Haul mill debris to sanitary landfull, 12-cy dump, 30-mi rt	$81.62	$326.46	Assumes 2 hours per load, 2 loads
		Mill Structure Demolition and Debris Removal Subtotal =		**$10,392.90**	
MINE WASTE CAPPING:					
		Earthen Cover:			
0.1	ac	Clear trees/brush from mill area and WR3	$7,057.87	$705.79	Assumed medium brush, medium trees, clear, grub, haul 2 mi
1	wk	XRF rental	$2,530.00	$2,530.00	
273	lcy	Smooth and compact waste material in place	$1.19	$325.50	
860	sy	Install filter fabric over compacted waste material	$1.38	$1,186.43	
0.1	ac	Clear and grub borrow area	$7,057.87	$705.79	Assumed medium brush, medium trees, clear, grub, haul 2 mi
300	lcy	Excavate, load, haul, and place borrow soil over areas	$8.42	$2,526.26	
8	msf	Fertilizer, 800 lb/ac	$18.63	$149.04	
8	msf	Seeding, slope mix, 6 lb/MSF, push spreader	$91.05	$728.41	Means+50% for USDA-FS seed mix
8	msf	Seeding, wildflowers, 0.6 lb/MSF, push spreader	$74.50	$595.97	Means+50% for USDA-FS seed mix
0.2	ac	Hydromulching, wood cellulose	$2,207.31	$441.46	
0.2	ac	Place wood slash back over cover	$763.73	$152.75	
		Earthen Cover Subtotal =		**$10,047.40**	
		Access Road Reclamation (Spur Road 150)			
1	LS	Rough grade to return to original condition	$2,000.00	$2,000.00	
		Access Road Reclamation Subtotal =		**$2,000.00**	
		Miscellaneous			
1	LS	Staging area prep	$500.00	$500.00	
1	LS	Mobilization	$15,000.00	$15,000.00	
1	LS	Temporary erosion control BMPs	$1,000.00	$1,000.00	
		Miscellaneous Subtotal =		**$16,500.00**	
		Post-removal Monitoring (3 year total)			
1	LS	Annual surface water monitoring, 2 locations and 3 events total, annual reports	$19,598.04	$19,598.04	Assumes limited analysis and no baseline sampling event
		Post-removal Monitoring Subtotal =		**$19,598.04**	

Data from R.S. Means, Dynamac USFS

Cost Estimate for Longshot Mine Removal Action
Alternative 4 - Excavation of Hotspots and In-place Capping

Qty	Unit	Description	Unit Cost	Cost	Comment
SUMMARY					
		Access Road Improvement Subtotal =		$5,000	
		Bat Gate/Cable Net Installation Subtotal =		$14,500	
		Mill Structure Demolition and Debris Removal Subtotal =		$10,393	
		Earthen Cover Subtotal =		$9,750	
		Access Road Reclamation Subtotal =		$2,000	
		Miscellaneous Subtotal =		$16,500	
		Removal Action Total =		**$58,143**	
		Design =		$15,863	
		Removal Action Oversight =		$25,108	Assumed 10-day construction period
		Post-removal Monitoring Subtotal =		$19,598	
		Subtotal =		**$118,712**	
		Contingency 20%		$23,742	
			ALTERNATIVE 4 TOTAL =	**$142,455**	

Notes:

ac = Acre
bcy = Bank cubic yard
BMP = Best management practice
cy = Cubic yard
ea = Each
ft = Feet
GCL = Geosynthetic clay liner
hp = Horespower
hr = Hour
in = Inch
lb/ac = Pound per acre
lb/MSF = Pound per thousand square feet
lcy = Loose cubic yard
lf = Lineal feet
LS = Lump sum
mi = Mile
msf = Thousand square feet
rt = Roundtrip
sy = Square yard
USDA-FS = U.S. Department of Agriculture Forest Service
wk = Week
XRF = X-ray fluorescence

Data from R.S. Means, Dynamac USFS

Estimated Removal Action Cost Summary
Longshot Mine EE/CA

TASK	Description	Alternative 2 Cost	Alternative 3 Cost		Alternative 4 Cost
			Option 1 Stope	Option 2 Repository	
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/Cable Net Installation	$14,500	$14,500	$14,500	$14,500
	Mill Structure Demolition and Debris Removal	$10,393	$10,393	$10,393	$10,393
	subtotal =	**$24,893**	**$24,893**	**$24,893**	**$24,893**
Mine Waste Removal	Access Road Construction	$0	$6,231	$0	$0
	Mine Waste Excavation	$6,934	$7,106	$7,258	$0
	Transportation and Disposal	$79,446			
	Cap Construction[(a)]	$0	$0	$3,153	$10,047
	Mine Waste Area Reclamation	$4,920	$5,783	$4,542	$0
	Access Road Reclamation	$2,000	$5,082	$2,000	$2,000
	subtotal =	**$93,301**	**$24,202**	**$16,954**	**$12,047**
Miscellaneous	Staging Area Preparation	$500	$500	$500	$500
	Mobilization	$20,000	$20,000	$20,000	$15,000
	Temporary Erosion Control BMPs	$1,000	$2,000	$2,000	$1,000
	Install Diversion Channel	$0	$1,149	$1,149	$0
	Install Temporary Fence Around Repository	$0	$0	$589	$0
	subtotal =	**$21,500**	**$23,649**	**$24,238**	**$16,500**
	Removal Action Subtotal =	**$144,694**	**$77,743**	**$71,085**	**$58,440**
Design and Oversight	Design	$15,106	$21,151	$21,151	$15,863
	Removal Action Oversight	$22,736	$25,108	$27,480	$25,108
	subtotal =	**$37,842**	**$46,259**	**$48,631**	**$40,971**
Post-removal Monitoring	Post-removal Monitoring for 3 years	$19,598	$19,598	$19,598	$19,598
	subtotal =	**$19,598**	**$19,598**	**$19,598**	**$19,598**
	SUBTOTAL =	**$202,134**	**$143,600**	**$139,314**	**$119,009**
Contingency	20% Contingency	$40,427	$28,720	$27,863	$23,802
	TOTAL COST WITH EARTHEN COVER=	**$ 242,560**	**$ 172,320**	**$ 167,177**	**$ 142,811**
	TOTAL COST WITH ENGINEERED COVER=	**NA**	**NA**	**$ 180,346**	**NA**

Notes:
[(a)]Cost based on cover option 2 (earthen cover).