ENGINEERING EVALUATION/COST ANALYSIS
MATTERHORN MILL SITE
SAN MIGUEL COUNTY, COLORADO

Prepared for

Grand Mesa, Uncompahgre, and Gunnison National Forests

July 16, 2013

HRL COMPLIANCE SOLUTIONS, INC.
Environmental Consulting

CONTENTS

FIGURES

TABLES

APPENDICES

Executive Summary

The Matterhorn Mill Site (mill site) is an inactive mill and associated tailings deposits located in the Upper San Miguel River Watershed near Lake Fork, a tributary of the San Miguel River in San Miguel County, Colorado (Figure 1-1). Former operations at the mill site resulted in the accumulation of tailings in a former tailings pond, settling pond, and around the outside of the mill building as well as accumulations of mill waste (process spillage and ore/concentrate) inside the mill building. The tailings and wastes contain elevated metals concentrations relative to background concentrations in native soil in the vicinity of the mill site.

The mill site is located on land under the jurisdiction and control of the U.S. Forest Service, except for the southwestern portion of the mill site which lies on private land owned by Pathfinder Development, Inc. The U.S. Forest Service is implementing this Engineering Evaluation/Cost Analysis (EE/CA) to address potential threats posed by the entire mill site, both the publicly- and privately-owned portions of the mill site. The EE/CA presents results of site investigations conducted to characterize existing site conditions, streamlined risk evaluations performed to assess potential threats to human health and the environment, and detailed analysis of removal action alternatives designed to reduce the potential human-health and ecological risks associated with tailings and waste accumulations at the mill site. The EE/CA was prepared in accordance with guidance presented in Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA (USEPA, 1993).

The mill site consists of a mill building containing remnants of milling equipment and machinery, accumulations of tailings in a former tailings pond and settling pond (Figure 1-2). Built in 1920, the mill processed primarily silver and lead ore from the San Bernardo Mine, operating intermittently from 1920 to 1942. After a 20-year hiatus, the mill was renovated and operated by Silver Hat Mining, Inc. from 1962 to 1968. The mill has been inactive since 1968.

The mill site has been the source of various investigations regarding its historical significance and the human-health and ecological concerns associated with the presence of mill tailings at the site. Previous studies include:

- Phase I Environmental Site Assessment and Limited Phase II Site Investigation by American Geologic Services, Inc. (AGS), 2005. Four samples of mill waste and soil were taken within the structure and analyzed for a range of metals.

- Preliminary Assessment/Site Investigation by Au' Authum Ki, Inc., 2006. Fourteen samples of tailings, surface water, soil, and vegetation were collected for laboratory analysis.

- Supplemental sampling to support EE/CA by HRL Compliance Solutions, Inc., 2008. Two composite samples were collected from test pits excavated in the tailings deposits within the tailings pond and settling pond for laboratory analysis.

- Archeological assessment to determine historical significance of the mill site by the Forest Service and The Collaborative, Inc., 2009. The mill structure was placed on the National Register of Historic Places and the Colorado State Register of Historic Properties on February 24, 2010.

Site investigation results were used to complete a streamlined risk evaluation for the mill site. The streamlined risk evaluation process was used to assess potential threats to human-health and the environment associated with surface water, tailings, sediment, soil, and vegetation at and in the vicinity of the mill site. The evaluation was performed by comparing analytical results for samples collected during the site investigations to background levels and established risk-based benchmarks. The established benchmarks used in the evaluation include (1) Risk Management Criteria (RMC) established by the U.S. Bureau of Land Management (BLM) for metals at BLM mine sites (Ford, 2004), (2) stream standards established by the Colorado Water Quality Control Commission (WQCC), and (3) Regional Screening Levels (RSL) and Soil Screening Levels (SSL) for Chemical Contaminants at Superfund Sites established by the U.S. Environmental Protection Agency (EPA).

For this evaluation, analytes present at concentrations exceeding the risk-based benchmarks by factors of 2 or less are considered to pose a low threat to human and ecological receptors, while concentrations exceeding the risk-based benchmarks by factors of more than 2 to 10, 10 to 100, and more than 100 are considered to pose moderate, high, and extremely high threats, respectively. The use of these descriptions provides a means of assessing relative threat and is not intended to be definitive of risk.

The primary contaminant sources at the mill site are mill wastes (processing spillage and ore/concentrate) within the mill building and tailings within the tailings pond and settling pond. Secondary sources associated with the mill site include the following:

- Surface water within the settling pond and small pond located northwest of the settling pond

- Surface water emanating from a spring downgradient of the mill site

- Soil comprising the berm constructed at the settling pond

- Sediment within the small pond located northwest of the settling pond

- Vegetation within and along the perimeter of tailings pond and settling pond

The primary human receptors potentially exposed to contaminants at the mill site are site visitors, site workers, and adjacent residents downgradient of the mill area. The principal exposure routes for the human receptors include ingestion, inhalation, and dermal contact.

The site visitors most likely expected in the tailings pond and settling pond areas include individuals using the areas for camping, hiking, ATV driving, or other forms of recreation. Site workers include individuals working within the mill building or within the tailings pond and settling pond areas.

The threats posed to adjacent residents consider the potential for site-derived contaminants to migrate from the primary source areas and onto adjacent private lands. Although no residences are currently located adjacent to the mill area, the adjacent resident scenario is considered appropriate because (1) the settling pond, which is considered a primary contaminant source, is located on private land immediately adjacent to the Forest Service land on which the tailings pond and mill building are located, (2) residential development could occur on the adjacent private land in the future, and (3) the potential exists for site contaminants to migrate to Lake Fork and ultimately to private lands located downstream of the mill site.

The primary ecological receptors potentially affected by contaminants at the mill include terrestrial biota (wildlife and livestock) and aquatic biota. The principal exposure routes to ecological receptors include ingestion and direct contact. The threats posed to ecological receptors are evaluated in this study based on the analytical results for (1) surface water, (2) tailings, sediment, and soil, and (3) vegetation.

Surface water at the mill site is limited to intermittent ponding of water in the settling pond in response to precipitation events and runoff. Water is likely present year-round in the small pond, located approximately 50 feet northwest of the settling pond, which receive inflow from the un-named drainage that originates in the small basin north of the mill site; the pond also likely receives some inflow from runoff originating on the mill site. The parameters reported at the highest levels in surface-water samples collected at the mill site relative to levels reported for the upstream Lake Fork sample include acidity, chloride, dissolved cadmium, dissolved copper, dissolved iron, total recoverable iron, dissolved lead, dissolved manganese, and dissolved zinc. While elevated levels of these parameters are not indicative of risk, the elevated values provide an indication of potential site-derived contamination.

Based on the analytical data available for this evaluation, surface water at the mill site poses potential threats to campers because of low pH and elevated concentrations of dissolved lead (small pond) and dissolved manganese (settling pond, small pond, and sampled spring). Total recoverable arsenic, dissolved cadmium, dissolved iron, dissolved lead, and dissolved manganese concentrations in surface water at the mill site pose potential threats to downstream domestic water supplies. However, the water – supply stream standards for these metals were not exceeded in the water sample collected from Lake Fork downstream of the mill site. These findings suggest that the elevated levels reported in surface water at the mill site are not causing exceedances of the water-supply standards in Lake Fork downstream of the mill site.

With respect to mill waste within the mill structure (processing spillage and ore/concentrate), the parameters posing the greatest threat to site/industrial workers are antimony, arsenic, and lead. With respect to tailings, sediment, and soil at the mill area, arsenic, antimony, and lead pose the greatest threat to adjacent residents, and arsenic and lead also pose the greatest threat to site visitors and site/industrial workers at the mill area. However, it should be note that the arsenic concentration reported for the background soil sample poses a risk to both adjacent residents and site/industrial workers. Antimony, arsenic, and iron in tailings, sediment, and soil at the mill site pose the greatest threat to groundwater as a potential drinking water source; however, again the arsenic concentration in the background sample poses a threat to groundwater as well.

Based on the analytical results reported for sample collected during site investigations at the mill site, the metals posing the greatest threat to human health (concentrations reported at levels more than 10 times the human-health criteria suggesting high to extremely high risk) are as follows:

- Mill Waste
    - Antimony – Site/industrial worker
    - Arsenic – Site/industrial worker
    - Lead – Site/industrial worker

- Tailings
    - Antimony – resident, protection of groundwater as potable source
    - Arsenic – resident, camper, site/industrial worker, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
    - Lead – resident
    - Iron – protection of groundwater as potable source

- Settling Pond Berm

- Arsenic – resident, site/industrial worker, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
  - Manganese – protection of groundwater as potable source
  - Iron – protection of groundwater as potable source

- Sediment in small perennial pond
  - Arsenic – resident, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
  - Iron – protection of groundwater as domestic source

- Intermittent surface water in settling pond
  - Arsenic – water supply stream standard
  - Iron – water supply stream standard
  - Manganese – water supply stream standard

- Surface water in small pond
  - Arsenic – water supply stream standard
  - Iron – water supply stream standard
  - Manganese – water supply stream standard

- Downgradient spring
  - Manganese – water supply stream standard

With respect to ecological receptors, surface water present within the small pond and intermittently present in the settling pond in response to precipitation runoff potential pose a threat to aquatic life because of low pH and elevated concentrations of cadmium, copper, iron, lead, manganese, and zinc. Of these, the parameters in surface water at the mill site posing the greatest threat to aquatic life are low pH, dissolved cadmium, dissolved copper, dissolved lead, and dissolved zinc. The parameters posing the greatest threat to aquatic life in water emanating from the spring downgradient of the mill site are low pH, dissolved cadmium, and dissolved zinc. However, the elevated concentrations in surface water at the mill site and in the spring do not appear to be impacting Lake Fork with respect to the aquatic-life standards.

Of the metals in tailings posing threats to ecological receptors, lead likely poses the greatest threat to livestock and wildlife at the mill site. The elevated lead concentrations reported for the tailings samples collected from the tailings and settling ponds and suspected tailing in the settling pond berm potentially pose a high threat to livestock and wildlife. Elevated concentrations of cadmium, copper, and zinc reported for samples collected at these features pose low to moderate threats to livestock and wildlife. Sediment within the small pond poses a low threat to livestock and wildlife based on the analyte concentrations reported to the sediment sample collected at the pond.

Vegetation growing within and adjacent to the tailing pond and settling pond potentially pose a moderate threat to domestic animals based on elevated concentrations of iron and lead.

Based on the analytical results reported for sample collected during site investigation at the mill site, the metals posing the greatest threat to ecological receptors (concentrations reported at levels more than 10 times the ecological criteria suggesting high to extremely high risk) are as follows:

- Settling pond surface water – aquatic life
    - Dissolved cadmium
    - Dissolved copper
    - Total recoverable iron
    - Dissolved lead
    - Dissolved zinc

- Small pond surface water – aquatic life
    - Dissolved cadmium
    - Dissolved copper
    - Dissolved lead
    - Dissolved zinc

- Downgradient spring – aquatic life
    - Dissolved cadmium
    - Dissolved zinc

- Tailings – livestock and wildlife
    - Lead

- Soil berm – livestock and wildlife
    - Lead

The mill wastes, tailings, and contaminated soil at the mill site pose threats to public health and the environment because of elevated concentrations of arsenic, antimony, and lead. Except for the mill wastes within the mill building, the primary threat is to residents based on EPA's residential soil standard and BLM's adjacent resident RMC. By reducing the threats based on these benchmarks, the private land which was formerly part of the mill operations (settling pond and soil berm) qualifies for unrestricted land use and the threats to adjacent residents are mitigated on the remaining portion of the mill site on public land. Mill wastes pose a potential threat to site/industrial worker within the mill building. By reducing potential threats to site workers, any potential threats to any individuals that may enter the building for lesser exposure durations than site workers will also be reduced.

Removal action objectives (RAOs) serve as a basis for selecting technologies and developing removal action alternatives. The goal of the removal action is to reduce human-health and ecological threats associated with mill wastes (process spillage and ore/concentrate) in the mill building, tailings around the mill building and within the tailings pond, and tailings within the settling pond and contaminated soil comprising the settling pond berm. Based on the characteristics of the mill wastes and tailings, the following specific objectives have been established for the removal action:

- Prevent or reduce actual or potential exposure of site workers and the general public to the threats posed by mill wastes (process spillage and ore/concentrate) inside the mill building.
- Prevent or reduce actual or potential exposure of humans and the local biotic community from direct contact with tailings within the settling pond and contaminated soil comprising the soil berm such that no land use restrictions would be placed on the lands on which the settling pond and berm are located. To meet unrestricted land use requirements, removal action goals will be the metals and cyanide criteria specified in BLM's RMC for the adjacent resident and EPA's RSL for residential soil, whichever is most restrictive; however, in no case will the goal be lower than the concentration reported for the background soil sample collected at the mill site. The remediation goal for a specific analyte will be the background soil concentration if the analyte concentration in the background soil sample is greater than one or both of the BLM and EPA criteria. The removal actions goals are presented in Table 4.2.
- Prevent or reduce actual or potential exposure of human and the local biotic community from direct contact with tailings around the outside of the mill building and within the tailings pond. The removal action goals for residual materials remaining after completion of the removal action will be the metals and cyanide criteria specified in BLM's RMC for the adjacent resident and EPA's RSL for residential soil, whichever is most restrictive; however, in no case will the goal be lower than the concentration reported for the background soil sample collected at the mill site. The remediation goal for a specific analyte will be the background soil concentration if the analyte concentration in the background soil sample is greater than one or both of the BLM and EPA criteria. The removal actions goals are presented in Table 4.2.
- Prevent or reduce the potential for off-site migration of contaminants as a result of erosion (wind or water) and mass wasting processes.
- Reduce the potential for generation of leachate in the tailings at the tailings pond and settling pond as a result of direct infiltration of precipitation and precipitation runoff.
- Protect the stability and integrity of the mill building and its contents.
- Maintain natural character of the mill site to the maximum extent practical.
- Satisfy state and federal Applicable or Relevant and Appropriate Requirements (ARARs).

The process for identifying and analyzing removal action alternatives designed to achieve the RAOs was implemented by first identifying potential response action technologies and process options, screening the technologies for applicability and feasibility in accordance with the scope of the removal action(s), and assembling the retained technologies into removal action alternatives for detailed analysis of effectiveness, implementability, and cost. The process resulted in the development of the following removal action alternatives:

- Alternative 1: No action (no actions are taken to mitigate or otherwise reduce the identified threats)
- Alternative 2: Consolidation and Containment (tailings around the outside of the mill structure, tailings in the settling pond, and contaminated soil comprising the settling pond berm are removed and placed on the tailings at the former tailings pond and the consolidated wastes are contained by covering with soil and vegetated cover)
    - Sub-Alternative 2A: Inclusion of Mill Wastes
    - Sub-Alternative 2B: Exclusion of Mill Wastes
- Alternative 3: Excavation, Consolidation, and On-Site Disposal (tailings within the former tailings pond, tailings around the outside of the mill structure, tailings in the settling pond, and contaminated soil comprising the settling pond berm are removed and placed in an excavated on-site disposal cell and the consolidated wastes are contained by covering with soil and vegetated cover)
    - Sub-Alternative 3A: Inclusion of Mill Wastes
    - Sub-Alternative 3B: Exclusion of Mill Wastes

Based on the detailed analysis of each alternative and a comparative analysis of the alternatives, Alternative 2B is recommended as the most effective, implementable, and cost-effective solution for reduction of the public-health and ecological threats posed by mill wastes, tailings, and contaminated soil at the mill site in accordance with the RAOs established for the removal action. Alternative 2B would be implemented as follows:

- Compact tailings within the tailings pond to densify the tailings and mitigate future settlement.
- Consolidation of tailings and contaminated soil comprising the soil berm at the existing tailings pond. Tailings within the settling pond and the soil berm adjacent to the settling pond will be excavated and placed on the compacted tailings at the existing tailings pond. Confirmation samples will be collected to demonstrate that soils remaining at the settling pond and berm area after removal do not pose a human-health threat. Following confirmation based on the analytical results, the excavation will be backfilled with clean fill material, the surface graded to be consistent with the natural character of the surrounding area, and all disturbed areas will be vegetated.
- Removal of tailings/wastes from around the outside of the mill building and place on the compacted tailings at the existing tailings pond. Tailings/wastes will not be removed from any areas where, through consultation with the Forest Service, it is determined that such removal would jeopardize the stability and integrity of the mill building and reasonable measures could not be taken to otherwise protect the structure. In all cases, care will be taken during removal of wastes from around the outside of the mill building to protect the stability and integrity of the structure and its contents.

- Mill wastes inside the mill building will remain in place, and the potential threats to public health posed by mill wastes (process spillage and ore/concentrate) will be mitigated by permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure.

- Reshape the consolidated waste materials at the tailing pond to accept a cover and provide positive runoff by raising the center portion of the tailings to create a minimum outward slope of 5 percent.

- Place a physical barrier (e.g., nonwoven geotextile) on the reshaped tailing pond. It is estimated that the physical barrier will cover a surface area of approximately 29,000 square feet.

- Place a soil cover (minimum 2-feet thick) over the physical barrier; it is estimated that approximately 2,150 cubic yards of soil/fill material will be required for the cover system. Ensure cover soil is capable of supporting vegetation, and amend soil as necessary. Plant native vegetation consistent with the natural character of the surrounding area on the soil cover.

- Install run-on/run-off and drainage controls as necessary to direct and control precipitation run-off.

Operation and maintenance activities associated with Alternative 2B would include periodic inspections to monitor the integrity of the soil cover, erosion control measures, and revegetation success. Operation and maintenance activities would also include inspection of the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure. The access road leading to the tailings area will not be reclaimed upon completion of the action; however, natural barriers/boulders will be placed across the access routes to discourage vehicle (including ATVs) access. The natural barriers will be removed when necessary to allow access for maintenance activities.

The estimated capital cost (construction and indirect costs) for Alternative 2B is $ 152,129.

Based on the annual budget established by the Forest Service for operation and maintenance at other nearby sites at which removal actions have been implemented by the Forest Service, an annual cost of $15,000 per year for three years of post-reclamation operation and maintenance is estimated for Alternative 2B.

The estimated net present value (over the three-year period) for Alternative 2B is $ 192,978.

1.0 INTRODUCTION

HRL Compliance Solutions, Inc. (HCS) in association with Western Water & Land, Inc. (WWL) prepared this Engineering Evaluation and Cost Analysis (EE/CA) for the U.S. Forest Service (Forest Service). The report presents an engineering evaluation and cost analysis of alternatives for a removal action at the Matterhorn Mill Site (mill site), an inactive/abandoned mill located in the Upper San Miguel River watershed near Lake Fork, a tributary of the San Miguel River in San Miguel County, Colorado (Figure 1-1). The mill site consists of a mill building containing remnants of milling equipment and machinery, an accumulation of tailings in the former tailings pond located adjacent to the mill building, and a settling pond located downgradient of the tailings area (Figure 1-2).

The removal action will address metals contamination in waste tailings, settling pond soil/sediment, and vegetation at the mill site. Data collected by various entities indicate that the waste tailings present at the mill pose an unacceptable risk to human health and the environment. Precipitation and groundwater percolating through the mill waste reacts with the waste tailings to produce metals-contaminated leachate which ultimately discharges to Lake Fork. As proposed in this EE/CA, the removal action for the mill site is intended to be the final remedy for reducing human-health and ecological risks at the mill and reducing the potential for mill waste to serve as a source for metals contamination in the Lake Fork. This EE/CA does not address mine drainage from the nearby San Bernardo Mine.

1.1 Authority

Except for the southwestern portion of the settling pond, the mill site is located on land under the jurisdiction and control of the U.S. Forest Service. The southwestern portion of the settling pond lies on private land owned by Pathfinder Development, Inc. The Forest Service is implementing this EE/CA to address potential threats posed by the entire mill site because constituents derived from mill site originated on lands were under its jurisdiction and control. The Forest Service has been delegated, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended and pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the responsibility to undertake response actions with respect to the release or threat of release of oil, petroleum products, hazardous substances, or pollutants and contaminants that pose an actual or potential threat to human health or welfare, or the environment. Under this authority, the

Forest Service may take action to protect public land resources and public land users from hazardous substances that pose a threat or potential threat to human health and the environment.

1.2 Project Background

The mill site has been the source of various investigations regarding its historical significance, and the human health and environmental concerns associated with the presence of mill tailings at the site. Previous studies include a Phase I Environmental Site Assessment by American Geological Services, Inc. (AGS) in 2005, a Preliminary Assessment/Site Investigation (PA/SI) by Au' Authum Ki., Inc. (AAK) in 2007, a supplemental site investigation conducted in support of this EE/CA by HRL Compliance Solutions, Inc. (HCS) in 2008, and an archaeological assessment performed by the Forest Service in 2010.

In 2005, AGS performed a Phase I Environmental Site Assessment and a Limited Phase II Site Investigation for the National Trust for Historic Preservation to identify existing or potential recognized environmental conditions or historical environmental conditions affecting the site (AGS, 2005). The results from the Phase I Environmental Assessment indicated the site was not currently or historically used as a hazardous waste disposal site and that there were no hazardous materials, biohazardous wastes, petroleum products, aboveground or underground storage tanks. A limited number of soil and mill waste samples were taken inside the mill and analyzed for a range of metals. The results from the AGS investigation are discussed in more detail in section 3.0.

In 2007, the Forest Service contracted with AAK to perform a PA/SI of the mill site to assess potential human-health and ecological threats resulting from former operations at the mill site. The scope of work performed for the PA/SI included the collection of surface-water, surface soil and surface tailings, and vegetation samples for laboratory analysis, and based on the analytical results, assessing the relative hazards to human health and the environment associated with existing conditions at the mill site. Based on AAK's findings, the Forest Service concluded that the tailings at the mill site presented a potential threat to the health of site visitors, site workers, and downstream residents as well as potential threats to wildlife and livestock and potential impacts water quality of the adjacent stream (Lake Fork).

In 2008, supplemental sampling was performed by HCS to complete the site characterization and support this EE/CA. The work performed by HCS included excavation of test pits within the tailings and settling pond areas to assess the depth of tailings and collect subsurface tailings samples for laboratory analysis.

In 2009, the Forest Service performed an archeological assessment of the mill site to determine its historical significance as a representation of 20th century silver mining and milling operations, as well as some emergency stabilization to prevent the structure from collapsing from heavy snows. The stabilization project was a joint effort between San Miguel County, Uncompahgre National Forest, Colorado Preservation, Inc. and the National Trust for Historic Preservation. The mill site was placed on the National Register of Historic Places and the Colorado State Register of Historic Properties on February 24, 2010.

1.3 Purpose of this EE/CA

The purpose of this EE/CA is to screen, develop, and evaluate potential removal action alternatives for reducing human-health and ecological threats posed by tailings at the mill site. The EE/CA was developed in accordance with the procedures established by the EPA for non-time-critical removal actions under CERCLA and the NCP. EPA guidance for non-time-critical removal actions is presented in *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993).

The data used to prepare this EE/CA were collected by various investigators during previous studies conducted at the mill site. The data were used to assess risks posed by tailings within the former tailings pond and the settling pond and evaluate the effectiveness, implementability, and cost of removal actions alternatives for reducing the risks. An Action Memorandum will be prepared by the Forest Service to document the selected alternative following receipt of public comment on this EE/CA.

1.4 Organization of this Document

The remainder of this EE/CA is organized as follows:

- Section 2.0 discusses the mill history, location, description, and a summary of geologic and hydrologic conditions.
- Section 3.0 provides a summary of the characterization scope of work; data used to characterize the source, nature and extent of contamination; and streamlined risk evaluation.
- Section 4.0 presents removal action objectives, including statutory framework on removal actions, removal action scope and schedule, identification of preliminary Applicable or Relevant and Appropriate Requirements (ARARs), and removal action objectives.
- Section 5.0 presents the identification and analysis of removal action technologies and alternatives.

- Section 6.0 provides a comparative analysis of removal action alternatives.
- Section 7.0 presents the recommended removal action alternative.
- Lists of acronyms and references are presented in Sections 8.0 and 9.0, respectively.

2.0 MILL SITE DESCRIPTION

This section provides a general description of the mill site, including mill location, mill features, mill history, and site geology and hydrology.

2.1 Site Description

The mill site is an abandoned/inactive mill located in the NW ¼ of the NE ¼ of Section 5, Township 41 North, Range 9 West of the New Mexico Principal Meridian along Highway 145 in San Miguel County (Figure 1-1). The Mill is approximately 2.8 miles south of Ophir in the Iron Springs Mining district of the Upper San Miguel River Watershed. The mill site is situated on a bench about 60 feet above the Lake Fork of the San Miguel River at an elevation of about 9,420 feet above mean sea level; mill site coordinates are N37°50’56.70” and W107°53’03.70”. A short access road leads to the mill site from Highway 145.

The mill building, former tailings pond, and settling pond are primarily on Forest Service land, with the exception of the southwestern portion of the settling pond which is located on private property owned by Pathfinder Development, Inc. The mill site is located on the unpatented Dave Day lode claim and Valley View No. 2 millsite claim, both of which are currently inactive/closed as of 2010 according to the Bureau of Land Management (BLM) LR2000 database.

The area encompassing the mill site is characterized by rugged, steep, high alpine terrain extending to above timber line. The mill site is bounded to the south and west by a steep hillside extending down to the Lake Fork of the San Miguel River. The Lake Fork flows through Forest Service land and privately owned property for approximately 1.5 miles from the mill to the confluence with Howard Fork to form the South Fork of the San Miguel River.

General site features at the mill site are shown in Figure 1-2. The mill site covers an area of approximately 1.7 acres. Mill site features include a large mill structure, a 1.02-acre tailings pile adjacent to the structure, a 0.34-acre settling pond located northwest of the tailings pile, and a small, bermed pond (35 to 40 feet in diameter and up to 20 feet deep) located northwest of the settling pond. An aerial tramway extends from the mill southwest across Lake Fork to the San Bernardo Mine, which was used during operations to transport ore to the mill. Archeologists have determined the existing mill structure to be historically significant, and in February 2010 the mill site was placed on the National Register of Historic Places and the Colorado State Register of Historic Properties. The mill building and equipment are largely intact and represent the first generation of the flotation system that replaced the old-style stamp mills and concentrating tables. The mill site is listed on the National Register of Historic Places under Criterion A for industry at the local level of significance for its contribution to the 20th century silver mining industry and Criterion C for engineering at the local level of significance.

Although largely intact, the mill structure has suffered damage from weathering and decay of support columns and siding from dirt build-up against the lower level from erosion from the slope above the mill. In 2009, Historicorps coordinated and led a three-day site clean-up and emergency stabilization of the building to prevent further deterioration until full restoration could be completed. Collapsed roof and framing materials were removed and the remaining walls were stabilized. A temporary shelter with metal roofing was constructed at the exposed western end of the mill to protect a Wilfley table. Historicorps plans for additional structure stabilization by excavating a run-off ditch parallel to the south side of the building to prevent further deterioration of the timber frame and exterior wood sheathing.

The mill site is in the Rocky Mountain subalpine zone, and plants and animals associated with subalpine environments have been observed at the mill. The mill is surrounded by coniferous forest. Large mammals that may be observed in the vicinity of the mill include elk, mule deer, black bear, mountain lion, and coyote. Small mammals that may also be observed include marmot and pika.

Snowmelt runoff in the vicinity of the mill site generally occurs from April to July, with peak runoff typically occurring in May and June. Runoff from thunderstorms is variable but typically occurs during the summer monsoon from July through early September. On-site, runoff flows into the settling pond where it ultimately infiltrates and evaporates; flows in excess of the pond's capacity will discharge to the drainage extending downstream of the settling pond to Lake Fork.

The human population in the upper San Miguel River watershed varies seasonally as tourists and temporary residents move into the area during the summer. San Miguel County's resident, year-round population is 7,359 (San Miguel County, 2012). Historically, the area's economy was based on industries such as mining, logging, ranching, and agriculture; currently the primary industry is tourism and outdoor recreation. The population around the mill area is limited to small communities such as the San Bernardo neighborhood directly south of the mill site and the town of Ophir approximately 2.8 miles to the northeast. The nearest urbanized area is the town of Telluride.

2.2 Mill History

The mill site is located in the historic Iron Springs mining district, Trout Lake mining area, in the Upper San Miguel River basin. The mill was built in 1920 to process primarily silver and lead ore from the San Bernardo Mine to the west. The mill structure was constructed with an overall height of 98 feet from ground level to the top of the highest level and a length of 145 feet and width of 46 feet (Collman, et.al., 1993). An aerial tramway, 1,700 feet long, was constructed to transport ore from the San Bernardo Mine to the mill. The mill operated intermittently between 1920 and 1942. After a 20 year hiatus, the mill was renovated and operated by Silver Hat Mining, Inc. from 1962 to 1968. The mill has been inactive since 1968.

The mill was operated on a froth-flotation process where ground ore is mixed with water and surfactants are used to separate minerals. The slurry remaining after the desired minerals have been separated was discharged to the tailings pond. Water in the tailings pond has long since evaporated and infiltrated, leaving an accumulation of tailings within the former pond area. It is uncertain when the settling pond was constructed downgradient of the tailings area, but it is suspected that the settling pond was constructed to promote settling of tailings material in runoff from the tailings area.

The history of the mill has been well documented in archeological studies regarding its local historical significance as a representation of the silver mining industry in the 20th century. The mill site was built using state-of-the-art milling equipment designed to process primarily silver ore, and lesser amounts of lead, copper, and gold ore. The mill used the flotation process, which replaced the common stamp-mill technology with a process that produced a higher grade of concentrate. Initially, the flotation cells may have used paddle agitation, but the mill was upgraded in 1922-1923 to incorporate the newer technology of air or “froth” agitation. Although the mill had been upgraded, mechanical problems caused the mill to remain closed through 1924. When the mill reopened, production was significantly increased, with 1926 being the peak year. In 1929, the stock market crash and onset of the Great Depression brought ore production and concentration to a halt and the mill was shut down. It opened again briefly from 1941 to 1942, but closed again during World War II. During the years 1961-1963, the Silver Hat Mining Company made improvements to the mine and the mill to stabilize and improve operations. A new concrete foundation was poured, a new electrical system was added, and ore processing equipment was repaired or replaced. The mine and mill operated until 1968, when the company allowed unpatented claims to lapse and the mill again shut down. It has not reopened since.

The mill structure sits on the unpatented Valley View No. 2 millsite claim, which was listed as closed/abandoned in 2010 by the BLM LR2000 database. The mill tailings and settling pond are located on the unpatented Dave Day lode claim, which was listed as closed/abandoned in 2010 by the BLM LR2000 database. The lands are under the jurisdiction and control of the Forest Service, with the exception of the southwestern portion of the settling pond which is located on private property.

In November of 2009, San Miguel County, Forest Service, Colorado Preservation, Inc., and the National Trust for Historic Preservation performed cleanup and construction activities at the mill site to provide emergency stabilization of the structure, which had a partially collapsed roof and damaged support columns from decay. A temporary shelter was built on the west end of the structure to protect a Wilfley Table.

On February 24, 2010 the mill site was listed on the National Register of Historic Places and the Colorado State Register of Historic Properties. The mill was placed on San Miguel County's historic register in 2005.

2.3 Geologic Setting

The mill site is situated on a bench, at an elevation approximately 150 feet above Lake Fork. According to the preliminary geologic map of the Mount Wilson quadrangle (Bromfield and Conroy, 1963), the bench likely consists of granodiorite porphyry, and the unconsolidated sediments overlying the bedrock bench consist of poorly sorted gravels including cobbles and boulders on intrusive rocks, Telluride Conglomerate, and San Juan Tuff. Soils at the mill site grade from silty sand (0 to 12 inches below ground surface) to clayey gravels at depth (30 to 60 inches below ground surface).

2.4 Hydrologic Setting

Lake Fork, located approximately 500 feet west to the mill site, is the primary surface water feature in the vicinity of the site. Lake Fork originates as discharge from Trout Lake which is located about 1.5 miles upstream of the mill site and joins Howard Fork approximately 1.5 miles downstream of the mill site to form South Fork of the San Miguel River. In addition, an un-named drainage of Lake Fork drains a small basin immediately north of the mill site. The drainage flows along the northern boundary of the mill site and into a small bermed pond before cascading down the steep hillside to Lake Fork. Saturated conditions observed at the ground surface along the alignment of the drainage in the center of the basin suggest that shallow groundwater is present upgradient of the mill site at least during some times of the year.

3.0 MILL SITE CHARACTERIZATION

Characterization of site conditions at the mill site was performed to obtain the information needed to evaluate human-health and ecological risks associated tailings accumulations and to evaluate removal action alternatives for the reducing those threats. The characterization was developed on the basis of data and information collected during three separate site investigation efforts. The investigations were conducted by AGS in 2005, AAK in 2006, and HCS in 2008. Photographs taken during the AAK and HCS characterization efforts are presented in Appendix A.

The site investigation performed by AGS in 2005 was associated with a limited Phase II Site Investigation and reported in *Phase I Environmental Site Assessment & Limited Phase II Site Investigation* (AGS, 2005). The purpose of the AGS investigation was to evaluate the metal content of the mill wastes located within the mill building.

The investigation performed by AAK in 2006 included the collection tailings, surface water, soil, and vegetation samples for laboratory analysis. Results of the AAK investigation are reported in *Assessment Summary Report – San Bernardo Mill, San Miguel County, Colorado* (AAK, 2007). The purpose of the investigation was to provide the data needed to complete a preliminary assessment of the threats posed to human health and the environment.

The investigation performed by HCS in 2008 included the collection of composite samples from test pits excavated in the tailings deposits within the tailings pond and settling pond. The investigation was conducted to support preparation of this EE/CA, and the objective of the investigation was to provide the data needed to assess metals concentrations at depth within the tailings deposits.

The reporting of investigation results is organized in this section by medium (tailings within the mill building, tailings [tailings pond and settling pond], surface water, soil, and vegetation). In each discussion, tables are presented to show the sampling results for the various media. Analytical results are compared to screening levels derived from state and federal human-health and ecological risk-based standards and risk management criteria (RMC) established by the BLM. Results for synthetic precipitation leaching procedure (SPLP) analyses performed on the tailings samples collected within the tailing pond and settling pond were used to compute leaching RMC for comparison to total metals results in the tailings.

In addition to the investigations designed to assess human-health and ecological threats associated with tailings at the mill site, archeological investigations were conducted by the Forest Service and The Collaborative, Inc. in 2009 to evaluate the historical significance of the mill site and apply for placement in the National Register of Historic Places.

3.1 Site Characterization Scope of Work

The scopes of work for the three site characterization efforts and the cultural resource inventory are outlined below.

3.1.1 AGS Environmental Site Assessment

AGS prepared the Phase I Environmental Assessment at the request of the National Trust for Historic Preservation to 1) assist in the evaluation of legal and financial liabilities associated with the property; 2) assist in the evaluation of the site's overall development potential; 3) assist in determining whether any immediate actions at the site are necessary to comply with existing environmental laws and regulations; and/or 4) constitute partial or whole appropriate inquiry for purposes of CERCLA's innocent landowner defense. Results from their record review and site visit indicated that none of the following materials were observed at the site:

- Hazardous materials or petroleum-based products
- Drums or unidentified containers
- Biohazardous waste
- Current or prior landfill activities
- Existing or historical aboveground storage tanks
- Existing or historical underground storage tanks
- Suspect PCB equipment or materials

- Suspect asbestos-containing materials; however, an inspection per the requirements set forth in the Asbestos Health Emergency Response Act or the Colorado Department of Public Health and Environment bulk asbestos sampling has not been performed at the site.

As part of the limited Phase II Site Investigation, AGS collected the following composite, mill-waste samples inside the mill building at the locations shown in Figure 3-1:

- Three soil samples where processing spillages occurred (MM-01, MM-02, MM-04)

- One sample from an ore/concentrate bin (MM-03)

3.1.2 AAK Site Investigation

The following samples were collected during the AAK Site Investigation at the locations shown in Figure 3-2:

- Five surface water samples
    - Lake Fork – upgradient of the mill (SW-1)
    - Lake Fork – downgradient of the mill (SW-2)
    - One sample from small bermed pond northwest of settling pond plus duplicate (SW-3)
    - One sample of ponded water within the settling pond (SW-4)
    - One sample from a spring located near the toe of the slope downgradient of the mill area (SW-5)

- Three composite near-surface (0 to 6") tailings samples from the tailings impoundment
    - One composite sample from the north half of tailings pond (T-1)
    - One composite sample from the south half of tailings pond plus duplicate (T-2)
    - One composite tailings sample from settling pond (T-3)

- Two soil samples
    - One near-surface (0 to 6"), composite soil sample from berm located on the west perimeter of settling pond (BERM)
    - One near-surface (0 to 6") composite background soil sample collected uphill approximately ¼ mile north of mill (BKG SOIL)

- One near-surface (0 to 6"), composite sediment sample from small, bermed pond located northwest of the settling pond (SED-1)

- Three composite vegetation samples
    - Composite sample collected along perimeter and within settling pond plus duplicate (VEG-POND)
    - Composite sample collected along perimeter and within tailings pond (VEG-T)

- Composite background sample collected uphill approximately ¼ mile north of mill (BKG VEG)

3.1.3 HCS Tailings Investigation

As part of the continued effort to characterize the mill site, HCS excavated test pits with a tractor-mounted backhoe to (1) investigate the extent of tailings within the tailings pond and settling pond, (2) collect subsurface tailings samples at the tailings pond and settling pond for geotechnical testing and chemical laboratory analyses, (3) investigate the depth of soil/unconsolidated materials in a potential soil borrow area, and (4) investigate the depth of soil/unconsolidated material in a potential on-site repository area. A total of four test pits were excavated at the tailings pond and one each at the settling pond, potential borrow area, and potential on-site repository area (Figure 3-2). Each test pit was excavated until backhoe refusal was encountered at the bedrock surface, and a lithologic log was prepared to describe the physical nature of the material encountered in each pit; the lithologic logs are provided in Appendix B.

Subsurface samples were collected from test pits excavated in the tailings pond and settling pond. Each sample was a composite of subsamples collected from the test pits. The tailings pond sample was a composite of the tailings excavated from four test pits, and the settling pond sample was a composite of the tailings excavated from one test pit. During backfilling, a 1.5-inch PVC piezometer was installed in one of the four test pits at the tailings pond and in the one test pit at the settling pond. No groundwater was encountered during test-pit excavation in October 2008. The piezometers were inspected on June 24, 2009, and again, no groundwater was present in the piezometers. During the 2008 sub-surface investigation, the following samples were collected for laboratory analysis at the locations shown in Figure 3-2:

- One composite sample from the tailings pond (Sample 1)
- Once composite sample from the settling pond (Sample 2)

3.1.4 Cultural Resource Inventory

In 2009, the Forest Service and The Collaborative, Inc. assessed the mill site against the National Register of Historic Places criteria for evaluation and submitted the application form required to place the mill on the register. These criteria specify that the quality of significance in American History, architecture, engineering, archeology, and culture is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, association, and

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of persons significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. that have yielded, or may be likely to yield, information important in prehistory or history.

The Matterhorn Mill was accepted as a site of historical significance under criterion A for local industry significance in its contribution to 20th century silver mining in Colorado, and criterion C for engineering at the local level of significance. According to the notes included on the site form and nomination, the Matterhorn Mill (5SM.6717) was originally recorded with the entire Matterhorn Mill Complex as 5SM.2738; however, only the Mill building itself (5SM.6717) has been listed on the National Register as of 2/24/2010.

3.2 Site Characterization Results

Results for each of the investigations described in Section 3.1 are discussed below.

3.2.1 Subsurface Tailings Investigation and Volume Estimation

The subsurface tailings investigation performed by HCS in 2008 involved the excavation of test pits to (1) investigate the extent of tailings within the tailings pond and settling pond, (2) collect subsurface tailings samples at the tailings pond and settling pond for geotechnical testing and chemical laboratory analyses, (3) investigate the depth of soil/unconsolidated materials in a potential soil borrow area, and (4) investigate the depth of soil/unconsolidated material in a potential on-site repository area. Analytical laboratory results for the samples collected during the investigation are discussed along with the tailings results reported for AAK investigation in Section 3.2.4. Results for the remaining portions of the HCS scope of work are discussed below.

Tailings Pond

The tailings pond covers an irregularly-shaped area, with a surface area of approximately 28,000 square feet. Wood timbers encountered in the western portion of the tailings pond suggest that a wooden trellis had been constructed along the western perimeter of the pond for delivery of tailings slurry from the mill. As a result, larger, sand-size tailings were deposited close in the western portion of the pond and finer, silt- and clay-sized tailings were deposited within the central and eastern portions of the pond. No groundwater was encountered in any of the test pits excavated within the tailing pond.

The tailings encountered within the tailings pond are generally classified as silty sand (SM) in accordance with the Unified Soil Classification System (USCS) following ASTM D 2487. Relatively undisturbed tailings samples were obtained from two of the test pits (Test Pit #1 and Test Pit #4) for in-situ moisture and density measurements. In addition a consolidation test (ASTM D 2435) was performed on a tailings sample collected at Test Pit #1 to estimate the magnitude of potential volume change during loading/consolidation of the deposit. Classification of the tailings samples is summarized below.

Tailings Sample Classification – Tailings Pond

Sample	% Sand	% Silt	% Clay	LL[1]	PI[1]	USCS
TP#1 @ 2.1'	54	44	2	NV	NP	SM
TP#4 @ 3.2'	81	19	0	NV	NP	SM
Tailings bulk	62	30	8	NV	NP	SM

[1] LL ≡ Liquid Limit; PI ≡ Plasticity Index; NV ≡ no value; NP ≡ not plastic

In-situ soil properties and consolidation results for the tailings samples obtained from the tailings pond are summarized below.

In-Situ Soil Properties – Tailings Pond

Identification	In situ properties			Consolidation properties	
	Water content (%)	Dry density (pcf)	Maximum density (pcf)	C_r	C_c
TP#1 @ 2.1'	18.3	100.3	-	1.7	5.6
TP#4 @ 3.2'	15.9	88.9	95.3	-	-
tailings bulk	15.8	-	-	-	-

The overall thickness of tailings encountered in the test pits at the tailings pond averages 6.7 feet and generally increases from south to north; increasing from approximately 5 feet in the south to approximately 9 feet in the north. Based on a surface area of 29,000 square feet and average thickness of 6.7 feet, the estimated volume of tailings within the tailings pond is 194,300 cubic feet or approximately 7,200 cubic yards.

Settling Pond

The settling pond is located immediately west and approximately 15 feet lower in elevation than tailings pond and has a surface area of approximately 3,250 square feet. The material excavated from the test pit at the settling pond primarily consisted of fine-grained tailings (silt and clay with some fine sand). The tailings filled a depression formed in part by an earthen berm adjacent to the western perimeter of the settling pond. It is suspected that the tailings in the settling pond originated at the tailings pond and were possibly transported to the settling pond in response to overflow from the tailings pond; however, it is possible that the tailings were deposited in the settling pond directly from the mill.

The tailings encountered in the test pit at the settling pond were generally classified at low-plasticity silt (ML) in accordance with the USCS. Classification of the tailings samples is summarized below.

Tailings Sample Classification – Settling Pond

Identification	% Sand	% Silt	% Clay	LL	PI	USCS
Tailings bulk	25	43	32	35	6	ML

[1] LL ≡ Liquid Limit; PI ≡ Plasticity Index

In-situ moisture content of the bulk tailings sample collected at the settling pond indicated a water content of 35.8 percent.

The total surface area of tailings-impacted lands at the settling pond is approximately 11,000 square feet; the area delineated in Figure 3-2. The test pit was excavated in the deepest portion of the pond which is located adjacent to the soil berm that served as the pond embankment. The thickness of tailings encountered in the test pit was approximately 3 feet. Based on visual observations and a topographic survey conducted at the site during the HCS investigation, the 3-foot thickness of tailings is projected to cover approximately 3,250 square feet of the tailings-impacted area. A thin veneer of tailings (generally less than 6 inches thick) covers the remaining 7,750 square feet of impacted land. Based on these surface areas and thicknesses, the estimated volume of tailings within the settling pond is 13,625 cubic feet or

505 cubic yards. The volume of soil comprising the berm serving as the embankment for the settling pond is approximately 184 cubic yards based on the topographic survey performed during the HCS investigation.

Potential On-site Disposal Area

An area for potential on-site disposal of tailings from the mill site was identified through consultation with the Forest Service. The area lies immediately north-northeast of the mill structure, below the former railroad grade. The test pit excavated within the potential disposal area encountered bedrock at 2.3 feet below ground surface.

Potential Soil Borrow Area

A potential on-site soil borrow area was identified in consultation with the Forest Service immediately east of the mill structure along a road cut above the mill. The test pit excavated in the area encountered bedrock at 1.5 feet below ground surface. The material excavated from the test pit appeared to be imported road base.

3.2.2 Mill Waste Inside the Mill Building

Mill-waste samples were collected inside the mill building at the locations shown in Figure 3-1. The samples were collected with a hand trowel at approximate three- to six-inch depths below the surface. Analytical results for the four samples are presented in Table 3.1. In general, metals concentrations were generally lowest and most similar in the samples collected in the vicinity of the ball mill (MM-01) and the floatation cells (MM-02). The metals concentrations reported for the sample collected near the Wilfley gravity table (MM-04) were generally higher than the levels reported for MM-01 and MM-02. The ore/concentrate sample (MM-03) generally had the highest metals concentrations with the exception of manganese and mercury. The metals results for MM-03 are greater by a factor of 2 or more compared to samples MM-01 and MM-02, and are generally greater than the concentrations in MM-04.

3.2.3 Surface Water

Surface-water samples were collected at the locations shown in Figure 3-2 and described in Section 3.1 and on the completed sampling forms (Appendix B). Analytical results for the surface-water samples are presented in Table 3.2.

Comparison of the analytical results for upgradient and downgradient samples collected from Lake Fork (SW-1: upstream and SW-2: downstream) provides an indication of potential impacts to the stream as a result of constituents derived from the mill. However, the reach along the mill area may also be impacted by constituents derived from mines (i.e., San Bernardo Mine) located west of the stream. Therefore, degradation of water quality within this reach of Lake Fork may not be solely attributed to impacts from the mill.

Analytical results for the samples collected from Lake Fork indicate near neutral pH and that water quality downgradient of the mill area is generally consistent with water quality upgradient of the mill. The parameters showing the greatest increase in concentration from the upgradient to downgradient sampling stations were dissolved manganese and dissolved zinc. The dissolved manganese concentration increased by a factor of at least 5, from less than 5 micrograms per liter (µg/L) upstream of the mill to 25 µg/L downstream of the mill. The dissolved zinc concentration increased by a factor of at least 3, from less than 10 µg/L upstream of the mill to 30 µg/L downstream of the mill. These increases may be attributed in part to the elevated levels of manganese and zinc reported for water samples collected from the small pond, settling pond, and downgradient spring.

Analytical results for the surface-water samples collected within the mill area (samples SW-3 [small pond] and SW-4 [settling pond]) show the waters to be acidic [(pH values of 2.9 to 3.7 s.u.]). Samples SW-3 and SW-4 contain the following parameters at levels 2 to 10 times greater than the levels reported for the upstream Lake Fork sample (SW-1):

- Physical parameters:
    - Total Suspended Solids
    - Total Dissolved Solids

- Inorganics

    - Boron
    - Dissolved Calcium
    - Dissolved Magnesium
    - Nitrogen Ammonia
    - Potassium
    - Sulfate

- Metals
    - Dissolved Antimony
    - Total Recoverable Chromium
    - Dissolved Nickel

  - Dissolved Selenium
  - Dissolved Silver

Samples SW-3 and SW-4 contain the following parameters at levels 10 to 100 times greater than the levels reported for the upstream Lake Fork sample (SW-1):

- Inorganics
  - Chloride

- Metals
  - Dissolved Arsenic
  - Total Recoverable Arsenic
  - Dissolved Copper

Samples SW-3 and SW-4 contain the following parameters at levels more than 100 times greater than the levels reported for the upstream Lake Fork sample (SW-1):

- Physical parameters:
  - Acidity

- Metals
  - Dissolved Cadmium
  - Dissolved Iron
  - Total Recoverable Iron
  - Dissolved Lead
  - Dissolved Manganese
  - Dissolved Zinc

Comparison of the analytical results for sample SW-5 (collected at a spring located downgradient of the mill area) to the results reported for the upstream Lake Fork sample indicates that the water contains elevated levels of total dissolved solids, dissolved calcium, dissolved magnesium, dissolved nitrate, sulfate, dissolved manganese, and dissolved zinc. The elevated levels for these parameters may, in part, reflect natural groundwater conditions in the region. However, it is likely that mill-derived constituents have adversely impacted water quality in the shallow groundwater system beneath and downgradient of the mill area. For example, the elevated levels of dissolved manganese and dissolved zinc in the spring sample may be associated with the high levels reported for these parameters in the water samples collected at the mill.

3.2.4 Tailings

Tailings, sediment, and soil samples were collected at the locations shown in Figure 3-2 and described in Section 3.1 and on the completed sampling forms (Appendix B). The near-surface tailings, sediment, and soil samples collected during the AAK investigation were obtained by collecting at least five subsamples at a depth of 0- to 6-inches within each identified sampling area. The subsurface tailings samples collected during the HCS investigation were obtained by collecting subsamples from test pits excavated within the tailings pond and the settling pond. Analytical results for the tailings, sediment, and soil samples are presented in Table 3.3.

3.2.4.1 Surface Tailings

Comparison of the analytical results reported for the surface tailings samples collected within the north half of tailings pond (T-1) to samples collected within the south half of tailings pond (T-2) shows that metals concentrations are generally consistent across the tailings pond area. Except for zinc, metals concentrations reported for the two tailings pond areas differ by less than a factor of 2. The zinc concentration reported for the sample T-2 is approximately 3.2 times greater than the zinc concentration reported for sample T-1.

Comparison of the average analytical results reported for tailings T-1 and T-2 to the analytical results reported for tailings sample T-3 (settling pond) also shows that metals concentrations are generally consistent for the two features. Except for cadmium, metals concentrations reported for the two features differ by less than a factor of 2.0. The average cadmium concentration reported for the tailings pond samples is approximately 3.0 times greater than the cadmium concentration reported for the settling pond.

Except for chromium, manganese, nickel, uranium, and vanadium, the average metals concentrations reported for the tailings pond and settling pond exceed the concentrations reported for surface background soil. The metals reported for the two features at concentrations exceeding background levels by more than a factor of 10 include antimony (131 times higher), arsenic (20 times higher), lead (98 times higher), mercury (11 times higher), and silver (38 times higher). The metals reported for the tailings areas at concentrations exceeding background levels by a factor of more than 2 but less than 10 include cadmium (8 times higher), copper (6 times higher), molybdenum (4 times higher), selenium (9 times higher), and zinc (9 times higher).

3.2.4.2 Subsurface Tailings

The analytical results reported for tailings pond surface samples T-1 and T-2 are generally consistent (within a factor of 2.0) with the results reported for the subsurface tailings pond sample. The analyte reported at highest concentration in the tailings pond subsurface sample relative to the average concentrations for the surface samples was total iron; the total iron concentration in the subsurface sample was 2.56 times higher than average concentration reported for the surface samples. These findings indicate that surface and subsurface tailings within the tailings pond are fairly homogeneous with respect to metals concentrations.

Most of the analytical results reported for settling pond surface sample T-3 are generally consistent (within a factor of 2.0) with the results reported for the subsurface settling pond sample. However, several analytes in the subsurface sample were reported at concentration more than 2.0 times greater than the concentrations reported for the surface sample, including total copper (2.73 time greater), total manganese (56.62 times greater), total mercury (4.15 times greater), total nickel (5.0 times greater), and total zinc (3.7 times greater).

Comparison of the subsurface samples collected from the tailings pond and settling pond indicates that the subsurface tailings in the settling pond contain notably higher concentrations of total manganese and total cadmium.

3.2.4.3 SPLP Results

In addition to total metals analyses, surface tailings samples T-1 (northern half of tailings pond) and T-3 (settling pond) and subsurface tailings samples at the tailings pond and settling pond were also analyzed for SPLP metals analyses. The SPLP analytical results for the samples are presented in Table 3.4. Except for chromium, mercury, molybdenum, uranium, and cyanide, each analyte was detected in one or more of the samples. For several of the analytes, concentrations are reported at values between the method detection limit and practical quantitation limit. Because the practical quantitation limit is considered the lowest concentration that can accurately be measured, the concentrations reported below the practical quantitation limit are considered estimated values. The metals reported at concentrations above the practical quantitation limits in one or more of the samples are cadmium, copper, iron, manganese, selenium, silver, zinc, and nitrogen ammonia. Of these analytes, manganese and zinc were reported at the highest concentrations; the highest manganese and zinc concentrations were reported for the subsurface sample collected at the settling pond.

3.2.5 Sediment

The composite sediment sample (SED-1) was collected within the smaller pond located northwest of the settling pond at the location shown in Figure 3-2 and described in Section 3.1 and on the completed sampling forms (Appendix B). The pond likely receives some runoff from the settling pond as well as runoff conveyed along the un-named drainage that drains the basin upgradient of the mill site. Analytical results for the sediment sample are presented in Table 3.3.

The metals reported at the highest concentrations in the sediment sample are arsenic, copper, iron, lead, manganese, and zinc. The metals reported for the sediment sample at concentrations exceeding background levels by more than a factor of 10 include antimony (21 times higher), arsenic (12 times higher), copper (18 times higher), iron (13 times higher), and silver (16 times higher). The metals reported for the sediment at concentrations exceeding background levels by a factor of more than 2 but less than 10 include cadmium (3 times higher), lead (6 times higher), mercury (4 times higher), molybdenum (4 times higher), selenium (4 times higher), and zinc (4 times higher).

3.2.6 Soil

A composite soil sample was collected from the berm located on the west perimeter of the settling pond shown in Figure 3-2 and described in Section 3.1 and on the completed sampling forms (Appendix B). Analytical results for the soil sample are presented in Table 3.3.

The metals reported at the highest concentrations in the soil sample are arsenic, copper, iron, lead, manganese, and zinc. The metals reported for the soil sample at concentrations exceeding background levels by more than a factor of 10 include antimony (42 times higher), arsenic (15 times higher), cadmium (12 times higher), copper (22 times higher), lead (45 times higher), and silver (16 times higher). The metals reported for the soil sample at concentrations exceeding background levels by a factor of more than 2 but less than 10 include iron (3 times higher), manganese (9 times higher), mercury (3 times higher), molybdenum (5 times higher), selenium (8 times higher), and zinc (9 times higher). These findings suggest that tailings may have been used in part to construct the berm.

3.2.7 Vegetation

Composite vegetation samples comprised of typical grasses were collected throughout the tailings area, settling pond, and within a background area located immediately northeast of the mill. Attempts were made to obtain an even distribution of samples within each area. Analytical results for the vegetation samples are presented in Table 3.5.

Comparison of the analytical results reported for vegetation samples VEG-T (tailings pond) and VEG-POND (settling pond) shows that metals concentrations are generally consistent for the two features. Except for manganese, metals concentrations reported for the two features differ by less than a factor of 2. The average manganese concentration reported for sample VEG-POND is approximately 4.0 times greater than the manganese concentration reported for sample VEG-T.

Except for mercury, molybdenum, and uranium, the average metals concentrations reported for vegetation samples collected from the tailings pond and settling pond exceed the concentrations reported for background soil. The average metals concentrations for vegetation at the tailings and settling ponds exceeded background levels by more than a factor of 10 for antimony (16 times higher), arsenic (17 times higher), iron (11 times higher), and lead (26 times higher). The metals reported for the two features at concentrations exceeding background levels by a factor of more than 2 but less than 10 include cadmium (3 times higher), copper (6 times higher), manganese (9 times higher), silver (3 times higher), and zinc (3 times higher).

3.3 Streamlined Risk Evaluation

The streamlined risk evaluation process was used to assess potential threats to human-health and the environment associated with surface water, tailings, sediment, soil, and vegetation at and in the vicinity of the mill site. The process was implemented in accordance with guidance presented in *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993). The evaluation was performed by comparing analytical results for samples collected during the site investigations to background levels and established risk-based benchmarks. The established benchmarks used in the evaluation include (1) Risk Management Criteria (RMC) established by the U.S. Bureau of Land Management (BLM) for metals at BLM mine sites (Ford, 2004), (2) stream standards established by the Colorado Water Quality Control Commission (WQCC), and (3) Regional Screening Levels (RSL) and

Soil Screening Levels (SSL) for Chemical Contaminants at Superfund Sites established by the U.S. Environmental Protection Agency (EPA).

The risk evaluation recognizes that some of the potential sources identified during site characterization efforts are located on Forest Service lands and some are located on adjacent private land. Because the tailings located on the adjacent private land were derived from former operations at the mill located on Forest Service land, the risk scenarios used for the evaluation were uniformly applied, regardless of current land ownership boundaries.

3.3.1 Potential Sources, Exposure Pathways, and Receptors

The primary contaminant sources at the mill site are mill wastes (processing spillage and ore/concentrate) within the mill building and tailings within the tailings pond and settling pond. Secondary sources associated with the mill site include the following:

- Surface water within the settling pond and small pond located northwest of the settling pond
- Surface water emanating from a spring downgradient of the mill site
- Soil comprising the berm constructed at the settling pond
- Sediment within the small pond located northwest of the settling pond
- Vegetation within and along the perimeter of tailings pond and settling pond

The primary human receptors potentially exposed to contaminants at the mill site are site visitors, site workers, and adjacent residents downgradient of the mill area. The principal exposure routes for the human receptors include ingestion, inhalation, and dermal contact.

The site visitors most likely expected in the tailings pond and settling pond areas include individuals using the areas for camping, hiking, ATV driving, or other forms of recreation. Site workers include individuals working within the mill building or within the tailings pond and settling pond areas.

The threats posed to adjacent residents consider the potential for site-derived contaminants to migrate from the primary source areas and onto adjacent private lands. Although no residences are currently located adjacent to the mill area, consideration of the adjacent resident scenario is considered appropriate because (1) the settling pond, which is considered a primary contaminant source, is located on private land immediately adjacent to the Forest Service land on which the tailings pond and mill building are located, (2) residential development could occur on the adjacent private land in the future, and (3) the potential exists for site contaminants to migrate to Lake Fork and ultimately to private lands located downstream of the mill site.

The primary ecological receptors potentially affected by contaminants at the mill include terrestrial biota (wildlife and livestock) and aquatic biota. The principal exposure routes to ecological receptors include ingestion and direct contact. The threats posed to ecological receptors are evaluated in this study based on the analytical results for (1) surface water, (2) tailings, sediment, and soil, and (3) vegetation.

3.3.2 Risk Evaluation Criteria

As discussed above, the established benchmarks used in the evaluation include (1) BLM RMC for metals at BLM mine sites (Ford, 2004), (2) RSL and SSL for Chemical Contaminants at Superfund Sites established by the EPA, and (3) stream standards established by the WQCC. Each benchmark is further discussed below.

The BLM RMC designed to protect human receptors were developed using available toxicity data and standard EPA exposure assumptions. The RMC designed to protect wildlife receptors were developed using toxicity values and wildlife intake assumptions reported in ecotoxicology literature. Human exposure scenarios were developed to provide realistic estimates of the types and extent of exposure to metals in water, soil, and sediments that individuals might experience at mine sites.

The EPA's RSL for Chemical Contaminants at Superfund Sites are intended to assist risk assessors in initial screening-level evaluations of environmental measurements. The RSL used in this evaluation assume the industrial and residential soil scenarios. The EPA's SSL used in this evaluation were developed by the EPA for protection of groundwater resources that may be used as a potable water source, using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface. A DAF of 1, assuming no dilution or attenuation, was not considered appropriate for this site.

Table 3.6 presents BLM RMC and EPA RSL for the resident, site visitor (camper and ATV driver), and site worker scenarios. As shown in the table, screening levels have been established for each scenario based on the most restrictive criterion for each parameter. The resulting screening levels are the benchmarks used relative threats based on the analytical results reported for samples collected during site investigation efforts.

Stream standards established by the WQCC provide a means of assessing potential threats associated with the designated uses specified for a given reach or stream. The standards used for the evaluation are those established for the mainstem of South Fork of the San Miguel River, specified in Regulation 35 – Classification and Numeric Standards for Gunnison and Lower Dolores River Basins (Segment 8 of the San Miguel River Basin). Although Lake Fork is the closest stream to the mill, the WQCC has not established stream standards for Lake Fork. The standards for South Fork are used for this evaluation because Lake Fork joins with Howard Fork to form South Fork downstream of the mill site. The designated uses specified for Segment 8 of the San Miguel River Basin include aquatic life cold 1, recreation E, water supply, and agriculture. For this evaluation, the benchmarks were used to assess the ecological threats based on aquatic-life standards and the human-health threats based on water-supply standards. Table 3.7 presents the surface water criteria used for the human-health risk evaluation (camper RMC and water-supply standards) and for the ecological evaluation (aquatic life).

On tables illustrating the comparisons of analyte concentrations to benchmarks, the analyte levels exceeding the criteria by 1 to 10 times, 10 to 100 times, and more than 100 times are denoted with "+", "++", and "+++", respectively. For this evaluation, analytes present at concentrations exceeding the risk-based benchmarks by factors of 2 or less are considered to pose a low threat to human health while concentrations exceeding the risk-based benchmarks by factors of more than 2 to 10, 10 to 100, and more than 100 are considered to pose moderate, high, and extremely high threats to human health, respectively. The use of these descriptions provides a means of assessing relative threat and is not intended to be definitive of risk.

3.3.3 Human Health Risk

The human-health risk evaluation considered the threats posed to (1) site workers as a result of mill waste accumulations within the mill structure, (2) site visitors and adjacent residents as a result of elevated metals concentrations in tailings, soil, sediment, and surface water, and (3) site workers as a result of elevated metals concentrations in tailings, soil, and sediment.

3.3.3.1 Mill Waste Within Mill Structure

Analytical results for tailings samples collected within the mill structure were compared to the BLM RMC for site workers and the EPA RSL for industrial workers. Results are presented in Table 3.8. The analytes reported at concentrations exceeding human-health criteria are antimony, arsenic, cadmium, copper, and lead. The concentrations reported at levels above the criteria for cadmium (MM-03 and MM-04) and copper (MM-03) exceed the screening levels by less than a factor of 2; therefore, elevated cadmium and copper concentrations are considered to pose a low risk site/industrial workers. The antimony, arsenic, and lead concentrations reported for the mill waste samples are considered to pose moderate to extremely high risk to site/industrial workers.

The relative threats to site/industrial workers based on the concentrations reported for the mill-waste samples are summarized as follows:

- Antimony
  - Processing spillage – moderate
  - Ore/concentrate – high

- Arsenic
  - Processing spillage and ore/concentrate – extremely high

- Cadmium
  - Processing spillage (MM-04) and ore/concentrate - low

- Copper
  - Ore/concentrate – low

- Lead
  - Processing spillage – high
  - Ore/concentrate – extremely high

3.3.3.2 Tailings, Sediment, and Soil

Table 3.9 presents a comparison of analytical results for tailings, sediment, and soil to BLM RMC for the adjacent resident and EPA RSLs for residential soil. Although the subsurface tailings are currently not exposed at the ground surface and available for direct human contact, the comparisons include the composite sub-surface samples collected at the tailings pond and settling pond because the currently buried materials could become exposed at the ground surface in the future as a result of erosion or other mass wasting processes. The metals reported at concentrations exceeding the screening levels for residential soil are antimony, arsenic, cadmium, copper, iron, lead, manganese, silver, and zinc. Of these metals, arsenic was reported at the highest levels relative to the RMC, with each of the on-site samples reporting concentrations exceeding the criterion by more than 100 times. However, it should be noted that the arsenic concentration in the background soil sample exceeded the criterion by nearly 24 times. The relative threats posed by the metals found to present at concentration exceeding the residential criteria are summarized as follows:

- Antimony
    - Tailings pond and settling pond tailings – high
    - Small pond sediment and soil berm – moderate

- Arsenic
    - Tailings pond, settling pond tailings, small pond sediment, and soil berm – extremely high
    - Background soil – moderate

- Cadmium
    - Tailings pond and soil berm – moderate

- Copper
    - Small pond sediment and soil berm – low

- Lead
    - Tailings pond north – high
    - Tailings pond south, settling pond tailings, and soil berm – moderate

- Manganese
    - Soil berm – moderate

- Silver
    - Tailings pond south – low

Table 3.10 presents a comparison of analytical results for tailings, sediment, and soil to BLM RMC for site visitors (camper and ATV driver). The metals reported at concentrations exceeding the site visitor RMC are antimony, arsenic, and lead. Of these metals, arsenic was reported at the highest levels relative to the RMC, with samples collected from the tailings pond, settling pond, and soil berm reporting concentrations exceeding the criterion by more than 10 but less than 100 times. The relative threats posed by the metals found to exceed the site visitor RMC are summarized as follows:

- Antimony
    - Tailings pond and settling pond tailings – low

- Arsenic
    - Tailings pond, settling pond tailings, and soil berm – high

  - Small pond sediment – moderate

- Lead
  - Tailings pond and settling pond tailings – moderate
  - Soil berm – low

Table 3.11 presents a comparison of analytical results for tailings, sediment, and soil to screening levels for site/industrial workers. The metals reported at concentrations exceeding the screening criteria are arsenic and lead. Of these metals, arsenic was reported at the highest levels relative to the criterion, with samples collected from the tailings pond and settling pond reporting concentrations exceeding the criterion by more than 100 times. The arsenic concentrations reported for the samples collected from the settling pond berm and sediment in the small exceeded the criterion by more than 10 but less than 100 times. However, it should be noted that the arsenic concentration in the background soil sample exceeded the criterion by nearly 6 times. The relative threats posed by the metals found to exceed the RSLs are summarized as follows:

- Arsenic
  - Tailings pond and settling pond tailings – extremely high
  - Small pond sediment and soil berm – high
  - Background soil – moderate

- Lead
  - Tailings pond, settling pond tailings, and soil berm – moderate

Table 3.12 presents a comparison of analytical results for tailings, sediment, and soil to EPA SSLs, the levels established by EPA to be protective of groundwater that may be used as a potable water source. Although groundwater is not being used as a potable water source at the mill site or private land adjacent to the mill site, the comparisons provide a general guide for assessing potential threats to groundwater resources at the site. The metals reported at concentrations exceeding the SSLs are antimony, arsenic, iron, manganese, mercury, and silver. Of these metals, arsenic was reported at the highest levels relative to the SSL, with each of the on-site samples reporting concentrations exceeding the criterion by more than 100 times. However, it should be noted that the arsenic concentration in the background soil sample also exceeded the criterion by more than 100 times. The relative threats posed by the metals found to exceed the SSLs are summarized as follows:

- Antimony
  - Tailings pond and settling pond tailings – high
  - Small pond sediment and soil berm – low

- Arsenic
  - Tailings pond, settling pond tailings. small pond sediment, soil berm, and background soil – extremely high

- Iron
  - Background soil – moderate
  - Tailings pond – moderate
  - Tailings pond (subsurface) - high
  - Settling pond – moderate
  - Small pond sediment and soil berm - high

- Manganese
  - Soil berm – high

- Mercury
  - Tailings pond north - low

- Silver
  - Tailings pond and settling pond tailings – moderate
  - Small pond sediment and soil berm - low

3.3.3.3 Surface Water

Analytical results for surface-water samples collected at the mill site were first compared to background levels as defined by the analytical results reported for the sample collected from Lake Fork upstream of the mill (SW-1). The upstream Lake Fork sample is considered "background" relative to the mill area. The analytical parameters reported at levels greater than background are presented in Table 3.13. For the samples collected at the mill site (SW-3, SW-4, and SW-5), the parameters reported at concentrations exceeding background levels by a factor of 10 or more are acidity (up to 207 times background), chloride (up to 12 times background), dissolved cadmium (up to 392 times background), dissolved copper (up to 100 times background), dissolved iron (up to 1,980 times background), total recoverable iron (up to 2,130 times background), dissolved lead (up to 1,030 times background), dissolved manganese (up to 1,966 times background), and zinc (up to 828 times background). As discussed in Section 3.2.2 of this report, site-derived contaminants may be contributing to the elevated levels of manganese and zinc reported for the sample collected from Lake Fork downstream of the mill area; however, other potential sources of metals contamination are present within the reach in addition to the mill site.

The human-health risks associated with metals in surface water at and downgradient of the mill site were evaluated by comparing the reported analyte concentrations to BLM RMC for the camper scenario and the water-supply specific standards established by the WQCC for Segment 8 of the San Miguel River

Basin. The BLM RMC are designed for protection of on-site visitors (campers) and provide for the most direct assessment of the potential threats that the waters pose to human health. The surface water RMC established by BLM consider incidental ingestion in combination with exposures from other media and pathways. The water-supply stream standards are designed for the protection of domestic water supply uses which have been identified at some location(s) to which the stream segment is tributary.

A comparison of analytical results for the surface-water samples to human-health criteria is presented in Table 3.14. As indicated, shaded values presented in bold-type exceed human-health criteria. The analytes reported at concentrations exceeding human-health criteria include sulfate, total recoverable arsenic, dissolved cadmium, dissolved iron, dissolved lead, dissolved manganese, and dissolved zinc. In addition to these analytes, the pH values reported for the water samples collected at the mill site were all below the range specified to the water-supply stream standard. The human-health criteria were not exceeded in the two surface-water samples collected from Lake Fork.

It should be noted that the arsenic criterion for domestic water supply established by the WQCC is a range, 0.02 µg/L to 10 µg/L. The first number in the range is a strictly health-based value, based on the WQCC's established methodology for human health-based standards. The second number in the range is the maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. The method detection limit for arsenic (0.5 µg/L) is more than 10 times greater than the low end of the range.

The relative threats posed by the analytes found to exceed the human-health criteria are summarized as follows:

- Sulfate
    - Settling pond and spring – low risk (water-supply stream standard)

- Arsenic, total recoverable
    - Settling pond – extremely high risk (water-supply stream standard 0.02 µg/L) but low/moderate risk (water-supply stream standard and MCL, 10 µg/L)
    - Small pond – high risk (water-supply stream standard 0.02 µg/L) but low risk (water-supply stream standard and MCL, 10 µg/L)

- Cadmium, dissolved
    - Settling pond, small pond, and spring – moderate risk (water-supply stream standard) and low risk (RMC camper)

- Iron, dissolved
  - Settling pond – extremely high risk (water-supply stream standard)
  - Small pond – high risk (water-supply stream standard)

- Lead, dissolved
  - Small pond – low/moderate risk (water-supply stream standard and RMC camper)

- Manganese, dissolved
  - Settling pond, spring, and small pond – extremely high risk (water-supply stream standard) and moderate risk (RMC camper)

- Zinc, dissolved
  - Settling pond and small pond – low risk (water-supply stream standard and RMC camper)

3.3.3.4 Human-Health Risk Evaluation Summary

Surface water at the mill site is limited to intermittent ponding of water in the settling pond in response to precipitation events and runoff. Water is likely present year-round in the small pond, located approximately 50 feet northwest of the settling pond, which receive inflow from the un-named drainage that originates in the small basin north of the mill site; the pond also likely receives some inflow from runoff originating on the mill site. The parameters reported at the highest levels in surface-water samples collected at the mill site relative to levels reported for the upstream Lake Fork sample include acidity, chloride, dissolved cadmium, dissolved copper, dissolved iron, total recoverable iron, dissolved lead, dissolved manganese, and zinc. While elevated levels of these parameters are not indicative of risk, the elevated values provide an indication of potential site-derived contamination.

Based on the analytical data available for this evaluation, surface water at the mill site poses potential threat to camper because of low pH and elevated concentrations of dissolved lead (small pond) and dissolved manganese (settling pond, small pond, and sampled spring). Total recoverable arsenic, dissolved cadmium, dissolved iron, dissolved lead, and dissolved manganese concentrations in surface water at the mill site pose potential threats to downstream domestic water supplies. However, the water – supply stream standards for these metals were not exceeded in the water sample collected from Lake Fork downstream of the mill site. These findings suggest that the elevated levels reported in surface water at the mill site are not causing exceedances of the water-supply standards in Lake Fork downstream of the mill site.

With respect to mill waste within the mill structure, the parameters posing the greatest threat to site/industrial workers are antimony, arsenic, and lead.

With respect to tailings, sediment, and soil at the mill area, the parameters posing the greatest threat to adjacent residents, as a result of contaminated materials potentially migrating from the site, are arsenic, antimony, and lead. Arsenic and lead also pose the greatest threat to site visitors and potential site/industrial workers at the mill area. However, it should be note that arsenic concentrations reported for the background soil sample pose a moderate risk to industrial workers and a high risk to residents. Antimony, arsenic, and iron in tailings, sediment, and soil at the mill pose the greatest threat to groundwater as a potential drinking water source; however, the arsenic concentration in the background sample exceeds the SSL by more the 100 times.

Based on the analytical results reported for sample collected during site investigation at the mill site, the metals posing the greatest threat to human health (concentrations reported at levels more than 10 times the human-health criteria suggesting high to extremely high risk) are as follows:

- Mill Waste
  - Antimony – Site/industrial worker
  - Arsenic – Site/industrial worker
  - Lead – Site/industrial worker

- Tailings
  - Antimony – resident, protection of groundwater as potable source
  - Arsenic – resident, camper, site/industrial worker, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
  - Lead – resident
  - Iron – protection of groundwater as potable source

- Settling Pond Berm
  - Arsenic – resident, site/industrial worker, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
  - Manganese – protection of groundwater as potable source
  - Iron – protection of groundwater as potable source

- Sediment in small perennial pond
  - Arsenic – resident, protection of groundwater as potable source (note: arsenic concentration in background soil high risk to resident and extremely high risk with respect to protection of groundwater as potable source)
  - Iron – protection of groundwater as domestic source

- Intermittent surface water in settling pond
    - Arsenic – water supply stream standard
    - Iron – water supply stream standard
    - Manganese – water supply stream standard
- Surface water in small pond
    - Arsenic – water supply stream standard
    - Iron – water supply stream standard
    - Manganese – water supply stream standard

- Downgradient spring
    - Manganese – water supply stream standard

3.3.4 Ecological Risk

Ecological threats attributed to former operations at the mill site are evaluated by comparing analytical results reported for surface-water, tailings, sediment, soil, and vegetation samples collected at the mill site to established benchmarks. Surface-water results are compared to the aquatic life stream standards established by the WQCC for Segment 8 of the San Miguel River Basin. Tailings, sediment, and soil results are compared to RMC established by BLM for wildlife and livestock and a vanadium benchmark derived by EPA. Vegetation results are compared to the maximum tolerable levels of dietary minerals for domestic animals (National Research Council, 1980).

3.3.4.1 Surface Water

The uses of surface water within Segment 8 of the San Miguel River have been classified as aquatic-life cold 1, recreation E, water supply, and agriculture. Hardness-dependent standards, referred to as “table value standards (TVSs)” in the regulation, were calculated in accordance with Regulation 31 – Basic Standards and Methodologies for Surface Water. Because hardness values are not available for South Fork, the calculations were performed using a conservative hardness value of 100 milligrams per liter (mg/L).

The risks associated with surface water to terrestrial biota were not directly assessed in this evaluation. It is recognized that any actions taken to protect aquatic life and humans (site visitors) would also provide protection for terrestrial biota.

A comparison of analytical results for the surface-water samples to aquatic-life stream standards for Segment 8 of the San Miguel River Basin is presented in Table 3.15. Based on the comparisons made in

Table 3.15, aquatic-life standards are not exceeded in Lake Fork upstream or downstream of the mill site. As shown in the table, the pH of water in the features sampled at the mill site is below the established stream standard, indicating a potential threat to aquatic life. The analytes posing potential threats to aquatic life in the small pond (SW-3) are dissolved cadmium (up to 45 times the standard), dissolved copper (up to 24 times the standard), total recoverable iron (up to 3 times the standard), dissolved lead (up to 41 times the standard), dissolved manganese (up to 6 times the standard), and dissolved zinc (up to 47 times the standard). The analytes posing potential threats to aquatic life in the settling pond (SW-4) are dissolved cadmium (93 times the standard), dissolved copper (111 times the standard), total recoverable iron (43 times the standard), dissolved lead (14 times the standard), dissolved manganese (3 times the standard), dissolved silver (3 times the standard), and dissolved zinc (67 times the standard). The analytes posing potential threats to aquatic life in water emanating from the spring (SW-5) are dissolved cadmium (31 times the standard), dissolved copper (7 times the standard), dissolved manganese (4times the standard), and dissolved zinc (24 times the standard).

These findings suggest that the parameters in on-site waters posing the greatest threat to aquatic life are low pH, dissolved cadmium, dissolved copper, dissolved lead, and dissolved zinc. The parameters posing the greatest threat to aquatic life in water emanating from the spring are low pH, dissolved cadmium, and dissolved zinc. However, the elevated concentrations in surface water at the mill site and in the spring do not appear to be impacting Lake Fork with respect to the aquatic-life standards.

3.3.4.2 Tailings, Sediment, and Soil

The ecological risks associated with metals in tailings, sediment, and soil at the mill site were evaluated by comparing the analytical results to RMC for metals in soil, including 2005 criteria for uranium and vanadium derived by the BLM and EPA, respectively. The livestock and wildlife RMC established by the BLM for soil are listed in Table 3.16. Comparisons are made in this evaluation to the median RMC and EPA-derived vanadium criterion. These comparisons are considered to be conservative given the home ranges of the individual receptors were not taken into account for this study. Although the subsurface tailings are currently not exposed at the ground surface and available for direct contact with ecological receptors, the comparisons include the composite sub-surface samples collected at the tailings pond and settling pond because the currently buried materials could become exposed at the ground surface in the future as a result of erosion or other mass wasting processes.

A comparison of total metal results for tailings, sediment and soil at the mill to the median RMC and EPA-derived vanadium standard is presented in Table 3.17. As shown, metals concentrations in the background soil sample did not exceed the screening level RMC for livestock and wildlife.

Tailings within the tailings and settling ponds and soil comprising the berm along the settling pond contains cadmium, copper, lead, and zinc at concentrations exceeding screening levels. Of these, the lead concentration poses a high threat while cadmium, copper, and zinc concentrations pose a low to moderate threat to ecological receptors.

Sediment within the small pond contains copper, lead, and zinc at concentrations exceeding screening levels. Based on these comparisons, copper poses a moderate threat and lead and zinc pose a low threat (less than 2 times the standard) to livestock and wildlife.

3.3.4.3 Vegetation

Vegetation at the mill site is considered both a receptor and dietary item for herbivores. Analyte levels in vegetation were evaluated by comparing analytical results for samples collected at the mill site to the maximum tolerable levels of dietary minerals for domestic animals (National Research Council, 1980). The maximum tolerable level, as defined in the National Research Council study, represents the dietary level that, when fed for a limited period will not impair animal performance and should not produce unsafe residues in human food derived from the animal. The maximum tolerable levels derived from the study are presented in Table 3.18.

A comparison of the analytical results for vegetation at the mill site and in the background area to maximum tolerable levels is presented in Table 3.19 Metals concentrations reported for the background vegetation sample are less than the maximum tolerable levels. Grasses growing in the vicinity of the tailings pond (sample VEG-T) contain cadmium, iron, and lead at concentrations exceeding the criteria. For the grasses, the cadmium concentration likely poses a low threat (result less than 2 times the criterion) while iron and lead concentrations may pose a moderate threat to domestic animals. Grasses growing in the vicinity of the settling pond contain cadmium, iron, lead, and manganese at concentrations exceeding the maximum tolerable levels. For these grasses, the reported cadmium and manganese concentrations likely pose a low threat (less than 2 times the criteria) while iron and lead may pose a moderate threat to domestic animals.

3.3.4.4 Ecological Risk Evaluation Summary

Surface water present within the small pond and intermittently present in the settling pond in response to precipitation runoff potential pose a threat to aquatic life because of low pH and elevated concentrations of cadmium, copper, iron, lead, manganese, and zinc. Of these, the parameters in surface water at the mill site posing the greatest threat to aquatic life are low pH, dissolved cadmium, dissolved copper, dissolved lead, and dissolved zinc. The parameters posing the greatest threat to aquatic life in water emanating from the spring downgradient of the mill site are low pH, dissolved cadmium, and dissolved zinc. However, the elevated concentrations in surface water at the mill site and in the spring do not appear to be impacting Lake Fork with respect to the aquatic-life standards.

Lead likely poses the greatest threat to livestock and wildlife at the mill site. The elevated lead concentrations reported for the tailings samples collected from the tailings and settling ponds and suspected tailing in the berm potentially pose a high threat to livestock and wildlife. Elevated concentrations of cadmium, copper, and zinc reported for samples collected at these features pose low to moderate threats to livestock and wildlife. Sediment within the small pond poses a low threat to livestock and wildlife based on the analyte concentrations reported to the sediment sample collected at the pond.

Vegetation growing within and adjacent to the tailing pond and settling pond may pose a moderate threat to domestic animals based on elevated concentrations of iron and lead.

Based on the analytical results reported for sample collected during site investigation at the mill site, the metals posing the greatest threat to ecological receptors (concentrations reported at levels more than 10 times the ecological criteria suggesting high to extremely high risk) are as follows:

- Settling pond surface water – aquatic life
  - Dissolved cadmium
  - Dissolved copper
  - Total recoverable iron
  - Dissolved lead
  - Dissolved zinc

- Small pond surface water – aquatic life
  - Dissolved cadmium
  - Dissolved copper
  - Dissolved lead
  - Dissolved zinc

- Downgradient spring – aquatic life
  - Dissolved cadmium
  - Dissolved zinc

- Tailings – livestock and wildlife
  - Lead
- Soil berm – livestock and wildlife
  - Lead

3.3.5 Risk Posed by Leachate

Because of the proximity of the mill site to Lake Fork and on-site surface-water features, RMC were derived in this evaluation based on the leaching characteristics of the tailings material comprising the northern section of the tailings pond and the settling pond. The leaching RMC are intended to protect the use classifications specified in the stream standards from leaching of metals. The leaching RMC were derived by using the standards specified for South Fork and the total metals and SPLP metals results reported for the tailings samples. The mean proportion leaching factor under the SPLP test was computed by dividing the total metal concentration by the SPLP concentration. A dilution-attenuation factor (DAF) of 20 was then applied using EPA's Soil Screening Level guidance (EPA, 1996). Leaching RMC were calculated according to the following formula:

Leaching RMC = Aquatic-Life Standard x Total Metals/SPLP x DAF

The derived leaching RMC are compared to the total concentrations of the respective metals in the tailings to assess whether the total metal concentrations pose a threat based on the leaching characteristics of the tailings material.

Comparisons of total metals results for the surface and subsurface samples collected at the tailings pond (T-1 and Matterhorn Tailings) and settling pond (T-3 and Matterhorn Settling) to leaching RMC derived from aquatic-life stream standards and water-supply stream standards are presented in Table 3.20. The leaching RMC values listed in the tables represent the levels above which the total metals concentrations in the corresponding tailings samples would produce leachate with concentrations exceeding water-quality standards. For example, the calculated leaching RMC derived from the aquatic-life stream standards for cadmium in the surface sample collected at the tailing pond (T-1) indicates that the cadmium concentration in leachate derived from the sample would exceed the water quality standard (0.42 µg/L) if the cadmium concentration in the tailings is greater than 18 mg/kg.

Leachate Generation and Aquatic-Life Stream Standards

For the tailings pond, lead was the only analyte reported at a concentration exceeding the leaching RMC derived from the aquatic-life stream standards. The lead concentration reported for the subsurface sample (Matterhorn Tailings) exceeded the leaching RMC by a factor of 2, suggesting the tailings pose a low threat with respect to leachate generation and potential impacts to aquatic life.

For the settling pond, cadmium, manganese, and zinc concentrations reported for the subsurface sample exceeded the leaching RMC derived from the aquatic-life stream standards. The comparisons suggest that cadmium concentrations in tailings within the settling pond may pose a high risk with respect to leachate generation and potential impacts to aquatic life, while manganese and zinc may pose a low to moderate threat.

Leachate Generation and Water-Supply Stream Standards

For the tailings pond, arsenic was the only analyte reported at a concentration exceeding the leaching RMC derived from the water-supply stream standards. The arsenic concentration in the surface sample collected at the tailings pond exceeded the leaching RMC by a factor of 2, suggesting the tailings pose a low threat with respect to leachate generation and potential impacts to water supplies.

For the settling pond, arsenic and manganese were the only analytes reported at concentrations exceeding the leaching RMC derived from the water-supply stream standards. The comparisons suggest that arsenic concentrations in subsurface tailings likely pose a low to moderate risk and that manganese concentrations in subsurface tailings may pose a high risk with respect to leachate generation and potential impacts to water supplies.

4.0 REMOVAL ACTION SCOPE, GOALS, AND OBJECTIVES

This section provides the statutory framework for the removal action, removal action scope and schedule, potential ARARs, and objectives for performing a removal action at the Matterhorn Mill Site.

4.1 Statutory Framework on Removal Actions

CERCLA Section 104(c)(1), as amended by the Superfund Amendments and Reauthorization Act (SARA), provides a framework for the removal action process. The process is a tool for accomplishing prompt risk reduction through implementation of an early action that is consistent with any final remedy that may be selected for site remediation. In some cases, the removal action itself becomes the final remedy. The removal action process is being applied to facilitate prompt risk reduction by reducing contaminant exposures and migration from the mill site.

The initial stage of the removal action process involves identifying the source and nature of a release or threatened release of hazardous substances to the environment and assessing the magnitude of the threat to public health and the environment. The primary contaminant sources at the mill site are mill wastes (processing spillage and ore/concentrate) within the mill building and tailings within the tailings pond and settling pond. Contaminant migration from the tailings accumulations occurs as runoff due to rainfall and snowmelt which infiltrates and percolates through the tailings and as tailings are transported by way of erosion and other mass wasting processes. Although the mill wastes are currently contained within the mill structure, the potential exists for the structure to collapse in the future with subsequent migration of the mill wastes in response to runoff and mass wasting processes. The primary threats to public health and the environment resulting from contaminants at and released from the mill site include the following:

- Elevated metals concentrations in the tailings accumulations at the tailing pond and settling pond
- Elevated metals concentrations in the berm/embankment at the settling pond
- Low pH and elevated metals concentrations in on-site surface water features (small perennial pond and intermittent ponding of water at the settling pond) and in water emanating from springs downgradient of the mill site
- Elevated metals concentrations in the mill wastes present within the mill structure.

Based on the results of previous water-quality and mill tailings sampling programs, the metals of primary concern (posing high to extremely high risk) to human health are antimony, arsenic, lead, iron, and manganese; low pH in water in the settling pond, small pond, and downgradient spring also poses a threat to human health. The metals of primary concern (posing high to extremely high risk to aquatic life) in surface water in the settling pond, small pond, and downgradient spring are dissolved cadmium, dissolved copper, total recoverable iron, dissolved lead, and dissolved zinc. Lead is the primary metal of concern (posing a high to extremely risk) to livestock and wildlife at the mill site. Further details concerning site characterization and evaluation of the human-health and ecological risks resulting from contaminant sources at the mill site are provided in Section 3.0 of this document.

4.2 Removal Action Scope and Schedule

The scope of this EE/CA is to evaluate appropriate removal actions to reduce threats to public health and the environment and reduce the potential for migration of contaminants from the mill site. The EE/CA focuses on mitigation of mill wastes (process spillage and ore/concentrate) within the mill structure and tailings accumulations associated with mill operations, including tailings around the mill structure, within the tailings pond, and within the settling pond and its associated soil berm/embankment. Mill wastes and tailings are the focus of the removal action because tailings and mill wastes have been identified as sources posing public-health and/or ecological threats and potentially releasing contaminants to the environment. The actions for the mill wastes involve measures to reduce the threats posed by elevated metals to individuals that may work in the mill structure and to reduce the potential for release of the wastes to the environment. The actions for the tailings accumulations on Forest Service lands (tailings pond and tailings around the mill structure) involve measures to reduce the threats posed by elevated metals to site visitors (campers and ATV drivers) and to reduce the potential for site-derived contaminants to migrate from the tailings pond and tailings around the mill structure and onto the adjacent private land. The actions for the settling pond and its associated soil berm involve measures to reduce threats posed by elevated metals concentrations in tailings in the settling pond and adjacent soil berm, both of which are located on lands that were formerly part of the mill site but subsequent to mill operations have been transferred to private ownership.

The scope of the removal action does not include addressing the threats associated with onsite surface water at the mill site. Onsite surface water is limited to the intermittent ponding of water in the settling pond in response to snowmelt and precipitation runoff. The potential for the settling pond to serve as a surface-water contaminant source will be mitigated by the actions implemented to address the human-health and ecological threats associated with the settling pond and soil berm.

The scope of the removal action does not include directly addressing potentially contaminated groundwater beneath the mill area. Improvements in the quality of groundwater present beneath the mill site are expected to result from implementation of the actions taken to reduce the impact of the mill wastes and tailings as a contaminant source.

The schedule for the removal action has not yet been determined by the Forest Service. Implementation of the alternative selected under this EE/CA will occur upon formal issuance of an Action Memorandum.

4.3 Identification and Development of ARARs and Potential Preliminary Remediation Goals

This section presents a discussion of the framework for identifying ARARs, types of ARARs, and the identification of ARARs for the Matterhorn Mill Site removal action.

4.3.1 Framework for Identifying Applicable or Relevant and Appropriate Requirements

Removal actions pursuant to CERCLA must attain, to the extent practicable considering the circumstances of the situation, ARARs under federal environmental or more stringent state environmental or facility siting laws (Final NCP, 40 Code of Federal Regulations [CFR] Part 300.415(i); Preamble to Final NCP, 55 Federal Register 8695 [March 8, 1990]).

ARARs are derived from both federal and state laws. The definitions of "applicable" or "relevant and appropriate" requirements are found in the NCP, 40 CFR Part 300.5. "Applicable requirements" refer to cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

"Relevant and appropriate requirements" refer to cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal and state environmental, or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site to attain goals protective of human health and the environment.

The analysis of requirements with respect to their relevance and appropriateness is somewhat flexible. Relevant statutes require that the types of removal or remedial actions being contemplated to treat the hazardous substances present, as well as the mine waste characteristics of the site, and other appropriate factors, be compared to determine relevant and appropriate requirements. As mentioned above, it is possible for only part of a requirement to be considered relevant and appropriate.

In addition to ARARs, this EE/CA identifies other Federal or State advisories, criteria, or guidance to be considered (TBC) for a particular release or removal action. TBCs are not required by the NCP but are meant to compliment the identified ARARs.

While the Forest Service may elect to obtain permits, it should be recognized that Congress limited the scope of a Federal agencies obligation to attain administrative ARAR through CERCLA Section 121(e), which states that no federal, state, or local permits requirements are required for on-site response actions. This includes procedural requirements. Only the substantive elements of other laws affect on-site responses. This permit exemption allows the response action to proceed in an expeditious manner, free from potentially lengthy delays associated with the permit process or an equivalent process. The lack of permitting authority does not impede implementation of an environmentally protective remedy, since CERCLA and the NCP already provide a procedural blueprint for responding to the release or threatened release of a hazardous substance into the environment.

4.3.2 Types of Applicable or Relevant and Appropriate Requirements

Three different categories of ARARs exist. The first type of ARAR, chemical-specific requirements, sets health-, risk-, or technology-based concentration limits for various constituents that may be found in or discharged to an environmental media. An example of this type of ARAR could potentially include the Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA) and the National Ambient Air Quality Standards (NAAQS) established under the Clean Air Act (CAA).

A second type of ARAR, action-specific requirements, sets controls or restrictions on particular kinds of activities related to management of hazardous substances, pollutants, or contaminants. An example of an action-specific ARAR is the Clean Water Act (CWA) pretreatment standards for discharges to a publicly owned treatment works (POTW).

The third type of ARAR includes location-specific requirements, which restrict activities on the basis of site characteristics and the immediate site environment. These requirements may restrict the type of removal action that can be implemented and may impose restraints on removal or remedial actions. Limits on activities affecting floodplains are examples of location-specific ARARs.

4.3.3 Identification of Applicable or Relevant and Appropriate Requirements

Potential ARARs for the Matterhorn Mill Site removal action generally include:

- Water quality standards
- Waste disposal standards
- Archaeological/Cultural resource requirements
- Colorado State air quality standards
- Colorado Mined Land Reclamation Standards
- Threatened and endangered species

Potential ARARS for the removal action are identified and summarized in Table 4.1.

4.4 Removal Action Objectives

Removal action objectives (RAOs) serve as a basis for selecting technologies and developing removal action alternatives. The goal of the removal action is to reduce human-health and ecological threats associated with mill wastes (process spillage and ore/concentrate) in the mill building, tailings around the mill building and within the tailings pond, and tailings within the settling pond and contaminated soil comprising the settling pond berm. Based on the characteristics of the mill wastes and tailings, the following specific objectives have been established for the removal action:

- Prevent or reduce actual or potential exposure of site workers and the general public to the threats posed by mill wastes (process spillage and ore/concentrate) inside the mill building.

- Prevent or reduce actual or potential exposure of humans and the local biotic community from direct contact with tailings within the settling pond and contaminated soil comprising the soil berm such that no land use restrictions would be placed on the lands on which the settling pond and berm are located. To meet unrestricted land use requirements, removal action goals will be the metals and cyanide criteria specified in BLM's RMC for the adjacent resident and EPA's RSL for residential soil, whichever is most restrictive; however, in no case will the goal be lower than the concentration reported for the background soil sample collected at the mill site. The remediation goal for a specific analyte will be the background soil concentration if the analyte concentration in the background soil sample is greater than one or both of the BLM and EPA criteria. The removal actions goals are presented in Table 4.2.

- Prevent or reduce actual or potential exposure of human and the local biotic community from direct contact with tailings around the outside of the mill building and within the tailings pond. The removal action goals for residual materials remaining after completion of the removal action will be the metals and cyanide criteria specified in BLM's RMC for the adjacent resident and EPA's RSL for residential soil, whichever is most restrictive; however, in no case will the goal be lower than the concentration reported for the background soil sample collected at the mill site. The remediation goal for a specific analyte will be the background soil concentration if the analyte concentration in the background soil sample is greater than one or both of the BLM and EPA criteria. The removal actions goals are presented in Table 4.2.

- Prevent or reduce the potential for off-site migration of contaminants as a result of erosion (wind or water) and mass wasting processes.

- Reduce the potential for generation of leachate in the tailings at the tailings pond and settling pond as a result of direct infiltration of precipitation and precipitation runoff.

- Protect the stability and integrity of the mill building and its contents.

- Maintain natural character of the mill site to the maximum extent practical.

- Satisfy state and federal ARARs.

5.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The process for identifying and analyzing removal action alternatives presented in this section follows EPA guidance for non-time-critical removal actions (USEPA, 1993). The process entails first identifying potential response action technologies and process options, screening the technologies for applicability and feasibility in accordance with the scope of the removal action(s), and assembling the retained technologies into removal action alternatives for detailed analysis.

The scope of the removal actions involves reduction of risks to public health and the environment associated with the tailings at the mill site. Technologies potentially appropriate for reducing threats posed by the tailings were identified on the basis of literature research, vendor information, and experience in conducting other EE/CAs, feasibility studies, and mine reclamation actions.

Arsenic, antimony, and lead are the primary metals in mill waste (process spillage and ore/concentrate) within the mill building, tailings in the tailings pond and settling pond, and soil in the settling pond berm posing human-health and ecological threats at the mill site. The removal action alternatives for the contaminant sources (waste, tailings, and contaminated soil) will focus on reducing the potential for direct exposure to the materials and preventing or reducing contaminant migration from the sources as a result of erosion (fluvial and wind) or mass wasting processes.

5.1 Preliminary Screening of Removal Action Technologies for Waste Rock

This section addresses potential removal action technologies for tailings, mill waste, and contaminated soil at the mill site on the basis of each technology’s ability to meet the RAOs and reclamation goals identified in Section 4.4 of this document. Tailings removal actions would be implemented to reduce the risk to human health and environment of exposure to the tailings and potential for off-site migration of tailings. Reductions in contaminant concentrations in surface water and groundwater will also likely occur as a result of the actions taken to mitigate the threats posed by the tailings.

5.1.1 Access Restrictions

Access restrictions would be implemented with the use of institutional controls. Potential process options include restricting entry inside the mill building, fencing and placement of signs to discourage direct access to controlled areas and warn of public hazards, as well as land use restrictions to limit the possible future uses of the mill area. Although access and land use restrictions would limit and discourage direct exposure to tailings and contaminated soil within the soil berm, implementation of these process options alone would not mitigate threats to human health and the environment posed by the tailings and contaminated soil or migration of contaminated media from the mill area. However, the controls are considered viable options when used in combination with other technologies.

Access restrictions, when used in combination with other process options, ***are retained*** as potential technologies for the removal action.

5.1.2 Engineering Controls

Engineering controls are commonly used to reduce contaminant migration by isolating the contaminated materials from direct exposure to the wind, surface water, and groundwater pathways. Engineering controls are generally not effective for the reduction of contaminant toxicity or volume. The potential engineering controls considered for the mill site include surface controls, subsurface controls, containment, on-site disposal, and off-site disposal.

5.1.2.1 Surface Controls

Surface controls are used to reduce contaminant migration by minimizing water and wind erosion of the contaminated material and reducing the potential for infiltration of surface-water runoff. Used alone, surface controls do not reduce the risks of direct exposure to the contaminated materials. Surface controls are commonly combined with source control technologies where risks due to direct exposure are of concern. The process options that are commonly used as surface controls include consolidation and erosion mitigation (run-on and run-off controls, revegetation, and grading).

Consolidation

Consolidation is used to group wastes of similar type in a common area for more efficient management or treatment. On-site wastes are excavated and transported to an identified on-site or off-site consolidation area. The consolidated wastes can then be managed, treated, and/or disposed as a single unit.

Consolidation is considered a viable surface control process option for management of tailings and contaminated soil at the mill site. Tailings within the settling pond and contaminated soil comprising the soil berm would be excavated and transported to the tailings pond for consolidation with tailings in the tailings pond.

Consolidation ***is retained*** as a potential surface control process for the removal action.

Erosion Protection

The potential transport of tailings offsite by wind and the fluvial processes associated with storm runoff, wind transport, and mass wasting processes is a concern at the mill site. Erosion mitigation includes but is not limited to run-on and run-off control, revegetation, and grading. Erosion mitigation can be accomplished by constructing diversions to channel surface water away from or around the contaminated area, regrading to lessen slopes and waste rock from fluvial channels, covering the contaminated material with erosion resistant materials such as natural or synthetic fabrics, and revegetating the surface of the contaminated area. Erosion protection is commonly a critical component of on-site reclamation efforts.

Erosion protection ***is retained*** as a potential surface control for the removal action.

Run-On and Run-Off Control

Run-on and run-off controls are used to prevent run-off from upslope areas (run-on) from contacting the contaminated material and to control run-off derived from precipitation falling on contaminated or otherwise disturbed areas. Controls include the use of earthen berms, V-ditches, channel diversions, and gravel drains (French drains). Run-on and run-off controls are commonly a critical component of on-site reclamation efforts.

Run-on and run-off control ***is retained*** as a potential surface control process for the removal action.

Revegetation

Revegetation is commonly used to stabilize surficial materials by reducing the potential for wind and surface-water erosion and minimize water infiltration through plant evapotranspiration processes. Revegetation is usually accompanied with ground preparation (grading or scarifying) and commonly requires application of soil amendments (nutrients and organic matter) as well as additives to improve pH conditions and water-storage capacity. Soil must be imported at sites where sufficient topsoil is not available on-site. Revegetation success is largely dependent on proper seed selection, site preparation, mulching, irrigation requirements, and fertilization. Proper seed mixes will consist of a diverse set of native species.

Erosion-control matting is commonly utilized in combination with revegetation. Erosion-control matting is used to control erosion on slopes and stabilize soils long enough for revegetation seedlings to establish in reclaimed areas. The mats are designed to be used on gradual to steep slopes and for both short-term biodegradable applications and long-term soil stabilization.

Revegetation with the use of erosion control matting ***is retained*** as a potential surface control process for the removal action.

Grading

Grading is used to consolidate mine waste materials, control erosion by decreasing side slopes associated with contaminated areas, construct diversion structures and run-on/run-off controls, and improve site aesthetics. Regrading work may include slope regrading and, in a broad sense, slope reinforcement (retaining walls). This improvement may include the construction of retaining walls to create terraces or benches, and armored or lined surfaces to protect against channel bank erosion. Armoring surfaces with gunite (shotcrete) or rip-rap, or establishing vegetation are common methods used to prevent erosion of diversion channels and structures. Grading may be conducted by the use of mechanized equipment, or in cases of remote, excessively steep, or restricted working space areas, manual labor is required.

Grading ***is retained*** as a potential surface control process for the removal action.

5.1.2.2 Subsurface Control

Subsurface controls are commonly used to (1) reduce the potential for interaction between contaminated materials and groundwater and infiltrating surface water and (2) provide a physical barrier between the contaminated materials and overlying cover soils.

Minimize Contact of Contaminated Materials and Groundwater/Surface Water

Physical controls for reducing interactions with groundwater are generally designed to intercept upgradient groundwater and direct the flow away from or around the contaminated material. Controls for reducing interactions with infiltrating surface water are designed to reduce the potential for such waters to contact the contaminated materials. Measures to intercept and control upgradient groundwater include the use of low-permeability liners, slurry walls, and intercept drains (e.g., French drains). Measures to reduce potential for contact with infiltrating surface water generally involve the use of a low-permeability cover overlying the contaminated materials.

Site characterization efforts associated with this EE/CA did not focus on the characterization of groundwater within the tailings or peripheral areas at the mill site. However, analytical results reported for Lake Fork downstream of the mill site indicate that stream standards are not exceeded downstream of the mill site; therefore, contaminant contributions, if any, from the mill site are not causing detrimental impacts to Lake Fork with regards to stream standards. Based on these findings, subsurface controls designed to reduce the potential for interaction between contaminated materials and groundwater and infiltrating surface water are not warranted at the mill site.

Subsurface control technologies for reducing interactions with groundwater and infiltrating surface water ***are not retained*** for the removal action.

Physical Barriers Between Cover Soil and Contaminated Materials

Physical barriers used to separate contaminated materials and cover soil are designed to provide mechanical separation of clean cover soil and the underlying contaminated materials. Such barriers also reduce the potential for erosional scours to expose and incise the contaminated materials. Such barriers include the use of a non-woven geotextile.

Physical barriers designed to provide a physical barrier between clean cover soil and underlying contaminated materials and reduce potential for erosional scouring of contaminated materials are considered viable options at the mill site. Therefore, subsurface controls such as the use of non-woven geotextile ***are retained*** for the removal action.

5.1.2.3 Containment

Containment is used as an on-site source control measure and involves capping the contaminated materials in place. By capping the material and implementing appropriate erosion controls, the technology can be used to eliminate direct exposure to the contaminated materials, reduce surface water infiltration, and create a land surface that can support vegetation. Prior to cap construction, regrading is commonly required to mitigate the potential for erosion and provide surface water run-on and runoff control.

Cap design is dependent on site-specific conditions and the intended function of the system. Caps can range from a one-layer system of vegetated soil to a complex multi-layer system consisting of soil and geosynthetic materials of low permeability. The cap cover is commonly vegetated to reduce soil moisture through plant uptake and evapotranspiration, limit soil erosion, improve aesthetics, and support future natural and productive use of the area. In all cases, caps should be designed to ensure that cover materials are less permeable than natural subsoils beneath the contained mill waste to avoid retention of water within the unit.

Cover designs commonly considered at mills and mines include natural-rock covers, soil covers, composite natural covers consisting of a low-permeability soil/clay layer overlain with native soil/rock, and geotextile covers with natural-rock or native soil cap. Low-permeability soil/clay or geotextile materials are incorporated in cover designs at site where removal action objectives include preventing direct precipitation from infiltrating the contaminated materials.

Containment with the use of a vegetated soil cover is considered a viable technology for tailings and contaminated soil at the mill site. The technology could be used to satisfy the removal action objectives by effectively reducing direct contact with the contaminated materials and reducing the potential for off-site migration in response to fluvial and wind erosion or mass wasting processes. In conjunction with revegetation and run-on controls, the technology would also reduce infiltration of direct precipitation and runoff into the waste materials in the covered areas.

The construction of structures/features to control off-site migration of materials is also considered a containment process option. The structures/features typically used at mines and mill sites to control off-site migration of materials include those designed to capture sediment while allowing water to pass through the feature (e.g., structural silt fences), water retention features (e.g., sedimentation ponds) in combination with constructed channels to direct flow to the feature, and retaining structures (constructed walls or earthern berms) designed to capture materials transported from the slope of the dump as a result of mass wasting.

Containment with a vegetated soil cover to eliminate direct exposure to waste rock and constructed structures/features to mitigate off-site migration of materials ***is retained*** as a potential technology for the removal actions.

5.1.2.4 Excavation and On-Site Disposal

On-site disposal is used as an on-site, surface source control measure. The technology is implemented by excavating the contaminated materials and placing the materials in an engineered, on-site repository. Prior to placement in the on-site repository, the contaminated material may be treated to stabilize or solidify the material, reduce mobility of contaminants, or remove contaminants through dissolution or leaching and precipitation processes. Repository design is a function of the characteristics of the mill waste and underlying hydrogeology. Potential designs range from an unlined repository with a vegetated soil cover to a fully lined and capped containment cell. Cover designs potentially applicable at the mill site include a natural-rock cover, a soil cover, a composite natural cover consisting of a low-permeability soil/clay layer overlain with native soil/rock, and a geotextile cover with a natural-rock or native soil cap. A leachate collection system may be incorporated in the design to allow monitoring and proper management of any leachate within the repository.

Construction of an on-site repository is a viable option for the mill site. However, the benefit gained by relocating tailings to an on-site repository, causing greater on-site disturbance, would need to be evaluated against management of consolidated wastes in place. Excavation and on-site disposal ***is retained*** as a potential technology for the removal actions.

5.1.2.5 Excavation and Off-Site Disposal

Off-site disposal is used as a source control measure. The technology involves excavating the contaminated materials and transporting the materials to an off-site area for disposal. The off-site area could be an area designated for consolidation of similar mill wastes (e.g., nearby tailings material), an engineered disposal area or repository constructed for similar mill wastes, a permitted solid waste landfill, or a hazardous-waste permitted facility. If the mill waste is to be transported off-site to a solid waste landfill, testing would be required to determine if the material has characteristics of a hazardous waste. Required analyses would include reactivity, corrosivity, and ignitability (RCI) testing and Toxicity Characteristic Leaching Procedure (TCLP) testing. If the material fails the RCI and/or TCLP criteria established for assessment of hazardous characteristics, the mill waste could not be placed in a solid waste landfill and would either need to be treated on-site and retested prior to disposal, or transported to a RCRA-permitted facility.

Off-site disposal in a repository designed specifically to receive the project waste tailings would preferably require the use of nearby USFS or other federal land. As described under "On-Site Disposal", the technology is implemented by excavating the contaminated materials and placing the materials in an engineered repository. Prior to placement in the off-site repository, the contaminated material may be treated to stabilize or solidify the material, reduce mobility of contaminants, or remove contaminants through dissolution or leaching and precipitation processes. Repository design is a function of the characteristics of the mill waste and underlying hydrogeology. Potential designs range from an unlined repository with a vegetated soil cover to a fully lined and capped containment cell. Potentially applicable cover designs include a natural-rock cover, a soil cover, a natural composite cover consisting of a low-permeability soil/clay layer overlain by rock/native soil, a geotextile cover with a natural-rock cap, and geotextile cover with soil cap. A leachate collection system may be incorporated in the design to allow monitoring and proper management of any leachate within the repository.

Off-site disposal as a means to manage tailings and other waste at the mill site is not considered a beneficial option because (1) on-site disposal is a viable option for management of the wastes, (2) disposal of the contaminated materials at an off-site repository or a permitted solid waste or RCRA facility would result in high transportation and disposal costs relative to the costs associated with viable on-site management options, (3) the USFS would retain liability for the waste under any off-site disposal scenario, (4) siting of a repository would require a thorough characterization study of at least one potential site followed by design and construction phases, and (5) transportation issues would be encountered regarding the transport of material on public roads, traffic requirements, and impacts to the roads themselves. Therefore, excavation and off-site disposal ***is not retained*** as a potential technology for the removal action.

5.1.3 Physical/Chemical Treatment

Physical/chemical treatment options are potential removal action technologies for management of wastes associated with mill sites. In-situ and ex-situ treatment can be implemented to reduce the mobility and toxicity of contaminants. Because treatment generally involves adding reagents to the contaminated media, in-situ treatment processes generally provide less control than ex-situ processes. In-situ physical/chemical treatment technologies commonly considered at mine and mill sites include soil washing, stabilization/solidification, and phytoremediation. Ex-situ process options commonly considered include physical separation, soil washing, chemical extraction, chemical reduction/oxidation, soil washing, stabilization/solidification, and reprocessing.

The use of physical/chemical treatment technologies at the mill site would require additional characterization of the wastes to evaluate treatment options, treatability testing to support selection of the appropriate process, and capability to fully capture and treat process waste streams. Physical/chemical treatment would not be cost effective at the mill site because of its high cost relative to other more viable technologies that could be implemented to mitigate the public-health and ecological threats posed by mill wastes, tailings, and contaminated soil at the mill site. Physical/chemical treatment ***is not retained*** as a potential technology for the removal action.

5.2 Response Alternative Development

EPA guidance for non-time-critical removal actions recommends that only the most qualified technologies that apply to the media or source of contamination be evaluated in detail in the EE/CA. In accordance with this guidance, removal action alternatives for the mill site were developed by combining the retained technologies to form alternative actions for meeting the RAOs and goals of the project. The most promising technologies that were identified and retained through the screening process are summarized in Table 5.1.

The technologies retained through the screening process have been combined to form the following removal action alternatives for the mill site:

- Alternative 1: No action
- Alternative 2: Consolidation and Containment
    - Sub-Alternative 2A: Inclusion of Mill Wastes
    - Sub-Alternative 2B: Exclusion of Mill Wastes
- Alternative 3: Excavation, Consolidation, and On-site Disposal
    - Sub-Alternative 3A: Inclusion of Mill Wastes
    - Sub-Alternative 3B: Exclusion of Mill Wastes

The no-action alternative is included as a baseline for comparison to the other potential alternatives. Under Sub-Alternatives 2A and 3A, mill wastes within the mill building will be removed for consolidation with tailings and contaminated soil. Under Sub-Alternatives 2B and 3B, institutional controls will be implemented to secure the mill building to prevent unauthorized access and mill wastes will left in place and not consolidated with tailings and contaminated soil. For Alternatives 2 and 3, a common set of technologies/process options will be incorporated into each alternative, including access controls (entry restriction, fencing/signage, and land use controls), surface controls (erosion protection, run-on/run-off controls, revegetation, grading), and subsurface controls (physical barrier between cover soil and contaminated materials). Application of these common technologies is discussed in Section 5.4 of this document, and details concerning each potential alternative are provided in Section 5.5 of this document.

5.3 Basis for Analysis of Alternatives

The removal action alternatives listed in Section 5.2 are described and evaluated in Section 5.5 based on each alternative's effectiveness, implementability, and cost. The effectiveness, implementability, and cost evaluation criteria are discussed in further detail below.

5.3.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objectives within the scope of the removal action. Effectiveness focuses on the degree to which an alternative provides adequate overall protection of human health and the environment; complies with ARARs; affords long-term protection by minimizing residual risk; provides reduction of toxicity, mobility, or volume of hazardous material; and minimizes short-term effects.

Overall Protection of Human Health and the Environment

This evaluation criterion serves as a final check in assessing whether each alternative provides adequate protection of human health and the environment. Evaluations of long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs (discussed below) were used to assess the overall protection of human health and the environment. This criterion was also used to evaluate how risks would be eliminated, reduced, or controlled through treatment, engineering, or institutional controls.

Compliance with ARARs

Compliance with ARARs addresses the ability of each alternative to attain the requirements that are applicable or relevant and appropriate to the alternative. The summary table of potential ARARs listed in Table 4.1 and discussed in Section 4.3 provides the basis for the evaluation.

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence addresses the risk remaining at the mill site after remediation goals have been met.

Reduction of Toxicity, Mobility, or Volume

Reduction of toxicity, mobility, or volume addresses the statutory preference for selecting removal actions that permanently and significantly reduce toxicity, mobility, and/or volume of hazardous materials at the mill site. This preference is satisfied when treatment is used to reduce principal risks through destruction or irreversible reductions of toxicity, mobility, and/or volume. This criterion focuses on the following:

- The degree of expected reduction in toxicity, mobility, or volume.
- The degree of irreversibility of the process.
- The type and quantity of residuals remaining following treatment.
- The statutory preference for treatment as a principal element.
- The relative amount of hazardous materials that will be destroyed or treated.

Short-term Effectiveness

Short-term effectiveness addresses the effects of each alternative in the protection of human health and the environment during the construction and implementation phase. The following factors were addressed during the evaluation process:

- Protection of the workers during removal actions - This factor assesses threats that may be posed to workers and the effectiveness and reliability of measures to be taken.
- Environmental impacts of the removal action - This factor addresses the potential adverse environmental impacts that may result from construction and implementation of a removal alternative, and evaluates the reliability of mitigation measures, if necessary, to prevent or reduce potential impacts.
- Time lapse before achievement of removal objectives - This factor includes an estimate of the time required to achieve protection at the mill site.

5.3.2 Implementability

Implementability evaluates the technical feasibility of implementing each alternative, the availability of required services and materials during its implementation, and the administrative feasibility.

Technical Feasibility and Availability

Technical feasibility and availability addresses the ability of the alternative to implement the removal action, the reliability of the alternative, and the availability of services and materials. The following factors were addressed during the evaluation process:

- Ability to construct and operate the technology
- Reliability of the technology
- Ease of undertaking additional removal actions or remedial actions if necessary
- Ability to monitor effectiveness of removal action
- Availability of necessary equipment, materials, and personnel

Administrative Feasibility

The administrative feasibility criterion addresses the following factors:

- Likelihood of public acceptance of the alternative, including state and local concerns

- Activities needed to coordinate with other agencies
- Ability to obtain necessary approvals or permits

5.3.3 Cost

The cost of each alternative is evaluated based on estimates of projected capital cost (e.g., construction costs) and operation and maintenance costs over a 10-year period. It is assumed that periodic inspections of the mill site will be performed by USFS personnel; therefore, no costs have been included for USFS inspections in these evaluations. Operation and maintenance costs are projected for the actions that will periodically be required to ensure effectiveness of the alternatives. Cost estimates are based on vendor information, cost-estimating guides, and actual costs incurred during similar activities at other mill and mine sites.

The net present value of each alternative was calculated as the sum of total capital cost plus the present worth of annual operation and maintenance cost (assuming an interest rate of 5 percent over a 10-year period). An interest rate of 5 percent was used on the basis of the EPA guidance (USEPA, 1988).

5.4 Commonalities of Alternatives

Certain technologies/process options and ancillary construction activities are common to removal action alternatives 2 and 3 for the mill site. Common technologies/process options include access restrictions (entry restrictions, fencing/signage, and land use), surface control (erosion protection, run-on/run-off controls, revegetation, grading), and subsurface controls (physical barrier between cover soil and contaminated materials). In addition to common technologies, each alternative would be implemented in a manner that ensures protection of the historic mill structure. Common ancillary construction activities include access road improvement, site safety and health, and permitting and coordination.

5.4.1 Access Restrictions

Access restrictions will be implemented during implementation of the removal actions to prevent unauthorized access to active work areas and discourage access to reclaimed areas. In addition, institutional controls will be implemented to restrict access to the mill building during the removal action. Permanent institutional controls will implemented upon completion of the action to secure the mill building and prevent unauthorized access inside the structure. Access controls will also include locked or otherwise secured entry points, fencing and/or natural barriers, and signage. Natural barriers will be used to prevent vehicle access to the mill site upon completion of the removal actions. Land use restrictions will be used to discourage livestock grazing at the mill area.

5.4.2 Surface Controls

Surface controls are incorporated in each proposed alternative to manage surface water run-on and run-off, provide erosion protection of disturbed areas during reclamation, revegetate reclaimed areas, and grade reclaimed surfaces to direct and control precipitation run-off.

Run-on controls will be installed to prevent stormwater runoff from entering areas disturbed during implementation of the removal action and to direct runoff away from the tailings disposal area. Run-off controls will be installed to reduce the sediment load carried by runoff originating within the disturbed areas. Run-on, run-off, and drainage controls may include earthen berms, riprap, V-ditches, hay bails, and temporary silt fencing. As a surface control, temporary silt fences, consisting of synthetic geotextile or equivalent material, are used to assist in control of sediment-laden runoff from disturbed areas. Temporary silt fences help contain overland flow and filter suspended soil particles from water, preventing environmental damage to areas adjacent to construction sites. Temporary silt fences and other temporary control features are maintained until permanent control measures have been installed at the site.

Erosion protection measures would be implemented to stabilize disturbed areas during reclamation. Such measure would include the use of erosion control matting as appropriate.

Revegetation measures will be implemented to stabilize surficial cover materials by reducing the potential for wind and surface-water erosion and minimize water infiltration through plant evapotranspiration processes.

Grading will be implemented to reduce the size of the consolidated disposal area where practical and to direct precipitation runoff away from the disposal area. In addition, grading will be used to shape reclaimed surfaces in a manner consistent with the natural character of the surrounding lands.

5.4.3 Subsurface Controls

The common subsurface control that would be implemented under both Alternatives 2 and 3 is installation of a physical barrier between cover soils and the underlying contaminated materials. The barrier would provide physical separation of the clean and contaminated media and reduce the potential for erosional scours to expose and incise the contaminated materials. Such barriers include the use of a non-woven geotextile.

5.4.4 Protection of Historic Structure

The historic mill structure and its contents would be protected from damage and care would be taken to avoid impacts to the stability of structure during implementation of either alternative 2 or alternative 3. Measures would be taken to stabilize any portions of the structure prior to conducting activities that could potentially threaten the structure, including activities such as removal a tailings from around the mill foundation and removal of mill wastes within the building.

5.4.5 Ancillary Construction Activities

The access road leading from mill bench to the tailings pond and settling pond area would be improved as an ancillary construction activity in addition to the primary reclamation actions associated with each alternative. The access road would be improved as necessary to provide access for the equipment needed to complete the removal action. Improvements will be limited to clearing fallen timber, boulders, and any vegetation restricting access along the road; minor grading to lessen slopes and widen the travelway as necessary, installation of temporary culverts at shallow drainage crossings. A shallow v-ditch will be installed along the uphill side of the road alignment to prevent runoff originating in undisturbed areas from contacting the road surface.

The selected removal actions will be implemented in strict accordance with procedures and protocols specified in the site safety and health plan(s) prepared by the reclamation contractor. The plans will address the procedures and protocols to be implemented to mitigate the physical and chemical hazards associated with the actions. On-site monitoring will be conducted to ensure worker safety and prevent off-site releases of contamination.

In accordance with the ARARs discussed in Section 4.3, compliance with permit requirements and coordination/consultation with various agencies and groups will be required prior to implementation of a removal action. These include federal, state, and county requirements. It is assumed that required permitting and coordination/consultation will be performed by the Forest Service, with contractor assistance.

While the Forest Service may elect to obtain permits, it should be recognized that Congress limited the scope of a Federal agencies obligation to attain administrative ARAR through CERCLA Section 121(e), which states that no federal, state, or local permit shall be required for the portion of any removal action conducted entirely on-site. This includes procedural requirements. Only the substantive elements of other laws affect on-site responses. This permit exemption allows the response action to proceed in an expeditious manner, free from potentially lengthy delays associated with the permit process or an equivalent process. The lack of permitting authority does not impede implementation of an environmentally protective remedy, since CERCLA and the NCP already provide a procedural blueprint for responding to the release or threatened release of a hazardous substance into the environment.

5.5 Detailed Analysis of Alternatives

The following removal action alternatives have been developed for detailed analysis of effectiveness, implementability, and cost:

- Alternative 1: No action
- Alternative 2: Consolidation and Containment
  - Sub-Alternative 2A: Inclusion of Mill Wastes
  - Sub-Alternative 2B: Exclusion of Mill Wastes
- Alternative 3: Excavation, Consolidation, and On-Site Disposal
  - Sub-Alternative 3A: Inclusion of Mill Wastes
  - Sub-Alternative 3B: Exclusion of Mill Wastes

5.5.1 Alternative No. 1: No Action

The no action alternative assumes that no steps are taken to promote reclamation of the mill site. The mill wastes, tailings, and contaminated soil in the soil berm will continue to pose threats to public health and the environment and to be transported from the mill areas by way of wind and water erosion and mass wasting. No further investigation or monitoring would be required at the mill.

5.5.1.1 Effectiveness

The overall effectiveness of the no-action alternative is low. Metals contamination at the mill site would continue to threaten human health and the environment, and no reductions in the human health and ecological risk associated with direct exposure to mill wastes, tailings, and contaminated soil would be expected in the future. The contaminated media would continue to migrate from the mill site by way of erosion and transport by water, wind, and mass wasting. The toxicity, mobility, and volume of metals contaminants would not be reduced under the no-action alternative. The no-action alternative would not lessen the Forest Service's existing liabilities associated with the mill site or promote improvement of environmental conditions within the Upper San Miguel Watershed.

5.5.1.2 Implementability

Implementation of the no-action alternative would be technically and administratively feasible. However, consideration would need to be given to public acceptance of the alternative. The no-action alternative may not be acceptable to the public, regulatory agencies, and the Forest Service, particularly because of the presence of mill site derived contamination on portions of the former mill operations area that currently located on private land.

5.5.1.3 Cost

No capital costs or indirect costs would be incurred under the no-action alternative. Other than periodic inspections by Forest Service personnel, no operation and maintenance costs would be incurred under the no-action alternative. However, the long-term costs associated with the no-action alternative are not known because there would be an ongoing risk associated with continued contaminant migration from the mill and direct exposure to humans and wildlife.

5.5.2 Alternative 2: Consolidation and Containment

The general activities to be performed under Alternative 2 include consolidation of mill wastes in accordance with Sub-Alternatives 2A or 2B along with tailings and contaminated soil at the existing tailings pond followed by containment of the consolidated wastes with a vegetated soil cover. Alternative 2 would be implemented as follows:

- Compact tailings within the tailings pond with a vibratory compactor to densify the tailings and mitigate future settlement.

- Consolidation of tailings and contaminated soil comprising the soil berm at the existing tailings pond. Tailings within the settling pond and the soil berm adjacent to the settling pond will be excavated and placed on the compacted tailings at the existing tailings pond. Assuming 30-percent contingencies to account for basal unconformities and over-excavation where necessary to meet RAOs, it is anticipated that approximately 660 cubic yards of tailings will be excavated from the settling pond and 240 cubic yards of soil will be excavated from the soil berm for consolidation at the disposal cell. A portable X-Ray Fluorescence (XRF) analyzer will be used to guide excavation of the contaminated materials and demonstrate that soils remaining at the settling pond and berm area after removal do not pose a human-health threat. The XRF will be used to measure the concentration of an indicator parameter (e.g., lead) which will be compared to the residential soil standard for that parameter (e.g., 400 mg/Kg for lead). Confirmation soil samples will be collected and analyzed by an analytical laboratory to verify that the soil remaining at the former settling pond and berm area do not pose a human-health threat based on the removal action goals specified for tailings within the settling pond and contaminated soil comprising the soil berm in Section 4.4 of this document. Following confirmation based on the analytical results, the excavation will be backfilled with clean fill material, the surface graded to be consistent with the natural character of the surrounding area, and all disturbed areas will be vegetated.

- Removal of tailings/wastes from around the outside of the mill building and place on the compacted tailings at the existing tailings pond. No characterization of tailings/wastes around the mill building has been completed to date; for cost estimating purposes, it is assumed that the volume of tailings/wastes to be excavated around the outside of the mill building and place on the compacted tailings at the tailings pond will not exceed 250 cubic yards. Tailings/wastes will be removed from areas delineated on the basis of XRF analysis of an indicator parameter (e.g., lead), with concentrations compared to the industrial worker standard for that parameter (e.g., 800 mg/Kg for lead). Confirmation samples for laboratory analysis will be collected to verify that the residual soils remaining after removal do not pose a threat based on the removal action goals specified for tailings around the outside of the mill building in Section 4.4 of this document. Tailings/wastes will not be removed from any areas where, through consultation with the Forest Service, it is determined that such removal would jeopardize the stability and integrity of the mill building and reasonable measures could not be taken to otherwise protect the structure. In all cases, care will be taken during removal of wastes from around the outside of the mill building to protect the stability and integrity of the structure and its contents.

- Management of mill wastes within the mill building in accordance with one of the following sub-alternatives:

    - Sub-Alternative 2A (Inclusion of Mill Wastes): Mill wastes within the mill building will be removed and placed on the compacted tailings at the existing tailings pond. Mill wastes will be removed from each of the four areas at which samples were collected during the AGS limited Phase II Site Investigation (Figure 3-1) and any other areas within the mill building where accumulations of mill wastes pose a public-health threat based on elevated metals concentrations. The volume of mill wastes to be removed from the mill building has not been delineated to date; for cost estimating purposes, it is assumed that up to 150 cubic yards of mill wastes will be removed from the mill building and placed on the compacted tailings at the tailings pond. A portable XRF analyzer will be used to guide removal of wastes from the four identified areas and to delineate the areas where mill wastes pose a public-health threat. The XRF will be used to measure concentrations of an indicator parameter (e.g., lead) which will be compared to the industrial worker standard for that parameter (e.g., 800 mg/Kg for lead). Wastes with concentrations of the indicator parameter exceeding the criterion will be removed and placed on the tailings pond for consolidation. Care will be taken during removal of wastes from within the mill building to protect the stability and integrity of the structure and its contents.

  - Sub-Alternative 2B (Exclusion of Mill Wastes): Mill wastes inside the mill building will remain in place, and the potential threats to public health posed by mill wastes (process spillage and ore/concentrate) will be mitigated by the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure.

- Reshape the consolidated waste materials at the tailing pond to accept a cover and provide positive runoff by raising the center portion of the tailings to create a minimum outward slope of 5 percent.

- Place a physical barrier (e.g., nonwoven geotextile) on the reshaped tailing pond. It is estimated that the physical barrier will cover a surface area of approximately 29,000 square feet.

- Place a soil cover (minimum 2-feet thick) over the physical barrier; it is estimated that approximately 2,150 cubic yards of soil/fill material will be required for the cover system. Ensure cover soil is capable of supporting vegetation, and amend soil as necessary. Plant native vegetation consistent with the natural character of the surrounding area on the soil cover.

- Install run-on/run-off and drainage controls as necessary to direct and control precipitation run-off.

Operation and maintenance activities associated with Alternative 2 would include periodic inspections to monitor the integrity of the soil cover, erosion control measures, and revegetation success. Operation and maintenance activities would also include inspection of the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure. The access road leading to the tailings area will not be reclaimed upon completion of the action; however, natural barriers/boulders will be placed across the access routes to discourage vehicle (including ATVs) access. The natural barriers will be removed when necessary to allow access for maintenance activities.

5.5.2.1 Effectiveness

Overall, Alternative 2 would provide a highly effective mechanism for protection of human health and the environment at the mill site in accordance with the removal action objectives specified in Section 4.4

of this document. The alternative would be a highly effective means of reducing threats to human health and the environment posed by tailings in the settling pond and contaminated soil in the soil berm and facilitating unrestricted land use within the settling pond and contaminated soil berm area. Through the use of consolidation, the alternative would reduce the overall footprint of contaminated areas at the mill site. The threats posed to public health and the environment as a result of direct contact with contaminated materials and the threat of offsite migration of the materials by way of water/wind erosion or mass wasting process would be effectively mitigated by covering the consolidated waste materials with soil. The configuration/shaping of the consolidated wastes, run-on/run-off and drainage controls, and vegetated soil cover, would reduce the potential for percolation of direct precipitation. Minimizing the potential for direct precipitation to percolate into the contaminated materials reduces the potential for generation of leachate. However, the alternative would not provide protection against the leaching of metals as a result of upgradient groundwater inflows. While the alternative would isolate the consolidated materials and thereby reduce the potential for off-site migration of site-derived contamination, the alternative would not provide reductions in the mobility, toxicity, or volume of on-site contaminated materials because the alternative does not include the use of treatment technologies required for such reductions.

Both of the sub-alternatives (2A and 2B) would provide protection against actual or potential exposure of site workers and the general public to the threats posed by mill wastes. Under Sub-Alternative 2A, mitigation of the threat of direct exposure to the wastes would be ensured by containment of the wastes beneath a vegetated soil cover. Although mill wastes would remain in place under Sub-Alternative 2B, exposure to the mill wastes would be mitigated by permanent institutional controls implemented to secure the structure and prevent unauthorized access into the mill building.

General compliance with ARARs would be achieved with implementation of Alternative 2.

There would likely be some short-term ecological and environmental effects due to construction activities from dust generation, vegetation clearing, and general construction noise during implementation of Alternative 2. These short-term impacts would be minimal, with exposure pathways minimized through engineering controls and personal protective equipment.

5.5.2.2 Implementability

Implementation of Alternative 2 is technically feasible at the mill site. The effectiveness of the alternative could be readily monitored by performing periodic site inspections to ensure the integrity of controls is maintained over time. The necessary resources and materials for Alternative 2 are readily available from nearby sources; however, a soil borrow area has not been identified in the vicinity of the mill site.

Alternative 2 is also administratively feasible at the mill site. Applicable permit and agency coordination requirements, as identified in Section 4.3 of this document, would need to be met before commencing construction operations.

5.5.2.3 Cost

The estimated costs for Alternative No. 2 are presented in Table 5.2, and a detailed breakdown of the costs is provided in Appendix C. Direct capital costs include mobilization and the labor and materials required to complete the ancillary construction activities discussed in Section 5.4 and activities associated with the removal action alternative discussed in Section 5.5.2 above. The total capital costs for Alternative 2 are summarized as follows:

- Alternative No. 2 (Sub-Alternative 2A) $ 158,029
- Alternative No. 2 (Sub-Alternative 2B) $ 152,129

Operation and maintenance costs correspond to the costs associated with post-reclamation inspection and maintenance. Under Forest Service policy, three years of post-reclamation operation and maintenance is included in evaluation of the costs associated with removal actions at sites under the jurisdiction and control of the Forest Service. Based on the annual budget established by the Forest Service for operation and maintenance at other nearby sites at which removal actions have been implemented by the Forest Service, an annual cost of $15,000 per year for three years of post-reclamation operation and maintenance is estimated for Alternative 2. The operation and maintenance costs associated with the two sub-alternatives are expected to be the same because implementation of permanent institutional controls to secure the mill building and prevent unauthorized access into the structure is common to both Sub-Alternative A or B.

5.5.3 Alternative 3: Excavation, Consolidation, and On-site Disposal

The general activities to be performed under Alternative 3 include consolidation of mill wastes in accordance with Sub-Alternatives 3A or 3B along with tailings and contaminated soil in an on-site disposal cell constructed with a vegetated soil cover. The disposal cell will be located north of the mill building in the vicinity of Test Pit No. 6 (Figure 3-2). Alternative 3 would be implemented as follows:

- Prepare disposal area by removing trees and clearing and grubbing the area to be disturbed for cell construction.

- Excavate disposal cell to bedrock; estimated to be less than 3 feet in the vicinity of Test Pit 6 but is expected to increase towards the center of the small basin. For cost estimating purposes, it is assumed that the volume of material excavated at the cell and the footprint of the disposal area will be similar to that of the tailings pond; therefore, it is anticipated that 9,360 cubic yards of material would be excavated at the cell and the footprint of the disposal cell would cover a surface area of approximately 29,000 square feet.

- Excavate tailings from the tailings pond and settling pond and soil from the soil berm. The excavated materials will be placed and compacted in the prepared cell footprint. Assuming 30-percent contingencies to account for basal unconformities and over-excavation where necessary to meet RAOs, it is anticipated that approximately 9,360 cubic yards of tailings will be excavated from the tailings pond, 660 cubic yards of tailings will be excavated from the settling pond, and 240 cubic yards of soil will be excavated from the soil berm for consolidation at the disposal cell. A portable XRF analyzer will be used to guide excavation of the contaminated materials and demonstrate that soils remaining at the tailings pond, settling pond, and berm areas after removal do not pose a human-health threat. The XRF will be used to measure the concentration of an indicator parameter (e.g., lead) which will be compared to the residential soil standard for that parameter (e.g., 400 mg/Kg for lead). Confirmation soil samples will be collected and analyzed by an analytical laboratory to verify that the soil remaining at the former settling pond and berm area do not pose a human-health threat based on the removal action goals specified for tailings within the tailings pond and settling pond and contaminated soil comprising the soil berm in Section 4.4 of this document. Following confirmation based on the analytical results, the excavations will be backfilled with clean fill material, the surface graded to be consistent with the natural character of the surrounding area, and all disturbed areas will be vegetated.

- Removal of tailings/wastes from around the outside of the mill building and place in the disposal cell; compacted during placement. No characterization of tailings/wastes around the mill building has been completed to date; for cost estimating purposes, it is assumed that the volume of tailings/wastes to be excavated around the outside of the mill building will not exceed 250 cubic yards. Tailings/wastes will be removed from areas delineated on the basis of XRF analysis of an indicator parameter (e.g., lead), with concentrations compared to the industrial worker standard for that parameter (e.g., 800 mg/Kg for lead). Confirmation samples for laboratory analysis will be collected to verify that the residual soils remaining after removal do not pose a threat based on the removal action goals specified for tailings around the outside of the mill building in Section 4.4 of this document. Tailings/wastes will not be removed from any areas where, through consultation with the Forest Service, it is determined that such removal would jeopardize the stability and integrity of the mill building and reasonable measures could not be taken to otherwise protect the structure. In all cases, care will be taken during removal of wastes from around the outside of the mill building to protect the stability and integrity of the structure and its contents.

- Management of mill wastes within the mill building in accordance with one of the following sub-alternatives:

  - Sub-Alternative 3A (Inclusion of Mill Wastes): Mill wastes within the mill building will be removed and placed in the disposal cell; compacted during placement. Mill wastes will be removed from each of the four areas at which samples were collected during the AGS limited Phase II Site Investigation (Figure 3-1) and any other areas within the mill building where accumulations of mill wastes pose a public-health threat based on elevated metals concentrations. The volume of mill wastes to be removed from the mill building has not been delineated to date; for cost estimating purposes, it is assumed that up to 150 cubic yards of mill wastes will be removed from the mill building. A portable XRF analyzer will be used to guide removal of wastes from the four identified areas and to delineate the areas where mill wastes pose a public-health threat. The XRF will be used to measure concentrations of an indicator parameter (e.g., lead) which will be compared to the industrial worker standard for that parameter (e.g., 800 mg/Kg for lead). Wastes with concentrations of the indicator parameter exceeding the criterion will be removed and placed on the tailings pond for consolidation. Care will be taken during removal of wastes from within the mill building to protect the stability and integrity of the structure and its contents.

  - Sub-Alternative 3B (Exclusion of Mill Wastes): Mill wastes inside the mill building will remain in place, and the potential threats to public health posed by mill wastes (process spillage and ore/concentrate) will be mitigated by the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure.

- Grade the compacted waste materials in the disposal cell to form 3H:1V side slopes.

- Place a physical barrier (e.g., nonwoven geotextile) on the graded, compacted wastes within the disposal cell. For cost estimating purposes, it is assumed that the configuration of the disposal cell will be similar to that of the Alternative 2 containment cell at the tailings pond; therefore, it is estimated that the physical barrier will cover a surface area of approximately 29,000 square feet.

- Place a soil cover (minimum 2-feet thick) over the physical barrier. For cost estimating purposes, it is assumed that the configuration of the disposal cell will be similar to that of the Alternative 2 containment cell at the tailings pond; therefore, it is estimated that approximately 2,150 cubic yards of soil/fill material will be required for the cover system. Ensure cover soil is capable of supporting vegetation, and amend soil as necessary. Plant native vegetation consistent with the natural character of the surrounding area on the soil cover.

- Install run-on/run-off and drainage controls at the disposal cell as necessary to direct and control precipitation run-off.

Operation and maintenance activities associated with Alternative 3 would include periodic inspections to monitor the integrity of the soil cover, erosion control measures, and revegetation success. Operation and maintenance activities would also include inspection of the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure. The access road leading to the tailings area and disposal cell will not be reclaimed upon completion of the action; however, natural barriers/boulders will be placed across the access routes to discourage vehicle (including ATVs) access. The natural barriers will be removed when necessary to allow access for maintenance activities.

5.5.3.1 Effectiveness

Overall, Alternative 3 would provide a moderately to highly effective mechanism for protection of human health and the environment at the mill site in accordance with the removal action objectives specified in Section 4.4 of this document. The alternative would be a highly effective means of reducing threats to human health and the environment posed by tailings in the settling pond and contaminated soil in the soil berm and facilitating unrestricted land use within the settling pond and contaminated soil berm area. Through the use of consolidation, the alternative would reduce the overall footprint of contaminated areas at the mill site. The threats posed to public health and the environment as a result of direct contact with contaminated materials and the threat of offsite migration of the materials by way of water/wind erosion or mass wasting process would be effectively mitigated by covering the consolidated waste materials placed within the disposal cell with soil. The configuration/shaping of the consolidated wastes within the disposal cell, run-on/run-off and drainage controls, and vegetated soil cover, would reduce the potential for percolation of direct precipitation. Minimizing the potential for direct precipitation to percolate into the contaminated materials reduces the potential for generation of leachate. However, the alternative would not provide protection against the leaching of metals as a result of upgradient groundwater inflows. While the alternative would isolate the consolidated materials and thereby reduce the potential for off-site migration of site-derived contamination, the alternative would not provide reductions in the mobility, toxicity, or volume of on-site contaminated materials because the alternative does not include the use of treatment technologies required for such reductions.

Both of the sub-alternatives (3A and 3B) would provide protection against actual or potential exposure of site workers and the general public to the threats posed by mill wastes. Under Sub-Alternative 3A, mitigation of the threat of direct exposure to the wastes would be ensured by containment of the wastes beneath a vegetated soil cover. Although mill wastes would remain in place under Sub-Alternative 2B, exposure to the mill wastes would be mitigated by permanent institutional controls implemented to secure the structure and prevent unauthorized access into the mill building.

General compliance with ARARs would be achieved with implementation of Alternative 3.

There would likely be some short-term ecological and environmental effects due to construction activities from dust generation, vegetation clearing, and general construction noise during implementation of Alternative 3. These short-term impacts would be minimal, with exposure pathways minimized through engineering controls and personal protective equipment.

5.5.3.2 Implementability

Implementation of Alternative 3 is technically feasible at the mill site. The effectiveness of the alternative could be readily monitored by performing periodic site inspections to ensure the integrity of controls is maintained over time. The necessary resources and materials for Alternative 3 are readily available from nearby sources; however, a soil borrow area has not been identified in the vicinity of the mill site.

Alternative 3 is also administratively feasible at the mill site; however, some public concerns may be raised because the disposal cell will be constructed in a natural area that has not been disturbed and contaminated materials will be placed in an area that currently is not contaminated. Applicable permit and agency coordination requirements, as identified in Section 4.3 of this document, would need to be met before commencing construction operations.

5.5.3.3 Cost

The estimated costs for Alternative No. 3 are presented in Table 5.2, and a detailed breakdown of the costs is provided in Appendix C. Direct capital costs include mobilization and the labor and materials required to complete the ancillary construction activities discussed in Section 5.4 and activities associated with the removal action alternative discussed in Section 5.5.2 above. The total capital costs for Alternative 3 are summarized as follows:

- Alternative No. 3 (Sub-Alternative 3A) $ 574,753

- Alternative No. 3 (Sub-Alternative 3B) $ 568,853

Operation and maintenance costs correspond to the costs associated with post-reclamation inspection and maintenance. Under Forest Service policy, three years of post-reclamation operation and maintenance is included in evaluation of the costs associated with removal actions at sites under the jurisdiction and control of the Forest Service. Based on the annual budget established by the Forest Service for operation and maintenance at other nearby sites at which removal actions have been implemented by the Forest Service, an annual cost of $15,000 per year for three years of post-reclamation operation and maintenance is estimated for Alternative 3. The operation and maintenance costs associated with the two sub-alternatives are expected to be the same because implementation of permanent institutional controls to secure the mill building and prevent unauthorized access into the structure is common to both Sub-Alternative A or B.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

In this section, the three alternatives, including sub-alternatives, evaluated in Section 5.0 are compared against each other to evaluate the relative performance of each alternative in relation to each of the criteria. The criteria used in this comparison are the same as those evaluated in Section 5.0, including effectiveness, implementability, and cost. A comparative analysis summary showing the rating of each alternative relative to the other alternatives is provided in Table 6.1. For each alternative listed in the tables, an overall rating of "low", "moderate", or "high" is given for each evaluation criterion. To better describe the overall ratings given, a numerical scale ranging from 1 (low) to 3 (high) is used to refine the rating for each narrative category. For example a rating of low (1) indicates the low end of the low category, while a rating of high (3) indicates the high end of the high category.

6.1 Effectiveness of Alternatives

The effectiveness of the alternatives is compared on the basis of six criteria: (1) compliance with RAOs, (2) overall protection of human health and the environment, (3) compliance with ARARs, (4) long-term effectiveness and permanence, (5) reduction of toxicity, mobility, or volume, and (6) short-term effectiveness. Both Alternatives 2 (A or B) and 3 (A or B) are considered equally effective with respect to these factors. The overall effectiveness of Alternate 1 (No Action) would be low compared to the other alternatives.

6.1.1 Compliance with RAOs

The RAOs specified in Section 4.4 of this document would be achieved equally with implementation of Alternatives 2 (A or B) or 3 (A or B). By consolidating all contaminated materials either at the tailings pond or in a disposal cell, each alternative provides an effective means of (1) preventing or reducing actual or potential exposure of site worker and the general public to threats posed by mill wastes within the mill building, (2) preventing or reducing actual or potential exposure of humans and the local biotic community from direct contact with tailings around the mill building and within the settling pond and contaminated soil comprising the soil berm, and (3) meeting unrestricted land use requirements for the portions of the former mill operations that are located on private land. By covering the consolidated materials with a physical barrier and vegetated soil cover, the alternatives provide and effective means of isolating the consolidated waste materials and preventing or reducing (1) actual or potential exposure of nearby human or animal populations from direct contact with the wastes, (2) the potential for off-site migration of the contaminants as a result of wind, erosion, and mass wasting processes, and (3) the potential for leachate generation as a result of direct infiltration of precipitation and precipitation runoff. Through proper implementation of either Alternative 2 or 3, the stability and integrity of the mill building and its contents will be protected, the natural character of the mill site will be maintained, and ARARs will be satisfied.

Compliance with the RAOs would not be achieved under the no-action alternative.

6.1.2 Overall Protection of Human Health and the Environment

The greatest risks to human health and the environment are attributed to direct contact with the mill wastes, tailings, and contaminated soil at the mill site. In addition, off-site migration of site-derived contaminants poses threats to human health and the environment in areas downgradient of the mill site.

Under the no-action alternative, there would be no reduction in the human health and ecological risks posed by the contaminated media at the mill site. Exposures to elevated metals in the contaminated materials and off-site migration of contaminants would be expected to continue in the future. Therefore, the no-action alternative would not promote protection of human health and the environment.

Alternatives 2 (A or B) and 3 (A or B) both provide protection of human health and the environment by eliminating the potential for direct exposure to the contaminated materials and reducing the potential for off-site migration of site-derived contamination.

Some short-term ecological and human health impacts would be anticipated during construction from dust generation, vegetation clearing, and general construction noise. These impacts would be minimized by use of engineering controls and personal protective equipment for on-site workers.

6.1.3 Compliance with ARARs

Under the no-action alternative, mill wastes, tailings, and contaminated soil will continue to pose human-health and ecological threats at the mill site. The contaminated materials would also continue to migrate from the mill site as a result of wind and water transport and mass wasting processes, impacting downwind and downgradient areas. No reductions in leachate generation and therefore, no improvement in downgradient water quality would be expected under the no-action alternative.

Alternatives 2 (A or B) and 3 (A or B) would generally provide the same level of compliance with ARARs since both would include consolidation of contaminated materials and isolation of those materials with use of a vegetated soil cover. The use of a vegetated soil cover on the physical barrier would reduce the potential for water to infiltrate through the cover and into the contaminated materials within the containment or disposal area.

None of the potential alternatives for the mill site are expected to result in reduction of metals concentrations in Lake Fork downgradient of the site to the levels reported upstream of the mill site. Such reductions are not expected because the mill site is not the only potential contaminant source within the stream reach, surface water discharges from the mill site only in response to precipitation runoff and the amount of water running off the mill site is small compared to the flow in Lake Fork. However, implementation of the removal action will contribute to the overall improvement of water quality within the upper San Miguel River watershed.

It is expected that contaminant-specific ARARs for ambient air would be met under Alternative 2 (A or B) and Alternative 3 (A or B). Some improvement of air quality is expected after the tailings have been covered in comparison to the existing exposed and unvegetated tailings areas.

Location-specific ARARs are expected to be met under either Alternative 2 (A or B) or Alternative 3 (A or B). Each alternative would be implemented in a manner that ensures protection of the stability and integrity of the mill structure and its contents. Any threatened or endangered species that may be present in the project area would not be impacted in the long-term because the removal action will be completed in a relatively short period of time, all disturbed areas will be reclaimed, and operation and maintenance activities required to support the action will not require a level of activity that is greater than that existing under current conditions. In addition, removal activities associated with any tailings or contaminated soil in contact with surface water within the un-named drainage adjacent to the mill area would be conducted such that any disturbance to the bed or banks of the drainage would be minimized. The bed and banks of any such affected drainage would be properly reclaimed and protected from flood erosion. In addition, proper controls will be implemented within each disturbed area to minimize erosion.

Action-specific ARARs are expected to be met by either Alternative 2 (A or B) or Alternative 3 (A or B). Compliance with stormwater runoff requirements and emissions of fugitive dust would be achieved through the use of best management practices. The actions would also reduce the amount of mill-derived leachate entering nearby surface water. The reduced metals concentrations in any future discharges of water from the mine area would not be expected to impact ambient water-quality conditions in Lake Fork and should contribute to the overall improvement of water quality within the basin. All activities performed in support of the actions will be conducted in compliance with procedures and protocols established by OSHA.

6.1.4 Long-term Effectiveness and Permanence

Both Alternatives 2 (A or B) and 3 (A or B) would be effective in the long-term. Both alternatives would provide long-term effectiveness provided the containment area or disposal cell is properly inspected and maintained over time. The use of a physical barrier between the contaminated materials and cover soil would require proper installation for either alternative to provide long-term effectiveness.

The no-action alternative would provide no long-term or permanent solution for the threats posed by the mill site.

6.1.5 Reduction of Toxicity, Mobility, or Volume

None of the alternatives considered in the analysis involve treatment of the mill waste, tailings, or contaminated soil, and therefore, the volume, toxicity, or mobility of contaminants in the media would not be reduced in any of the alternatives. The existing volume of contaminated materials will remain on-site, and the materials will not be treated or otherwise stabilized to reduce toxicity or mobility. However, reduction of mobility with respect to off-site migration of contaminated materials would be reduced through implementation of the actions taken under Alternatives 2 (A or B) or 3 (A or B) to physically isolate the materials through containment or on-site disposal with a vegetated soil cover.

6.1.6 Short-term Effectiveness

Some short-term ecological and human-health impacts would be anticipated during implementation of Alternatives 2 or 3 from dust generation, vegetation clearing, and general construction noise. In addition, site workers will be subject to potential threats (e.g., direct contact, inhalation, and ingestion) associated with the mill waste, tailings, and contaminated soil during implementation of the action. Short-term impacts to the public and workers during construction would be minimal, with exposure pathways minimized through engineering controls (e.g., restricting public access) and the use of personal protective equipment. Ecological impacts would be minimized by implementation of best management practices for control emissions of fugitive dust, off-site migration of sediment from disturbed areas, and protection of surface water channels. The duration of short-term impacts to human health and the environment would be limited because the actions could be completed within one construction season.

Although there would be no construction-related impacts for the no-action alternative, the impacts from direct contact with the mill wastes, tailings, and contaminated soil would continue in both the short-term and long-term.

6.2 Implementation of Alternatives

Alternative 2 and Alternative 3 are both technically and administratively feasible. Essential project components including technical expertise, equipment, and materials are readily available in western Colorado. Although the amount of native soil and fill material available on-site is not known, it is anticipated that the amount of borrow material available on-site will not be sufficient to support the actions and some soil will likely need to be imported to the mill site from nearby permitted sources. Experienced personnel should be used to ensure that proper quality assurance/quality control protocols are implemented during installation containment structures and erosion-control features. It is expected that such personnel are available in the regional area.

Administratively, Alternative 3 would likely be more difficult to implement than Alternative 2. It is anticipated that concerns raised by the public as well as other federal or state and local agencies could impact acceptance/approval of the alternative. Such concerns would include increased disturbance to natural lands, construction of a repository in an area that otherwise is not contaminated and greater expenditure of public funds when an equally effective alternative is available for consideration.

With respect to the two sub-alternatives, Sub-Alternative B is considered technically and administratively more feasible than Sub-Alternative A. Worker safety would be the primary concern during implementation of Sub-Alternative A. As a result, actions would be required to stabilize the mill structure and improve access ways within the structure to the degree necessary to ensure worker safety. Exposure to safety hazards would not warranted because removal of the wastes (Sub-Alternative A) would not be necessary since the threats posed by the mill wastes would effectively be mitigated by the use of the permanent institutional controls to prevent unauthorized access common to each sub-alternative. Because the building is located on land under the jurisdiction and control of the Forest Service, the Forest Service can administer the enforcement and inspections/maintenance required to ensure the integrity of the permanent institutional controls over time. If at any time it is determined that the integrity of the controls cannot be maintained, resulting in potential threats to public health and the environment, the Forest Service has the authority to implement the removal action(s) necessary at that time to mitigate the threats, including removal of the mill wastes for proper disposal. Therefore, Sub-Alternative B is considered to be technically and administratively more implementable than Sub-Alternative A

Although technical feasibility is not an issue for the no-action alternative, some consideration would need to be given to the administrative feasibility of the alternative. The no-action alternative may not be acceptable to the public, regulatory agencies and the Forest Service because current threats to public health and the environment, as described in the streamlined risk evaluation, will remain at the mill site and continue in the future. In addition, removal of tailings and contaminated soil comprising the soil berm on former mill site lands that are now private would likely not be acceptable to the Forest Service.

6.3 Cost

No capital costs or indirect costs would be incurred under the no-action alternative. Other than periodic inspections by Forest Service personnel, no operation and maintenance costs would be incurred under the no-action alternative. However, the long-term costs associated with the no-action alternative are not known because there would be ongoing threats to public health and the environment from direct contact with the with the contaminated materials, and contaminant sources (tailings at the settling pond and contaminated soil comprising the soil berm) would remain on the private land that formerly was part of the mill site. In addition, contaminated materials would continue to migrate off-site, potentially resulting in damage to other resources, and requiring future action.

The estimated costs for Alternatives 2 and 3 are presented in Table 5.2. As shown, the costs will be lower for Alternative 2 compared to Alternative 3, and the costs for Sub-Alternative B will be lower than Sub-Alternative A.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

This EE/CA was prepared in accordance with EPA guidance documents for non-time-critical removal actions under CERCLA. The purpose of the EE/CA is to identify and analyze alternative removal actions intended to address threats to public health and the environment associated with mill wastes (processing spillage and ore/concentrate) within the mill building, tailings around the mill building, tailings within the tailings pond and settling pond, soil comprising the soil berm constructed at the settling pond at the mill site. Three removal action alternatives (including a no-action alternative) were identified and analyzed in this EE/CA.

The mill wastes, tailings, and contaminated soil at the mill site pose threats to public health and the environment because of elevated concentrations of arsenic, antimony, and lead. Except for the mill wastes within the mill building, the primary threat is to residents based on EPA's residential soil standard and BLM's adjacent resident RMC. By reducing the threats based on these benchmarks, the private land which was formerly part of the mill operations (settling pond and soil berm) qualifies for unrestricted land use and the threats to adjacent residents are mitigated on the remaining portion of the mill site on public land. Mill wastes pose a potential threat to site/industrial worker within the mill building. By reducing potential threats to site workers, any potential threats to any individuals that may enter the building for lesser exposure durations than site workers will also be reduced. The RAOs established for the removal action are directed towards reducing the human-health and ecological risks associated with the contaminated materials by minimizing the potential for direct exposure to the materials, reducing potential off-site migration of the contaminated media, and reducing potential for leach generation.

Based on the comparative analysis of the alternatives presented in Section 6.0 of this document, Alternative 2B is the most effective, implementable, and cost-effective solution for reduction of the public-health and ecological threats posed by mill wastes, tailings, and contaminated soil at the mill site in accordance with the RAOs established for the removal action. Alternative 2B would be implemented as follows:

- Compact tailings within the tailings pond with a vibratory compactor to densify the tailings and mitigate future settlement.
- Consolidation of tailings and contaminated soil comprising the soil berm at the existing tailings pond. Tailings within the settling pond and the soil berm adjacent to the settling pond will be

excavated and placed on the compacted tailings at the existing tailings pond. Assuming 30-percent contingencies to account for basal unconformities and over-excavation where necessary to meet RAOs, it is anticipated that approximately 660 cubic yards of tailings will be excavated from the settling pond and 240 cubic yards of soil will be excavated from the soil berm for consolidation at the disposal cell. A portable X-Ray Fluorescence (XRF) analyzer will be used to guide excavation of the contaminated materials and demonstrate that soils remaining at the settling pond and berm area after removal do not pose a human-health threat. The XRF will be used to measure the concentration of an indicator parameter (e.g., lead) which will be compared to the residential soil standard for that parameter (e.g., 400 mg/Kg for lead). Confirmation soil samples will be collected and analyzed by an analytical laboratory to verify that the soil remaining at the former settling pond and berm area do not pose a human-health threat based on the removal action goals specified for tailings within the settling pond and contaminated soil comprising the soil berm in Section 4.4 of this document. Following confirmation based on the analytical results, the excavation will be backfilled with clean fill material, the surface graded to be consistent with the natural character of the surrounding area, and all disturbed areas will be vegetated.

- Removal of tailings/wastes from around the outside of the mill building and place on the compacted tailings at the existing tailings pond. No characterization of tailings/wastes around the mill building has been completed to date; for cost estimating purposes, it is assumed that the volume of tailings/wastes to be excavated around the outside of the mill building and place on the compacted tailings at the tailings pond will not exceed 250 cubic yards. Tailings/wastes will be removed from areas delineated on the basis of XRF analysis of an indicator parameter (e.g., lead), with concentrations compared to the industrial worker standard for that parameter (e.g., 800 mg/Kg for lead). Confirmation samples for laboratory analysis will be collected to verify that the residual soils remaining after removal do not pose a threat based on the removal action goals specified for tailings around the outside of the mill building in Section 4.4 of this document. Tailings/wastes will not be removed from any areas where, through consultation with the Forest Service, it is determined that such removal would jeopardize the stability and integrity of the mill building and reasonable measures could not be taken to otherwise protect the structure. In all cases, care will be taken during removal of wastes from around the outside of the mill building to protect the stability and integrity of the structure and its contents.

- Mill wastes inside the mill building will remain in place, and the potential threats to public health posed by mill wastes (process spillage and ore/concentrate) will be mitigated by the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure.

- Reshape the consolidated waste materials at the tailing pond to accept a cover and provide positive runoff by raising the center portion of the tailings to create a minimum outward slope of 5 percent.

- Place a physical barrier (e.g., nonwoven geotextile) on the reshaped tailing pond. It is estimated that the physical barrier will cover a surface area of approximately 29,000 square feet.

- Place a soil cover (minimum 2-feet thick) over the physical barrier; it is estimated that approximately 2,150 cubic yards of soil/fill material will be required for the cover system. Ensure cover soil is capable of supporting vegetation, and amend soil as necessary. Plant native vegetation consistent with the natural character of the surrounding area on the soil cover.

- Install run-on/run-off and drainage controls as necessary to direct and control precipitation run-off.

Operation and maintenance activities associated with Alternative 2B would include periodic inspections to monitor the integrity of the soil cover, erosion control measures, and revegetation success. Operation and maintenance activities would also include inspection of the permanent institutional controls implemented to secure the mill building and prevent unauthorized access inside the structure. The access road leading to the tailings area will not be reclaimed upon completion of the action; however, natural barriers/boulders will be placed across the access routes to discourage vehicle (including ATVs) access. The natural barriers will be removed when necessary to allow access for maintenance activities.

The estimated capital cost (construction and indirect costs) for Alternative 2B is $ 152,129.

Based on the annual budget established by the Forest Service for operation and maintenance at other nearby sites at which removal actions have been implemented by the Forest Service, an annual cost of $15,000 per year for three years of post-reclamation operation and maintenance is estimated for Alternative 2B.

The estimated net present value (over the three-year period) for Alternative 2B is $ 192,978.

8.0 ACRONYMS AND ABBREVIATIONS

AAK	Au' Authum Ki, Inc
AGS	American Geologic Services, Inc.
ARAR	Applicable or relevant and appropriate requirement
ATV	All-terrain vehicle
BLM	U.S. Bureau of Land Management
CAA	Clean Air Act
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CWA	Clean Water Act
DAF	Dilution attenuation factor
EE/CA	Engineering evaluation and cost analysis
EPA	U.S. Environmental Protection Agency
HCS	HRL Compliance Solutions, Inc.
LL	Liquid limit
MCL	Maximum Contaminant Level
mg/Kg	Milligrams per kilogram
mg/L	Milligrams per liter
ML	Low-plasticity silt
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan
PA/SI	Preliminary Assessment/Site Investigation
PI	Plasticity Index
POTW	Publicly Owned Treatment Works

RAO	Removal Action Objective
RCI	Reactivity, corrosivity, and ignitability
RMC	Risk Management Criteria
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SM	silty sand
SPLP	Synthetic Precipitation Leach Procedure
SSL	Soil Screening Level
s.u.	Standard Units
TBC	To Be Considered
TCLP	Toxicity Characteristics Leaching Procedure
TVS	Table Value Standard
μg/L	Micrograms per liter
μS/cm	MicroSiemens per centimeter
USCS	Unified Soil Classification System
WQCC	Water Quality Control Commission
WWL	Western Water & Land, Inc.
XRF	X-Ray Fluorescence

9.0 REFERENCES

American Geological Services, Inc., 2005. *Phase I Environmental Site Assessment & Limited Phase II Site Investigation*. November.

Au' Authum Ki, Inc., 2007. *Site Assessment Report – San Bernardo Mill, San Miguel County, CO*. April.

Bromfield, C.S. and Conroy, A.R., 1963. Preliminary Geologic Map of the Mount Wilson Quadrangle, San Miguel County, Colorado: U.S. Geological Survey, Mineral Investigations Field Studies Map MF-273.

Collman, et.al., 1993. *The RGS Story, Volume III – Over the Bridges…Vance Junction to Ophir.* Sundance Publications, Limited, Denver, Colorado.

Colorado Department of Public Health and Environment, 2013. *Regulation No. 35 – Classification and Numeric Standards for Gunnison and Lower Dolores River Basins.*

Ford K.L., 2004. *Risk Management Criteria for Metals at BLM Mining Sites*. Technical Note 390 (revised); BLM/RS/ST-97/001+1703. October.

National Research Council, 1980. Mineral Tolerance of Domestic Animals. Prepared for Food and Drug Administration. July.

U.S. Environmental Protection Agency, 2013. Regional Screening Levels. Available at www.epa.gov.

________________________________, 1996. *Soil Screening Guidance.* Office of Solid Waste and Emergency Response. Publication No.9355.4-23. July.

________________________________, 1993. *Guidance on Conducting Non-time Critical Removal Actions Under CERCLA.* Publication: 9360.0-32FS. December.

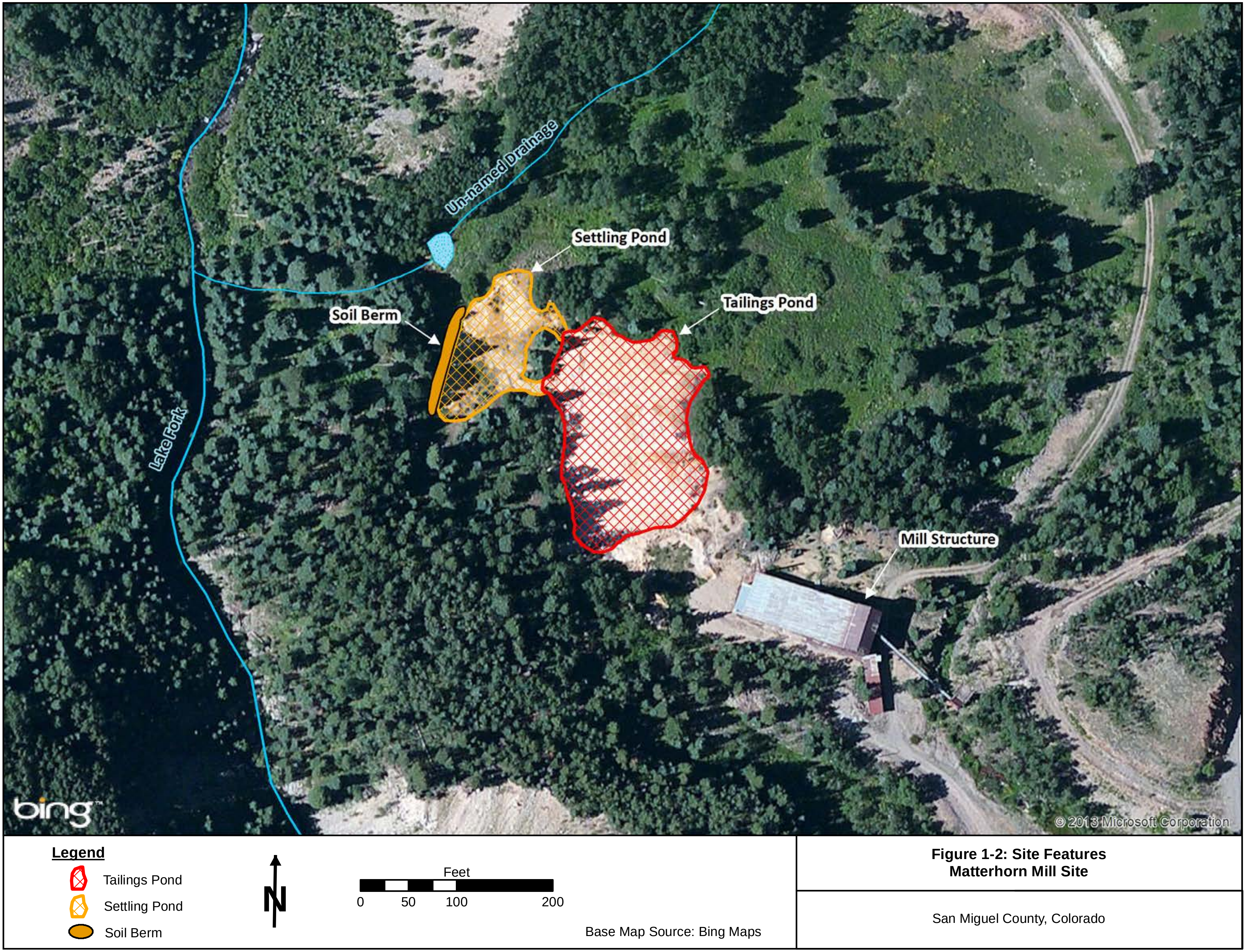
________________________________, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*. OSWER Directive 9355.3-01. EPA 540-6-89-004.

FIGURES

Base Map Source: US Topo Maps

Figure 1-1: Site Location
Matterhorn Mill Site

San Miguel County, Colorado



Base Map Source: Bing Maps

Figure 1-2: Site Features
Matterhorn Mill Site

San Miguel County, Colorado

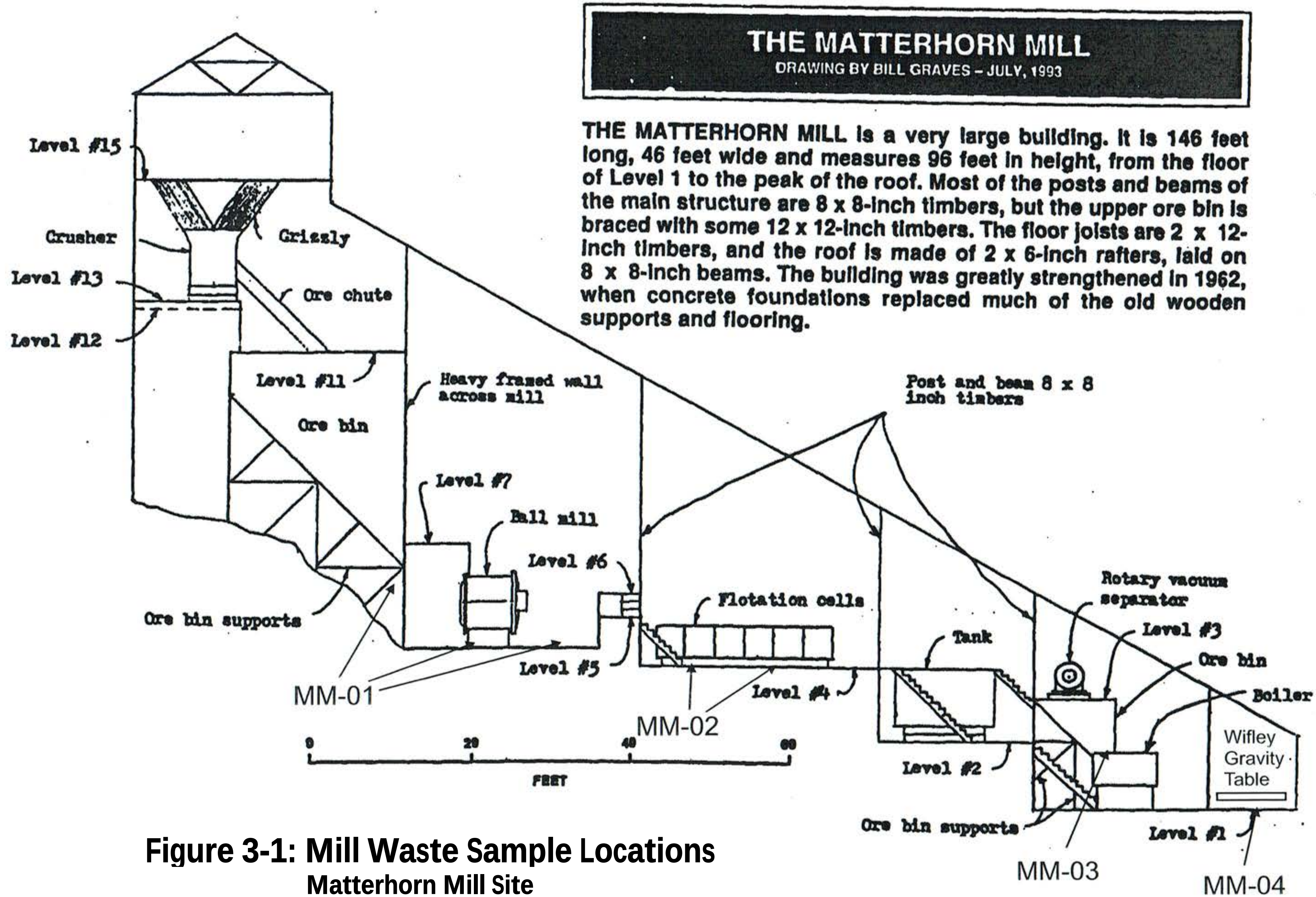


Figure 3-1: Mill Waste Sample Locations
Matterhorn Mill Site
San Miguel County, CO

From American Geological Services, Inc., 2005

Legend

- Surface-Water Sample
- Tailings, Sediment, or Soil Sample
- Test Pit
- Background Vegetation & Soil Area

N

Feet

0 125 250 500

Base Map Source: Bing Maps

Figure 3-2: Sample Locations
Matterhorn Mill Site

San Miguel County, Colorado

TABLES

Table 3.1: Metal Results for Mill Processing Waste Samples Inside Mill Structure
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Units	MM-01 Processing Spillage	MM-02 Processing Spillage	MM-03 Ore/concentrate	MM-04 Processing Spillage
Metals					
Antimony, Total	mg/Kg	682	256	4380	880
Arsenic, Total	mg/Kg	712	286	1880	910
Cadmium, Total	mg/Kg	35.6	15.4	175	109
Copper, Total	mg/Kg	2010	2040	10400	2400
Lead, Total	mg/Kg	29400	12800	111000	64400
Manganese, Total	mg/Kg	3230	542	574	533
Mercury, Total	mg/Kg	1.20	0.63	< 0.05 U	0.91
Silver, Total	mg/Kg	332	150	890	350
Zinc, Total	mg/Kg	6780	2870	31600	22800
Inorganics					
Solids, Percent	%	90.8	96.1	89.7	70.3

Qualifiers are defined as follows:

U Analyte was not detected at the Method Detection Limit

Table 3.2: Analytical Results for Surface-Water Samples
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Units	SW-1	SW-2	SW-3		SW-4	SW-5
		Lake Fork - Up	Lake Fork - Down	Small Pond	Duplicate	Settling Pond	Spring
Physical							
Field Parameters							
Flow rate	cfs	~ 100.0	----	----	----	----	~ 1.0 gpm
Temperature	ºC	10.1	9.6	8.9	----	6.9	5.9
pH	s.u.	7.78	7.5	3.7	----	2.92	4.04
Conductivity	(uS/cm)	241	273	980	----	986	820
Dissolved Oxygen	(mg/L)	8.48	8.45	0.44	----	5.68	7.91
Oxidation-Reduction Pot.	(mV)	126.4	119.3	486	----	-116	313
Laboratory Parameters							
Acidity as $CaCO_3$	mg/L	< 2 U	< 2 U	114	106	413	90
Total Alkalinity	mg/L	63	64	< 2 U	< 2 U	< 2 U	< 2 U
Total Suspended Solids	mg/L	< 5 U	< 5 U	< 5 U	< 5 U	28 B	< 5 U
Total Dissolved Solids	mg/L	150	170	510	510	440	650
Hardness as $CaCO_3$	mg/L	106	122	240	250	84	360
Bicarbonate as CaCO3	mg/L	63	64	< 2 U	< 2 U	< 2 U	< 2 U
Carbonate as CaCO3	mg/L	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Cation-Anion Balance	%	-2.2	0	7	4.8	-13	1.3
Hydroxide as CaCO3	mg/L	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Inorganic							
Boron	mg/L	0.01 B	0.03 B	< 0.01 U	< 0.01 U	0.03 B	0.01 B
Calcium, dissolved	mg/L	37.4	42.9	78.1	81.5	28.3	121
Chloride	mg/L	2 B	2 B	24	24	2 B	12
Cyanide, total	mg/L	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U
Magnesium, dissolved	mg/L	3	3.6	10.8	11.3	3.3	14
Nitrate as N, dissolved	mg/L	0.06 B	0.06 B	0.11	0.11	0.05 B	0.34
Nitrate/Nitrite as N, dissolved	mg/L	0.06 B	0.06 B	0.11 H	0.11	0.05 BH	0.34 H
Nitrite as N, dissolved	mg/L	< 0.01 U	< 0.01 U	< 0.01 U	< 0.01 U	0 UH	0 UH
Nitrogen, ammonia	mg/L	< 0.05 U	< 0.05 U	0.25 B	0.18 B	0.13 B	0.05 B
Potassium	mg/L	0.3 B	< 0.3 U	1.4	1.5	1.9	1.4
Sodium, dissolved	mg/L	3.5	4.2	6.2	6.5	6.5	9.8
Sulfate	mg/L	50 H	60 H	220 H	250 H	290	360
Sulfide as S	mg/L	0.04 B	< 0.02 U	0.03 B	0.03 B	< 0.02 U	< 0.02 U
Sum of Anions	meq/L	2.3	2.6	5.3	5.9	6.1	7.9
Sum of Cations	meq/L	2.2	2.6	6.1	6.5	4.7	8.1
Metals							
Antimony, dissolved	µg/L	< 0.4 U	< 0.4 U	1.2 B	1.1 B	1.1 B	< 0.4 U
Arsenic, dissolved	µg/L	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	10.6	< 0.5 U
Arsenic, total recoverable	µg/L	< 0.5 U	< 0.5 U	0.8 B	0.6 B	20.6	< 0.5 U
Cadmium, dissolved	µg/L	< 0.1 U	< 0.1 U	18.9	19	39.2	13.1
Chromium, total recoverable	µg/L	< 10 U	< 10 U	< 10 U	< 10 U	30 B	20 B
Copper, dissolved	µg/L	< 10 U	< 10 U	200	220	1000	60
Iron, dissolved	µg/L	< 20 U	< 20 U	4180	4760	39600	50 B
Iron, total recoverable	µg/L	< 20 U	< 20 U	3050	3060	42600	30 B
Lead, dissolved	µg/L	< 0.1 U	< 0.1 U	102	103	35.7	1
Manganese, dissolved	µg/L	< 5 U	25 B	8810	9830	5040	5830
Mercury, total	µg/L	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U
Nickel, dissolved	µg/L	< 10 U	< 10 U	30 B	30 B	20 B	30 B
Selenium, dissolved	µg/L	0.5 B	0.4 B	< 0.1 U	< 0.1 U	1.2 B	0.1 B
Silver, dissolved	µg/L	< 0.05 U	< 0.05 U	< 0.05 U	< 0.05 U	0.21 B	0.08 B
Zinc, dissolved	µg/L	< 10 U	30 B	5450	5790	8280	3000

Qualifiers are defined as follows:

B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit

U Analyte was not detected at the Method Detection Limit

H Holding time was exceeded

Table 3.3: Analytical Results for Soil, Tailings, and Sediment Samples Compared to Background Soil Samples
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
			Surface Samples[1]			Subsurface Sample[2]	Surface Sample[1]	Subsurface Sample[2]	Surface Sample[1]	Surface Sample[1]
		BKG	T-1	T-2		Matterhorn Tailings	T-3	Matterhorn Settling	Berm	Sed - 1
			Tailings Pond - North	Tailings Pond - South		Test Pit Composite	Settling Pond - Tailings	Test Pit Composite	Berm Composite	Sediment Composite
		10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals										
Antimony, Total	mg/Kg	0.5 B	**62 +++**	**67 +++**	**64 +++**	**63 +++**	**69 +++**	**76 +++**	**21 ++**	**10.5 ++**
Arsenic, Total	mg/Kg	9.3	**161 ++**	**242 ++**	**150 ++**	**302 ++**	**178 ++**	**183 ++**	**139 ++**	**111 ++**
Cadmium, Total	mg/Kg	0.74	**6.38 +**	**7.63 ++**	**6.68 +**	**2.11 +**	**2.3 +**	**13.2 ++**	**8.72 ++**	**1.94 +**
Chromium, Total	mg/Kg	15	5 B	3 B	3 B	5	4 B	4 B	**16 +**	**19 B+**
Copper, Total	mg/Kg	17	**105 +**	**94 +**	**90 +**	**228 ++**	**96 +**	**262 ++**	**377 ++**	**298 ++**
Iron, Total	mg/Kg	19400	**26800 +**	18700	**20300 +**	**56100 +**	**28400 +**	**36200 +**	**60400 +**	**252000 ++**
Lead, Total	mg/Kg	37	**4300 +++**	**3720 +++**	**3760 +++**	**5490 +++**	**2780 ++**	**2530 ++**	**1680 ++**	**240 +**
Manganese, Total	mg/Kg	583	51.1	30.4	27.4	84.3	71.7	**4060 +**	**4980 +**	147
Mercury, Total	mg/Kg	0.05 B	**0.83**	**0.56**	**0.54**	**0.48**	**0.33**	**1.37**	**0.13 B**	**0.2 B**
Molybdenum, Total	mg/Kg	2 B	**7 +**	**7 +**	**8 +**	**16 +**	**6 +**	**8 +**	**10 +**	**7 B**
Nickel, Total	mg/Kg	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	**16**	< 6 U
Selenium, Total	mg/Kg	0.45	**4.22 +**	**4.28 +**	**4.24 +**	**5.39 ++**	**2.71 +**	**3.39 +**	**3.42 +**	**1.97 +**
Silver, Total	mg/Kg	< 1 U	**41 ++**	**38 ++**	**41 ++**	**72 ++**	**32 ++**	**36 ++**	**16 ++**	**16 ++**
Uranium, Total	mg/Kg	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	**4.03**
Vanadium, Total	mg/Kg	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	108	**434 +**	**1390 ++**	**1370 ++**	**543 +**	**552 +**	**2040 ++**	**1020 +**	**385 +**
Inorganics										
Cyanide, Total	mg/Kg	< 0.3 U	< 0.4 U	< 0.3 U	< 0.3 U	< 0.3 UH	< 0.4 U	< 0.2 UH	0.7 B	< 0.8 U
Nitrogen, ammonia	mg/Kg	22	25	20	21	34	24	12 B	22	26
Solids, percent	%	74.1	75.4	85.4	85.3	72.6	73.3	86	74.1	29.1

[1] Surface samples collected from 0 to 6 inches below ground surface
[2] Subsurface samples collected as composite of material excavated from test pits
Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit
H Analysis exceeded method hold time
Value in bold indicates level exceeds background level
+ Value exceeds background level by 1 to 10 times
++ Value exceeds background level by 10 to 100 times
+++ Value exceeds background level by more than 100 times

Table 3.4: SPLP Metal Results for Tailings Samples
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Unit	Tailings Pond									Settling Pond							
		Surface Sample T-1 10/4/2006			Subsurface Sample Matterhorn Tailings 10/16/2008						Surface Sample T-3 10/5/2006			Subsurface Sample Matterhorn Settling 10/16/2008				
Metals																		
Antimony	mg/L		0.0007	B		0.0008	B					0.0005	B		0.0018	B		
Arsenic	mg/L		0.0008	B	<	0.0005	U				<	0.0005	U		0.0014	B		
Cadmium	mg/L		0.0029			0.002						0.0011			0.0863			
Chromium	mg/L	<	0.01	U	<	0.01	U				<	0.01	U	<	0.01	U		
Copper	mg/L		0.04	B		0.15						0.03	B		0.01	B		
Iron	mg/L		0.1			0.08						0.05	B	<	0.02	U		
Lead	mg/L	<	0.04	U		0.1	B				<	0.04	U		0.05	B		
Manganese	mg/L		0.023	B		0.588						0.432			33.6			
Mercury	mg/L	<	0.0002	U	<	0.0002	U				<	0.0002	U	<	0.0002	U		
Molybdenum	mg/L	<	0.01	U	<	0.01	U				<	0.01	U	<	0.01	U		
Nickel	mg/L	<	0.01	U		0.01	B				<	0.01	U		0.04	B		
Selenium	mg/L		0.0002	B		0.0003	B					0.0002	B		0.0016			
Silver	mg/L		0.00023	B		0.00097						0.0003	B		0.00005	B		
Uranium	mg/L	<	0.0001	U	<	0.0001	U				<	0.0001	U	<	0.0001	U		
Vanadium	mg/L	<	0.005	U		0.005	B				<	0.005	U	<	0.005	U		
Zinc	mg/L		0.71			0.48						0.28			5.77			
Inorganics																		
Cyanide	mg/L	<	0.005	U	<	0.005	U				<	0.005	U	<	0.005	U		
Nitrogen, ammonia	mg/L		N/A			0.57						N/A		<	0.3	U		

Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit

Table 3.5: Analytical Results for Vegetation Samples
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Units	BKG VEG	VEG-T	VEG-POND	
		Background	Tailings Pile	Settling Pond	DUPLICATE
Metals					
Antimony	mg/Kg	0.6 B	10.1	9.8	8.5
Arsenic	mg/Kg	1	16.5	19	15.1
Cadmium	mg/Kg	0.24 B	0.74	0.62	0.47
Chromium	mg/Kg	1 B	2 B	2 B	2 B
Copper	mg/Kg	4 B	31	20	19
Iron	mg/Kg	276	1930	3880	3360
Lead	mg/Kg	8 B	207	228	194
Manganese	mg/Kg	91.8	275	1130	1100
Mercury	mg/Kg	< 0.4 U	< 0.3 U	< 0.3 U	< 0.4 U
Molybdenum	mg/Kg	3 B	< 1 U	< 1 U	< 1 U
Nickel	mg/Kg	1 B	2 B	2 B	2 B
Selenium	mg/Kg	0.19 B	0.4	0.45	0.33
Silver	mg/Kg	< 1 U	3	4	3
Uranium	mg/Kg	< 0.05 U	< 0.05 U	0.05 B	< 0.05 U
Vanadium	mg/Kg	0.5 B	0.8 B	0.8 B	0.8 B
Zinc	mg/Kg	66	234	173	151
Inorganics					
Moisture Content	%	75.6	73.2	75.5	75.6

Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit

Table 3.6: Human-Health Screening Criteria for Soil, Sediment, and Tailings
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Resident			BLM Site Visitor RMC			Site/Industrial Worker		
		Screening Level[1]	BLM RMC	EPA RSL	Screening Level[1]	Camper	ATV Driver	Screening Level[1]	BLM RMC	EPA RSL
Metals										
Antimony, Total	mg/Kg	3	3	31	50	50	750	100	100	410
Arsenic, Total	mg/Kg	0	1	0	20	20	300	2	12	2
Cadmium, Total	mg/Kg	3	3	70	70	70	950	100	100	800
Chromium, Total	mg/Kg	-----	-----	----	-----	-----	-----	-----	-----	----
Copper, Total	mg/Kg	250	250	3,100	5,000	5,000	70,000	7,400	7,400	41,000
Iron, Total	mg/Kg	55,000	-----	55,000	-----	-----	-----	720,000	-----	720,000
Lead, Total	mg/Kg	400	400	400	1,000	1,000	1,000	800	2,000	800
Manganese, Total	mg/Kg	960	960	1,800	19,000	19,000	250,000	23,000	28,000	23,000
Mercury, Total	mg/Kg	2	2	10	40	40	550	43	60	43
Molybdenum, Total	mg/Kg	390	-----	390	-----	-----	-----	5,100	-----	5,100
Nickel, Total	mg/Kg	135	135	1,500	2,700	2,700	38,000	4,000	4,000	20,000
Selenium, Total	mg/Kg	35	35	390	700	700	9,600	1,000	1,000	5,100
Silver, Total	mg/Kg	35	35	390	700	700	9,600	1,000	1,000	5,100
Uranium, Total	mg/Kg	230	-----	230	-----	-----	-----	3,100	-----	3,100
Vanadium, Total	mg/Kg	390	-----	390	-----	-----	-----	5,200	-----	5,200
Zinc, Total	mg/Kg	2,000	2,000	23,000	40,000	40,000	550,000	60,000	60,000	310,000
Inorganics										
Cyanide, Total	mg/Kg	22	-----	22	-----	-----	-----	140	-----	140
Nitrogen, ammonia	mg/Kg	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Screening Level corresponds to the most restrictive criterion .

Table 3.7: Human-Health and Aquatic Life Screening Criteria for Surface Water
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Human Health			Aquatic Life	
		BLM Camper RMC[1]	WQCC Stream Standard[2]		WQCC Stream Standard[2]	
			Acute	Chronic	Acute	Chronic
Physical						
Field Parameters						
Flow rate	cfs	-----	----	----	----	
Temperature	ºC	-----	----	----	----	
pH	s.u.	-----	----	----	6.5 - 9.0	
Conductivity	(uS/cm)	-----	----	----	----	
Dissolved Oxygen	(mg/L)	-----	----	----	6.0	
Oxidation-Reduction Pot.	(mV)	-----	----	----	----	
			----	----		
Laboratory Parameters						
Acidity as $CaCO_3$	mg/L	-----	----	----	----	
Alkalinity as $CaCO_3$	mg/L	-----	----	----	----	
Total Suspended Solids	mg/L	-----	----	----	----	
Total Dissolved Solids	mg/L	-----	----	----	----	
Hardness as $CaCO_3$	mg/L	-----	----	----	----	
Bicarbonate as CaCO3	mg/L	-----	----	----	----	
Carbonate as CaCO3	mg/L	-----	----	----	----	
Cation-Anion Balance	%	-----	----	----	----	
Hydroxide as CaCO3	mg/L	-----	----	----	----	
Inorganic						
Boron	mg/L	-----	----		0.75 [4]	
Calcium, dissolved	mg/L	-----	----		----	
Chloride	mg/L	-----	250		----	
Cyanide	mg/L	-----	0.2		0.005	
Magnesium, dissolved	mg/L	-----	----		----	
Nitrate as N, dissolved	mg/L	-----	10		----	
Nitrate/Nitrite as N, dissolved	mg/L	-----	----		----	
Nitrite as N, dissolved	mg/L	-----	1		0.05	
Nitrogen, ammonia	mg/L	-----	----		10.66 [5]	3.82 [5]
Potassium	mg/L	-----	----		----	
Sodium	mg/L	-----	----		----	
Sulfate	mg/L	-----	250		----	
Sulfide as S	mg/L	-----	----		----	
Sum of Anions	meq/L	-----	----		----	
Sum of Cations	meq/L	-----	----		----	
Metals						
Antimony, dissolved	µg/L	124	6 [3]		----	----
Arsenic, dissolved	µg/L	93	----	----	340	150
Arsenic, total recoverable	µg/L	-----	0.02		----	----
Cadmium, dissolved	µg/L	155	5 [3]		1.7 [6]	0.42 [6]
Chromium, dissolved	µg/L	-----	50 [3]		----	74 [6]
Copper, dissolved	µg/L	11,490	1000 [3]		13 [6]	9 [6]
Iron, dissolved	µg/L	-----	300		----	----
Iron, total recoverable	µg/L	-----	----	----	----	1000
Lead, dissolved	µg/L	50	50 [3]		65 [6]	2.5 [6]
Manganese, dissolved	µg/L	1,548	50 [3]		2986 [6]	1650 [6]
Mercury, total	µg/L	-----	2 [3]		----	0.01
Nickel, dissolved	µg/L	6,194	100 [3]		468 [6]	52 [6]
Selenium, dissolved	µg/L	1,548	50 [3]		18.4	4.6
Silver, dissolved	µg/L	1,548	100 [3]		2.0 [6]	0.08 [6]
Zinc, dissolved	µg/L	92,909	5000 [3]		143 [6]	124 [6]

[1] From Ford, 2004; applies to incidental ingestion in combination with exposures from other media and pathways.
[2] Numeric standards for Segment 8 of the San Miguel River Basin
[3] The water-supply standard is based on total recoverable analysis.
[4] Agriculture standard
[5] Based on average pH and temperature of Lake Fork (7.64 s.u. and 9.85° C)
[6] Hardness dependent criterion calculated on basis of a conservative hardness value of 100 mg/L; sufficient data are not available to assess hardness value of potential receiving stream during low flow.

Table 3.8: Human-Health Screening Criteria for Mill Waste Within Mill Structure
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	BLM RMC Site Worker	EPA RSL Industrial Worker	Screening Level[1]	MM-01 Processing Spillage	MM-02 Processing Spillage	MM-03 Ore/Concentrate	MM-04 Processing Spillage
Metals								
Antimony, Total	mg/Kg	100	410	100	**682 +**	**256 +**	**4380 ++**	**880 +**
Arsenic, Total	mg/Kg	12	1.6	1.6	**712 +++**	**286 +++**	**1880 +++**	**910 +++**
Cadmium, Total	mg/Kg	100	800	100	35.6	15.4	**175 +**	**109 +**
Chromium, Total	mg/Kg	-----	----	----	n/a	n/a	n/a	n/a
Copper, Total	mg/Kg	7,400	41,000	7,400	2010	2040	**10400 +**	2400
Iron, Total	mg/Kg	-----	720,000	720,000	n/a	n/a	n/a	n/a
Lead, Total	mg/Kg	2,000	800	800	**29400 ++**	**12800 ++**	**111000 +++**	**64400 ++**
Manganese, Total	mg/Kg	28,000	23,000	23,000	3230	542	574	533
Mercury, Total	mg/Kg	60	43	43	1.20	0.63	< 0.05 U	0.91
Molybdenum, Total	mg/Kg	-----	5,100	5,100	n/a	n/a	n/a	n/a
Nickel, Total	mg/Kg	4,000	20,000	4,000	n/a	n/a	n/a	n/a
Selenium, Total	mg/Kg	1,000	5,100	1,000	n/a	n/a	n/a	n/a
Silver, Total	mg/Kg	1,000	5,100	1,000	332	150	890	350
Uranium, Total	mg/Kg	-----	3,100	3,100	n/a	n/a	n/a	n/a
Vanadium, Total	mg/Kg	-----	5,200	5,200	n/a	n/a	n/a	n/a
Zinc, Total	mg/Kg	60,000	310,000	60,000	6780	2870	31600	22800
Inorganics								
Cyanide, Total	mg/Kg	-----	610	610	n/a	n/a	n/a	n/a
Nitrogen, ammonia	mg/Kg	-----	-----	----	n/a	n/a	n/a	n/a

[1] Screening Level corresponds to the most restrictive criterion for site/industrial workers
Qualifiers are defined as follows:
U Analyte was not detected at the Method Detection Limit
Shaded value in bold indicates level exceeds most restrictive screening level
+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
++ Value exceeds criterion by 10 to 100 times; high risk
+++ Value exceeds criterion by more than 100 times; extremely high risk
n/a = not analyzed

Table 3.9: Analytical Results for Tailings, Sediment, and Soil Samples Compared to BLM Adjacent Resident RMC

Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Resident			Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
						Surface Samples[2]			Subsurface Sample[3]	Surface Sample[2]	Subsurface Sample[3]	Surface Sample[2]	Surface Sample[2]
		BLM RMC	EPA RSL	Screening Level[1]	BKG	T-1 Tailings Pond - North	T-2 Tailings Pond - South		Matterhorn Tailings Test Pit Composite	T-3 Settling Pond - Tailings	Matterhorn Settling Test Pit Composite	Berm Berm Composite	Sed - 1 Sediment Composite
					10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals													
Antimony, Total	mg/Kg	3	31	3	0.5 B	**62** ++	**67** ++	**64** ++	**63** ++	**69** ++	**76** ++	**21** +	**10.5** +
Arsenic, Total	mg/Kg	1	0.39	0.39	**9.3** ++	**161** +++	**242** +++	**150** +++	**302** +++	**178** +++	**183** +++	**139** +++	**111** +++
Cadmium, Total	mg/Kg	3	70	3	0.74	**6.38** +	**7.63** +	**6.68** +	2.11	2.3	**13.2** +	**8.72** +	1.94
Chromium, Total	mg/Kg	-----	----	-----	15	5 B	3 B	3 B	5	4 B	4 B	16	19 B
Copper, Total	mg/Kg	250	3,100	250	17	105	94	90	228	96	**262** +	**377** +	**298** +
Iron, Total	mg/Kg	-----	55,000	55,000	19400	26800	18700	20300	**56100** +	28400	36200	**60400** +	**252000** +
Lead, Total	mg/Kg	400	400	400	37	**4300** ++	**3720** +	**3760** +	**5490** ++	**2780** +	**2530** +	**1680** +	240
Manganese, Total	mg/Kg	960	1,800	960	583	51.1	30.4	27.4	84.3	71.7	**4060** +	**4980** +	147
Mercury, Total	mg/Kg	2	10	2	0.05 B	0.83	0.56	0.54	0.48	0.33	1.37	0.13 B	0.2 B
Molybdenum, Total	mg/Kg	-----	390	390	2 B	7	7	8	16	6	8	10	7 B
Nickel, Total	mg/Kg	135	1,500	135	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	16	< 6 U
Selenium, Total	mg/Kg	35	390	35	0.45	4.22	4.28	4.24	5.39	2.71	3.39	3.42	1.97
Silver, Total	mg/Kg	35	390	35	< 1 U	41	**38** +	**41** +	**72** +	32	**36** +	16	16
Uranium, Total	mg/Kg	-----	230	230	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	4.03
Vanadium, Total	mg/Kg	-----	390	390	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	2,000	23,000	2,000	108	434	1390	1370	543	552	**2040** +	1020	385
Inorganics													
Cyanide, Total	mg/Kg	-----	22	22	< 0.3 U	< 0.4 U	< 0.3 U	< 0.3 U	< 0.3 UH	< 0.4 U	< 0.2 UH	0.7 B	< 0.8 U
Nitrogen, ammonia	mg/Kg	-----	-----	-----	22	25	20	21	34	24	12 B	22	26

[1] Screening Level corresponds to the most restrictive criterion .

[2] Surface samples collected from 0 to 6 inches below ground surface

[3] Subsurface samples collected as composite of material excavated from test pits

Qualifiers are defined as follows:

B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit

U Analyte was not detected at the Method Detection Limit

H Holding time was exceeded

Shaded value in bold indicates level exceeds Screening Level

\+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10

++ Value exceeds criterion by 10 to 100 times; high risk

+++ Value exceeds criterion by more than 100 times; extremely high risk

Table 3.10: Analytical Results for Tailings, Sediment, and Soil Samples Compared to BLM Site Visitor RMC

Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	BLM Site Visitor RMC			Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
						Surface Samples[2]			Subsurface Sample[3]	Surface Sample[2]	Subsurface Sample[3]	Surface Sample[2]	Surface Sample[2]
					BKG	T-1	T-2		Matterhorn Tailings	T-3	Matterhorn Settling	Berm	Sed - 1
		Screening Level[1]	Camper	ATV Driver		Tailings Pond - North	Tailings Pond - South		Test Pit Composite	Settling Pond - Tailings	Test Pit Composite	Berm Composite	Sediment Composite
					10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals													
Antimony, Total	mg/Kg	50	50	750	0.5 B	**62 +**	**67 +**	**64 +**	**63 +**	**69 +**	**76 +**	21	10.5
Arsenic, Total	mg/Kg	20	20	300	9.3	**161 +**	**242 ++**	**150 +**	**302 ++**	**178 +**	**183 +**	**139 +**	**111 +**
Cadmium, Total	mg/Kg	70	70	950	0.74	6.38	7.63	6.68	2.11	2.3	13.2	8.72	1.94
Chromium, Total	mg/Kg	-----	-----	-----	15	5 B	3 B	3 B	5	4 B	4 B	16	19 B
Copper, Total	mg/Kg	5,000	5,000	70,000	17	105	94	90	228	96	262	377	298
Iron, Total	mg/Kg	-----	-----	-----	19400	26800	18700	20300	56100	28400	36200	60400	252000
Lead, Total	mg/Kg	1,000	1,000	1,000	37	**4300 +**	**3720 +**	**3760 +**	**5490 +**	**2780 +**	**2530 +**	**1680 +**	240
Manganese, Total	mg/Kg	19,000	19,000	250,000	583	51.1	30.4	27.4	84.3	71.7	4060	4980	147
Mercury, Total	mg/Kg	40	40	550	0.05 B	0.83	0.56	0.54	0.48	0.33	1.37	0.13 B	0.2 B
Molybdenum, Total	mg/Kg	-----	-----	-----	2 B	7	7	8	16	6	8	10	7 B
Nickel, Total	mg/Kg	2,700	2,700	38,000	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	16	< 6 U
Selenium, Total	mg/Kg	700	700	9,600	0.45	4.22	4.28	4.24	5.39	2.71	3.39	3.42	1.97
Silver, Total	mg/Kg	700	700	9,600	< 1 U	41	38	41	72	32	36	16	16
Uranium, Total	mg/Kg	-----	-----	-----	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	4.03
Vanadium, Total	mg/Kg	-----	-----	-----	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	40,000	40,000	550,000	108	434	1390	1370	543	552	2040	1020	385
Inorganics													
Cyanide, Total	mg/Kg	-----	-----	-----	< 0.3 U	< 0.4 U	< 0.3 U	< 0.3 U	< 0.3 UH	< 0.4 U	< 0.2 UH	0.7 B	< 0.8 U
Nitrogen, ammonia	mg/Kg	-----	-----	-----	22	25	20	21	34	24	12 B	22	26

[1] Screening Level corresponds to the most restrictive criterion

[2] Surface samples collected from 0 to 6 inches below ground surface

[3] Subsurface samples collected as composite of material excavated from test pits

Qualifiers are defined as follows:

B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit

U Analyte was not detected at the Method Detection Limit

H Holding time was exceeded

Shaded value in bold indicates level exceeds screening level

+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10

++ Value exceeds criterion by 10 to 100 times; high risk

+++ Value exceeds criterion by more than 100 times; extremely high risk

Table 3.11: Analytical Results for Tailings, Sediment, and Soil Samples Compared to EPA Industrial Worker Criteria
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Site/Industrial Worker			Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
					BKG	Surface Samples[2]			Subsurface Sample[3]	Surface Sample[2]	Subsurface Sample[3]	Surface Sample[2]	Surface Sample[2]
						T-1	T-2		Matterhorn Tailings	T-3	Matterhorn Settling	Berm	Sed - 1
		Screening Level[1]	EPA RSL	BLM RMC		Tailings Pond - North	Tailings Pond - South		Test Pit Composite	Settling Pond - Tailings	Test Pit Composite	Berm Composite	Sediment Composite
					10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals													
Antimony, Total	mg/Kg	100	410	100	0.5 B	62	67	64	63	69	76	21	10.5
Arsenic, Total	mg/Kg	1.6	1.6	12	**9.3 +**	**161 +++**	**242 +++**	**150 ++**	**302 +++**	**178 +++**	**183 +++**	**139 ++**	**111 ++**
Cadmium, Total	mg/Kg	100	800	100	0.74	6.38	7.63	6.68	2.11	2.3	13.2	8.72	1.94
Chromium, Total	mg/Kg	-----	----	-----	15	5 B	3 B	3 B	5	4 B	4 B	16	19 B
Copper, Total	mg/Kg	7,400	41,000	7,400	17	105	94	90	228	96	262	377	298
Iron, Total	mg/Kg	720,000	720,000	-----	19400	26800	18700	20300	56100	28400	36200	60400	252000
Lead, Total	mg/Kg	800	800	2,000	37	**4300 +**	**3720 +**	**3760 +**	**5490 +**	**2780 +**	**2530 +**	**1680 +**	240
Manganese, Total	mg/Kg	23,000	23,000	28,000	583	51.1	30.4	27.4	84.3	71.7	4060	4980	147
Mercury, Total	mg/Kg	43	43	60	0.05 B	0.83	0.56	0.54	0.48	0.33	1.37	0.13 B	0.2 B
Molybdenum, Total	mg/Kg	5,100	5,100	-----	2 B	7	7	8	16	6	8	10	7 B
Nickel, Total	mg/Kg	4,000	20,000	4,000	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	16	< 6 U
Selenium, Total	mg/Kg	1,000	5,100	1,000	0.45	4.22	4.28	4.24	5.39	2.71	3.39	3.42	1.97
Silver, Total	mg/Kg	1,000	5,100	1,000	< 1 U	41	38	41	72	32	36	16	16
Uranium, Total	mg/Kg	3,100	3,100	-----	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	4.03
Vanadium, Total	mg/Kg	5,200	5,200	-----	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	60,000	310,000	60,000	108	434	1390	1370	543	552	2040	1020	385
Inorganics													
Cyanide, Total	mg/Kg	140	610	-----	< 0.3 U	< 0.4 U	< 0.3 U	< 0.3 U	< 0.3 UH	< 0.4 U	< 0.2 UH	0.7 B	< 0.8 U
Nitrogen, ammonia	mg/Kg	-----	-----	-----	22	25	20	21	34	24	12 B	22	26

[1] Screening Level corresponds to the most restrictive criterion
[2] Surface samples collected from 0 to 6 inches below ground surface
[3] Subsurface samples collected as composite of material excavated from test pits
Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit
H Holding time not met
Shaded value in bold indicates level exceeds screening level
+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
++ Value exceeds criterion by 10 to 100 times; high risk
+++ Value exceeds criterion by more than 100 times; very high risk

Table 3.12: Analytical Results for Tailings, Sediment, and Soil Samples Compared to EPA SSLs
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	EPA Risk-Based SSLs [1]	Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
				Surface Samples[3]			Subsurface Sample[4]	Surface Sample[3]	Subsurface Sample[4]	Surface Sample[3]	Surface Sample[3]
			BKG	T-1 Tailings Pond - North	T-2 Tailings Pond - South		Matterhorn Tailings Test Pit Composite	T-3 Settling Pond - Tailings	Matterhorn Settling Test Pit Composite	Berm Berm Composite	Sed - 1 Sediment Composite
			10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals											
Antimony, Total	mg/Kg	5.4	0.5 B	**62** ++	**67** ++	**64** ++	**63** ++	**69** ++	**76** ++	**21** +	**10.5** +
Arsenic, Total	mg/Kg	0.026	**9.3** +++	**161** +++	**242** +++	**150** +++	**302** +++	**178** +++	**183** +++	**139** +++	**111** +++
Cadmium, Total	mg/Kg	----	0.74	6.38	7.63	6.68	2.11	2.3	13.2	8.72	1.94
Chromium, Total	mg/Kg	3600000 [2]	15	5 B	3 B	3 B	5	4 B	4 B	16	19 B
Copper, Total	mg/Kg	440	17	105	94	90	228	96	262	377	298
Iron, Total	mg/Kg	5,400	**19400** +	**26800** +	**18700** +	**20300** +	**56100** ++	**28400** +	**36200** +	**60400** ++	**252000** ++
Lead, Total	mg/Kg	280 [2]	37	4300	3720	3760	5490	2780	2530	1680	240
Manganese, Total	mg/Kg	420	**583** +	51.1	30.4	27.4	84.3	71.7	**4060** +	**4980** ++	147
Mercury, Total	mg/Kg	0.66	0.05 B	**0.83** +	0.56	0.54	0.48	0.33	**1.37** +	0.13 B	0.2 B
Molybdenum, Total	mg/Kg	32	2 B	7	7	8	16	6	8	10	7 B
Nickel, Total	mg/Kg	400	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	16	< 6 U
Selenium, Total	mg/Kg	8	0.45	4.22	4.28	4.24	5.39	2.71	3.39	3.42	1.97
Silver, Total	mg/Kg	12	< 1 U	**41** +	**38** +	**41** +	**72** +	**32** +	**36** +	**16** +	**16** +
Uranium, Total	mg/Kg	420	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	4.03
Vanadium, Total	mg/Kg	1,560	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	5,800	108	434	1390	1370	543	552	2040	1020	385
Inorganics											
Cyanide, Total	mg/Kg	1.88	< 0.3 U	< 0.4 U	< 0.3 U	< 0.3 U	< 0.3 UH	< 0.4 U	< 0.2 UH	0.7 B	< 0.8 U
Nitrogen, ammonia	mg/Kg	----	22	25	20	21	34	24	12 B	22	26
Solids, percent	%	-----	74.1	75.4	85.4	85.3	72.6	73.3	86	74.1	29.1

[1] EPA Risk-Based Soil Screening Level with a dilution attenuation factor of 20 (table values multiplied by 20).
[2] EPA MCL based soil screening levels with a DAF of 20 used because no risk based SSL was reported for parameter.
[3] Surface samples collected from 0 to 6 inches below ground surface
[4] Subsurface samples collected as composite of material excavated from test pits

Qualifiers are defined as follows:
- B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
- U Analyte was not detected at the Method Detection Limit
- H Holding time not met

Shaded value exceeds most restrictive human-health criterion
- \+ Value exceeds most restrictive criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
- ++ Value exceeds most restrictive criterion by 10 to 100 times; high risk
- +++ Value exceeds most restrictive criterion by more than 100 times; extremely high risk

Table 3.13: Analytical Parameters Reported at Levels Greater Than Background as Defined by Lake Fork Upstream of Mill

Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	SW-1 Lake Fork - Up	SW-3 Small Pond	SW-3 Duplicate	SW-4 Settling Pond	SW-5 Spring	SW-2 Lake Fork - Down
Physical							
Laboratory Parameters							
Acidity as $CaCO_3$	mg/L	< 2 U	**114 ++**	**106 ++**	**413 +++**	**90 ++**	< 2 U
Total Suspended Solids	mg/L	< 5 U	< 5 U	< 5 U	**28 B+**	< 5 U	< 5 U
Total Dissolved Solids	mg/L	150	**510 +**	**510 +**	**440 +**	**650 +**	**170 +**
Inorganic							
Boron	mg/L	0.01 B	< 0.01 U	< 0.01 U	**0.03 B+**	0.01 B	**0.03 B+**
Calcium, dissolved	mg/L	37.4	**78.1 +**	**81.5 +**	28.3	**121 +**	**42.9 +**
Chloride	mg/L	2 B	**24 ++**	**24 ++**	2 B	**12 +**	2 B
Magnesium, dissolved	mg/L	3	**10.8 +**	**11.3 +**	**3.3 +**	**14 +**	**3.6 +**
Nitrate as N, dissolved	mg/L	0.06 B	**0.11 +**	**0.11 +**	0.05 B	**0.34 +**	0.06 B
Nitrate/Nitrite as N, dissolved	mg/L	0.06 B	**0.11 H+**	**0.11 +**	0.05 BH	**0.34 H+**	0.06 B
Nitrogen, ammonia	mg/L	< 0.05 U	**0.25 B+**	**0.18 B+**	**0.13 B+**	**0.05 B+**	< 0.05 U
Potassium	mg/L	0.3 B	**1.4 +**	**1.5 +**	**1.9 +**	**1.4 +**	< 0.3 U
Sodium, dissolved	mg/L	3.5	**6.2 +**	**6.5 +**	**6.5 +**	**9.8 +**	**4.2 +**
Sulfate	mg/L	50 H	**220 H+**	**250 H+**	**290 +**	**360 +**	**60 H+**
Metals							
Antimony, dissolved	µg/L	< 0.4 U	**1.2 B+**	**1.1 B+**	**1.1 B+**	< 0.4 U	< 0.4 U
Arsenic, dissolved	µg/L	< 0.5 U	< 0.5 U	< 0.5 U	**10.6 +**	< 0.5 U	< 0.5 U
Arsenic, total recoverable	µg/L	< 0.5 U	**0.8 B**	**0.6 B**	**20.6**	< 0.5 U	< 0.5 U
Cadmium, dissolved	µg/L	< 0.1 U	**18.9 +++**	**19 +++**	**39.2 +++**	**13.1 +++**	< 0.1 U
Chromium, total recoverable	µg/L	< 10 U	< 10 U	< 10 U	**30 B+**	**20 B+**	< 10 U
Copper, dissolved	µg/L	< 10 U	**200 ++**	**220 ++**	**1000 ++**	**60 +**	< 10 U
Iron, dissolved	µg/L	< 20 U	**4180 +++**	**4760 +++**	**39600 +++**	**50 B+**	< 20 U
Iron, total recoverable	µg/L	< 20 U	**3050 +++**	**3060 +++**	**42600 +++**	**30 B+**	< 20 U
Lead, dissolved	µg/L	< 0.1 U	**102 +++**	**103 +++**	**35.7 ++**	**1 +**	< 0.1 U
Manganese, dissolved	µg/L	< 5 U	**8810 +++**	**9830 +++**	**5040 +++**	**5830 +++**	**25 B+**
Nickel, dissolved	µg/L	< 10 U	**30 B+**	**30 B+**	**20 B+**	**30 B+**	< 10 U
Selenium, dissolved	µg/L	0.5 B	< 0.1 U	< 0.1 U	**1.2 B+**	0.1 B	0.4 B
Silver, dissolved	µg/L	< 0.05 U	< 0.05 U	< 0.05 U	**0.21 B+**	**0.08 B+**	< 0.05 U
Zinc, dissolved	µg/L	< 10 U	**5450 +++**	**5790 +++**	**8280 +++**	**3000 +++**	**30 B+**

Qualifiers are defined as follows:

B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit

U Analyte was not detected at the Method Detection Limit

H Holding time was exceeded

Value in bold indicates level exceeds background level

\+ Value exceeds background level by 1 to 10 times

++ Value exceeds background level by 10 to 100 times

+++ Value exceeds background level by more than 100 times

Table 3.14: Analytical Results for Surface-Water Samples Compared to Human-Health Screening Criteria
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	BLM Camper RMC[1]	WQCC Stream Standard[2] Acute	WQCC Stream Standard[2] Chronic	SW-1 Lake Fork - Up	SW-3 Small Pond	SW-3 Duplicate	SW-4 Settling Pond	SW-5 Spring	SW-2 Lake Fork - Down
Physical										
Field Parameters										
Flow rate	cfs	-----	----	----	~ 100.0	----	----	----	~ 1.0 gpm	----
Temperature	ºC	-----	----	----	10.1	8.9	----	6.9	5.9	9.6
pH	s.u.	-----	5.0 - 9.0		7.78	**3.7**	----	**2.92**	**4.04**	7.5
Conductivity	(uS/cm)	-----	----	----	241	980	----	986	820	273
Dissolved Oxygen	(mg/L)	-----	----	----	8.48	0.44	----	5.68	7.91	8.45
Oxidation-Reduction Pot.	(mV)	-----	----	----	126.4	486	----	-116	313	119.3
			----	----						
Laboratory Parameters										
Acidity as $CaCO_3$	mg/L	-----	----	----	< 2 U	114	106	413	90	< 2 U
Total Alkalinity	mg/L	-----	----	----	63	< 2 U	< 2 U	< 2 U	< 2 U	64
Total Suspended Solids	mg/L	-----	----	----	< 5 U	< 5 U	< 5 U	28 B	< 5 U	< 5 U
Total Dissolved Solids	mg/L	-----	----	----	150	510	510	440	650	170
Hardness as $CaCO_3$	mg/L	-----	----	----	106	240	250	84	360	122
Bicarbonate as CaCO3	mg/L	-----	----	----	63	< 2 U	< 2 U	< 2 U	< 2 U	64
Carbonate as CaCO3	mg/L	-----	----	----	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Cation-Anion Balance	%	-----	----	----	-2.2	7	4.8	-13	1.3	0
Hydroxide as CaCO3	mg/L	-----	----	----	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Inorganic										
Boron	mg/L	-----	----		0.01 B	< 0.01 U	< 0.01 U	0.03 B	0.01 B	0.03 B
Calcium, dissolved	mg/L	-----	----		37.4	78.1	81.5	28.3	121	42.9
Chloride	mg/L	-----	250		2 B	24	24	2 B	12	2 B
Cyanide, total	mg/L	-----	0.2		< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U
Magnesium, dissolved	mg/L	-----	----		3	10.8	11.3	3.3	14	3.6
Nitrate as N, dissolved	mg/L	-----	10		0.06 B	0.11	0.11	0.05 B	0.34	0.06 B
Nitrate/Nitrite as N, dissolved	mg/L	-----	----		0.06 B	0.11 H	0.11	0.05 BH	0.34 H	0.06 B
Nitrite as N, dissolved	mg/L	-----	1		< 0.01 U	< 0.01 U	< 0.01 U	0 UH	0 UH	< 0.01 U
Nitrogen, ammonia	mg/L	-----	----		< 0.05 U	0.25 B	0.18 B	0.13 B	0.05 B	< 0.05 U
Potassium	mg/L	-----	----		0.3 B	1.4	1.5	1.9	1.4	< 0.3 U
Sodium, dissolved	mg/L	-----	----		3.5	6.2	6.5	6.5	9.8	4.2
Sulfate	mg/L	-----	250		50 H	220 H	250 H	**290 +**	**360 +**	60 H
Sulfide as S	mg/L	-----	----		0.04 B	220 H	0.03 B	< 0.02 U	< 0.02 U	< 0.02 U
Sum of Anions	meq/L	-----	----		2.3	5.3	5.9	6.1	7.9	2.6
Sum of Cations	meq/L	-----	----		2.2	6.1	6.5	4.7	8.1	2.6
Metals										
Antimony, dissolved	µg/L	124	6[3]		< 0.4 U	1.2 B	1.1 B	1.1 B	< 0.4 U	< 0.4 U
Arsenic, dissolved	µg/L	93	----	----	< 0.5 U	< 0.5 U	< 0.5 U	10.6	< 0.5 U	< 0.5 U
Arsenic, total recoverable	µg/L	-----	0.02 - 10		< 0.5 U	**0.8 B++**	**0.6 B++**	**20.6 +++**	< 0.5 U	< 0.5 U
Cadmium, dissolved	µg/L	155	5[3]		< 0.1 U	**18.9 +**	**19 +**	**39.2 +**	**13.1 +**	< 0.1 U
Chromium, total recoverable	µg/L	-----	50[3]		< 10 U	< 10 U	< 10 U	30 B	20 B	< 10 U
Copper, dissolved	µg/L	11,490	1000[3]		< 10 U	200	220	1000	60	< 10 U
Iron, dissolved	µg/L	-----	300		< 20 U	**4180 ++**	**4760 ++**	**39600 +++**	50 B	< 20 U
Iron, total recoverable	µg/L	-----	----	----	< 20 U	3050	3060	42600 +	30 B	< 20 U
Lead, dissolved	µg/L	50	50[3]		< 0.1 U	**102 +**	**103 +**	35.7	1	< 0.1 U
Manganese, dissolved	µg/L	1,548	50[3]		< 5 U	**8810 +++**	**9830 +++**	**5040 +++**	**5830 +++**	25 B
Mercury, total	µg/L	-----	2[3]		< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U
Nickel, dissolved	µg/L	6,194	100[3]		< 10 U	30 B	30 B	20 B	30 B	< 10 U
Selenium, dissolved	µg/L	1,548	50[3]		0.5 B	< 0.1 U	< 0.1 U	1.2 B	0.1 B	0.4 B
Silver, dissolved	µg/L	1,548	100[3]		< 0.05 U	< 0.05 U	< 0.05 U	0.21 B	0.08 B	< 0.05 U
Zinc, dissolved	µg/L	92,909	5000[3]		< 10 U	**5450 +**	**5790 +**	**8280 +**	3000	30 B

[1] From Ford, 2004; applies to incidental ingestion in combination with exposures from other media and pathways.
[2] Numeric standards for Segment 8 of the San Miguel River Basin
[3] The water-supply standard is based on total recoverable analysis.

Qualifiers are defined as follows:
- B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
- U Analyte was not detected at the Method Detection Limit
- H Holding time was exceeded

Shaded value in bold indicates level exceeds one or more of the criteria
- \+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
- ++ Value exceeds criterion by 10 to 100 times; high risk
- +++ Value exceeds criterion by more than 100 times; extremely high risk

Table 3.15: Comparison of Analytical Results for Surface-Water Samples to Aquatic-Life Stream Standards
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Aquatic Life Stream Standard[1]		SW-1	SW-2	SW-3		SW-4	SW-5
		Acute	Chronic	Lake Fork - Up	Lake Fork - Down	Small Pond	Duplicate	Settling Pond	Spring
Physical									
Field Parameters									
Flow rate	cfs	----		~ 100.0	----	----	----	----	~ 1.0 gpm
Temperature	ºC	----		10.1	9.6	8.9	----	6.9	5.9
pH	s.u.	6.5 - 9.0		7.78	7.5	**3.7**	----	**2.92**	**4.04**
Conductivity	(uS/cm)	----		241	273	980	----	986	820
Dissolved Oxygen	(mg/L)	6.0		8.48	8.45	0.44	----	5.68	7.91
Oxidation-Reduction Pot.	(mV)	----		126.4	119.3	486	----	-116	313
Laboratory Parameters									
Acidity as $CaCO_3$	mg/L	----		< 2 U	< 2 U	114	106	413	90
Alkalinity as $CaCO_3$	mg/L	----		63	64	< 2 U	< 2 U	< 2 U	< 2 U
Total Suspended Solids	mg/L	----		< 5 U	< 5 U	< 5 U	< 5 U	28 B	< 5 U
Total Dissolved Solids	mg/L	----		150	170	510	510	440	650
Hardness as $CaCO_3$	mg/L	----		106	122	240	250	84	360
Bicarbonate as CaCO3	mg/L	----		63	64	< 2 U	< 2 U	< 2 U	< 2 U
Carbonate as CaCO3	mg/L	----		< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Cation-Anion Balance	%	----		-2.2	0	7	4.8	-13	1.3
Hydroxide as CaCO3	mg/L	----		< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Inorganic									
Boron	mg/L	0.75 [2]		0.01 B	0.03 B	< 0.01 U	< 0.01 U	0.03 B	0.01 B
Calcium, dissolved	mg/L	----		37.4	42.9	78.1	81.5	28.3	121
Chloride	mg/L	----		2 B	2 B	24	24	2 B	12
Cyanide, total	mg/L	0.005		< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U	< 0.005 U
Magnesium, dissolved	mg/L	----		3	3.6	10.8	11.3	3.3	14
Nitrate as N, dissolved	mg/L	----		0.06 B	0.06 B	0.11	0.11	0.05 B	0.34
Nitrate/Nitrite as N, dissolved	mg/L	----		0.06 B	0.06 B	0.11 H	0.11	0.05 BH	0.34 H
Nitrite as N, dissolved	mg/L	0.05		< 0.01 U	< 0.01 U	< 0.01 U	< 0.01 U	0 UH	0 UH
Nitrogen, ammonia	mg/L	10.66 [3]	3.82 [3]	< 0.05 U	< 0.05 U	0.25 B	0.18 B	0.13 B	0.05 B
Potassium	mg/L	----		0.3 B	< 0.3 U	1.4	1.5	1.9	1.4
Sodium	mg/L	----		3.5	4.2	6.2	6.5	6.5	9.8
Sulfate	mg/L	----		50 H	60 H	220 H	250 H	290	360
Sulfide as S	mg/L	----		0.04 B	< 0.02 U	0.03 B	0.03 B	< 0.02 U	< 0.02 U
Sum of Anions	meq/L	----		2.3	2.6	5.3	5.9	6.1	7.9
Sum of Cations	meq/L	----		2.2	2.6	6.1	6.5	4.7	8.1
Metals									
Antimony, dissolved	µg/L	----	----	< 0.4 U	< 0.4 U	1.2 B	1.1 B	1.1 B	< 0.4 U
Arsenic, dissolved	µg/L	340	150	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	10.6	< 0.5 U
Arsenic, total recoverable	µg/L	----	----	< 0.5 U	< 0.5 U	0.8 B	0.6 B	20.6	< 0.5 U
Cadmium, dissolved	µg/L	1.7 [4]	0.42 [4]	< 0.1 U	< 0.1 U	**18.9 ++**	**19 ++**	**39.2 ++**	**13.1 ++**
Chromium, dissolved	µg/L	----	74 [4]	< 10 U	< 10 U	< 10 U	< 10 U	30 B	20 B
Copper, dissolved	µg/L	13 [4]	9 [4]	< 10 U	< 10 U	**200 ++**	**220 ++**	**1000 +++**	**60 +**
Iron, dissolved	µg/L	----	----	< 20 U	< 20 U	4180	4760	39600	50 B
Iron, total recoverable	µg/L	----	1000	< 20 U	< 20 U	**3050 +**	**3060 +**	**42600 ++**	30 B
Lead, dissolved	µg/L	65 [4]	2.5 [4]	< 0.1 U	< 0.1 U	**102 ++**	**103 ++**	**35.7 ++**	1
Manganese, dissolved	µg/L	2986 [4]	1650 [4]	< 5 U	25 B	**8810 +**	**9830 +**	**5040 +**	**5830 +**
Mercury, total	µg/L	----	0.01	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U
Nickel, dissolved	µg/L	468 [4]	52 [4]	< 10 U	< 10 U	30 B	30 B	20 B	30 B
Selenium, dissolved	µg/L	18.4	4.6	0.5 B	0.4 B	< 0.1 U	< 0.1 U	1.2 B	0.1 B
Silver, dissolved	µg/L	2.0 [4]	0.08 [4]	< 0.05 U	< 0.05 U	< 0.05 U	< 0.05 U	**0.21 B+**	0.08 B
Zinc, dissolved	µg/L	143 [4]	124 [4]	< 10 U	30 B	**5450 ++**	**5790 ++**	**8280 ++**	**3000 ++**

[1] Aquatic-life stream standards established by the Colorado Water Quality Control Commission for Segment 8 of the San Miguel River Basin
[2] Agriculture standard
[3] Based on average pH and temperature of Lake Fork (7.64 s.u. and 9.85° C)
[4] Hardness dependent criterion calculated on basis of a conservative hardness value of 100 mg/L; sufficient data are not available to assess hardness value of potential receiving stream during low flow.

Shaded value in bold indicates level exceeds standard
- \+ Value exceeds standard by 1 to 10 times; low risk 1-2 and moderate risk 2-10
- ++ Value exceeds standard by 10 to 100 times
- +++ Value exceeds standard by more than 100 times

Qualifiers are defined as follows:
- B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
- U Analyte was not detected at the Method Detection Limit
- H Holding time was exceeded

Table 3.16: Livestock and Wildlife Risk Management Criteria for Metals in Soils
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	Screening Level Median	BLM Risk Management Criteria[1]										
			Deer Mouse	Cottontail	Bighorn Sheep	White-Tailed Deer	Mule Deer	Elk	Cattle	Sheep	Mallard	Canada Goose	Robin
Metals													
Antimony	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Arsenic	mg/Kg	319	230	438	387	319	200	328	419	352	116	61	4
Cadmium	mg/Kg	3	7	6	9	3	3	3	15	12	1	2	0.3
Chromium	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Copper	mg/Kg	131	640	358	64	128	102	131	413	86	141	161	7
Iron	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Lead	mg/Kg	127	142	172	152	124	106	127	244	203	59	34	6
Manganese	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Mercury	mg/Kg	9	2	15	6	11	9	11	45	38	4	6	1
Molybdenum	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Nickel	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Selenium	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Silver	mg/Kg	----	----	----	----	----	----	----	----	----	----	----	----
Uranium [2]	mg/Kg	2770	156	1238	1211	3229	2770	3323	9855	8282	3285	1596	366
Vanadium	mg/Kg	280 [3]	----	----	----	----	----	----	----	----	----	----	----
Zinc	mg/Kg	275	419	373	369	267	222	275	1082	545	196	271	43

[1] From *Risk Management Criteria for Metals at BLM Mine Sites* (Ford, 2004)

[2] Value derived by the BLM in 2005 based on ORNL (1996) chemical toxicity values and uptake to plants.

[3] Value specific for mammalian receptors; from *Ecological Soil Screening Levels for Vanadium* (EPA, 2005)

Table 3.17: Analytical Results for Tailings, Sediment, and Soil Compared to Livestock and Wildlife Screening Criteria
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Units	RMC Median Screening Level	Background Soil	Tailings Pond - Tailings				Settling Pond - Tailings		Settling Pond - Soil	Small Pond - Sediment
				Surface Samples[1]			Subsurface Sample[2]	Surface Sample[1]	Subsurface Sample[2]	Surface Sample[1]	Surface Sample[1]
			BKG	T-1	T-2		Matterhorn Tailings	T-3	Matterhorn Settling	Berm	Sed - 1
				Tailings Pond - North	Tailings Pond - South		Test Pit Composite	Settling Pond - Tailings	Test Pit Composite	Berm Composite	Sediment Composite
			10/5/2006	10/4/2006	10/4/2006	Duplicate	10/16/2008	10/5/2006	10/16/2008	10/5/2006	10/14/2006
Metals											
Antimony, Total	mg/Kg	----	0.5 B	62	67	64	63	69	76	21	10.5
Arsenic, Total	mg/Kg	319	9.3	161	242	150	302	178	183	139	111
Cadmium, Total	mg/Kg	3	0.74	**6.38 +**	**7.63 +**	**6.68 +**	2.11	2.3	**13.2 +**	**8.72 +**	1.94
Chromium, Total	mg/Kg	----	15	5 B	3 B	3 B	5	4 B	4 B	16	19 B
Copper, Total	mg/Kg	131	17	105	94	90	**228 +**	96	**262 +**	**377 +**	**298 +**
Iron, Total	mg/Kg	----	19400	26800	18700	20300	56100	28400	36200	60400	252000
Lead, Total	mg/Kg	127	37	**4300 ++**	**3720 ++**	**3760 ++**	**5490 ++**	**2780 ++**	**2530 ++**	**1680 ++**	**240 +**
Manganese, Total	mg/Kg	----	583	51.1	30.4	27.4	84.3	71.7	4060	4980	147
Mercury, Total	mg/Kg	9	0.05 B	0.83	0.56	0.54	0.48	0.33	1.37	0.13 B	0.2 B
Molybdenum, Total	mg/Kg	----	2 B	7	7	8	16	6	8	10	7 B
Nickel, Total	mg/Kg	----	10	< 1 U	< 1 U	< 1 U	< 0 U	< 1 U	5	16	< 6 U
Selenium, Total	mg/Kg	----	0.45	4.22	4.28	4.24	5.39	2.71	3.39	3.42	1.97
Silver, Total	mg/Kg	----	< 1 U	41	38	41	72	32	36	16	16
Uranium, Total	mg/Kg	2770	2.01	< 1 U	< 1 U	< 1 U	0.44	< 1 U	0.42	2 B	4.03
Vanadium, Total	mg/Kg	280	37.2	8.2	5	5.4	10.6	6.1	6.1	30.9	19
Zinc, Total	mg/Kg	275	108	**434 +**	**1390 +**	**1370 +**	**543 +**	**552 +**	**2040 +**	**1020 +**	**385 +**

Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit
Shaded value in bold indicates level exceeds screening level
\+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
++ Value exceeds criterion by 10 to 100 times; high risk
+++ Value exceeds criterion by more than 100 times; extremely high risk

Table 3.18: Maximum Tolerable Levels of Dietary Minerals in Vegetation for Domestic Animals
Matterhorn Mill Site (San Miguel County, Colorado

Parameter	Unit	Screening Level [2]	Maximum Tolerable Level [1]					
			Cattle	Sheep	Swine	Poultry	Horse	Rabbit
Metals								
Antimony	mg/Kg	70	----	----	----	----	----	70-150
Arsenic	mg/Kg	50	50	50	50	50	50	50
Cadmium	mg/Kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium	mg/Kg	1000	1000	1000	1000	1000	1000	1000
Copper	mg/Kg	225	100	25	250	300	800	200
Iron	mg/Kg	750	1000	500	3000	1000	500	500
Lead	mg/Kg	30	30	30	30	30	30	30
Manganese	mg/Kg	700	1000	1000	400	2000	400	400
Mercury	mg/Kg	2	2	2	2	2	2	2
Molybdenum	mg/Kg	15	10	10	20	100	5	500
Nickel	mg/Kg	50	50	50	100	300	50	50
Selenium	mg/Kg	2	2	2	2	2	2	2
Silver	mg/Kg	100	----	----	100	100	----	----
Uranium	mg/Kg	----	----	----	----	----	----	----
Vanadium	mg/Kg	10	50	50	10	10	10	10
Zinc	mg/Kg	500	500	300	1000	1000	500	500

[1] From *Mineral Tolerance of Domestic Animals* (National Research Council, 1980).

[2] Screening Level corresponds with the median value for cattle, sheep, swine, poultry, horse, and rabbit.

Table 3.19: Analytical Results for Tailings and Background Vegetation Samples Compared to Maximum Tolerable Levels
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Units	Maximum Tolerable Level [1]	BKG VEG	VEG-T	VEG-POND	
			Background	Tailings Pile	Settling Pond	DUPLICATE
Metals						
Antimony	mg/Kg	70	0.6 B	10.1	9.8	8.5
Arsenic	mg/Kg	50	1	16.5	19	15.1
Cadmium	mg/Kg	0.5	0.24 B	**0.74 +**	**0.62 +**	0.47
Chromium	mg/Kg	1000	1 B	2 B	2 B	2 B
Copper	mg/Kg	225	4 B	31	20	19
Iron	mg/Kg	750	276	**1930 +**	**3880 +**	**3360 +**
Lead	mg/Kg	30	8 B	**207 +**	**228 +**	**194 +**
Manganese	mg/Kg	700	91.8	275	**1130 +**	**1100 +**
Mercury	mg/Kg	2	< 0.4 U	< 0.3 U	< 0.3 U	< 0.4 U
Molybdenum	mg/Kg	15	3 B	< 1 U	< 1 U	< 1 U
Nickel	mg/Kg	50	1 B	2 B	2 B	2 B
Selenium	mg/Kg	2	0.19 B	0.4	0.45	0.33
Silver	mg/Kg	100	< 1 U	3	4	3
Uranium	mg/Kg	----	< 0.05 U	< 0.05 U	0.05 B	< 0.05 U
Vanadium	mg/Kg	10	0.5 B	0.8 B	0.8 B	0.8 B
Zinc	mg/Kg	500	66	234	173	151

[1] Median value reported for cattle, sheep, swine, poultry, horse, and rabbit in *Mineral Tolerance of Domestic Animals* (National Research Council, 1980).

Qualifiers are defined as follows:

B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit

U Analyte was not detected at the Method Detection Limit

Shaded value in bold indicates level exceeds maximum tolerable level

\+ Value exceeds maximum tolerable level by 1 to 10 times; low risk 1-2 and moderate risk 2-10

++ Value exceeds maximum tolerable level by 10 to 100 times; high risk

+++ Value exceeds maximum tolerable level by more than 100 times; extremely high risk

Table 3.20: Comparison of Total Metals Results for Tailings to Leaching RMC Derived from Aquatic-Life Standards
Matterhorn Mill Site (San Miguel County, Colorado)

Parameter	Tailings Pond					
	Surface Sample (T-1)			Subsurface Sample (Matterhorn Tailings)		
	SPLP Metals (mg/L)	Leaching RMC	Total Metals (mg/Kg)	SPLP Metals (mg/L)	Leaching RMC	Total Metals (mg/Kg)
Metals						
Antimony	0.0007 B	NS	62	0.0008 B	NS	63
Arsenic	0.0008 B	603750	161	< 0.0005 U	3624000	302
Cadmium	0.0029	18	6.38	0.002	9	2.11
Chromium	< 0.01 U	1480	5 B	< 0.01 U	1480	5
Copper	0.04 B	473	105	0.15	274	228
Iron	0.1	NS	26800	0.08	NS	56100
Lead	< 0.04 U	10750	4300	0.1 B	2745	**5490 +**
Manganese	0.023 B	73317	51.1	0.588	4731	84.3
Mercury	< 0.0002 U	2	0.83	< 0.0002 U	1	0.48
Molybdenum	< 0.01 U	NS	7	< 0.01 U	NS	16
Nickel	< 0.01 U	104	< 1 U	0.01 B	0	< 0 U
Selenium	0.0002 B	1941	4.22	0.0003 B	1653	5.39
Silver	0.00023 B	285	41	0.00097	119	72
Uranium	< 0.0001 U	NS	< 1 U	< 0.0001 U	NS	0.44
Vanadium	< 0.005 U	NS	8.2	0.005 B	NS	10.6
Zinc	0.71	1516	434	0.48	2806	543
Inorganics						
Cyanide	< 0.005 U	8	< 0.4 U	< 0.005 U	12	< 0.3 UH
Nitrogen, ammonia	N/A	----	25	0.57	----	34

Parameter	Settling Pond					
	Surface Sample (T-3)			Subsurface Sample (Matterhorn Settling)		
	SPLP Metals (mg/L)	Leaching RMC	Total Metals (mg/Kg)	SPLP Metals (mg/L)	Leaching RMC	Total Metals (mg/Kg)
Metals						
Antimony	0.0005 B	NS	69	0.0018 B	NS	76
Arsenic	< 0.0005 U	2136000	178	0.0014 B	392143	183
Cadmium	0.0011	18	2.3	0.0863	1	**13.2 ++**
Chromium	< 0.01 U	1184	4 B	< 0.01 U	1184	4 B
Copper	0.03 B	576	96	0.01 B	4716	262
Iron	0.05 B	NS	28400	< 0.02 U	NS	36200
Lead	< 0.04 U	6950	2780	0.05 B	2530	2530
Manganese	0.432	5477	71.7	33.6	3988	**4060 +**
Mercury	< 0.0002 U	1	0.33	< 0.0002 U	3	1.37
Molybdenum	< 0.01 U	NS	6	< 0.01 U	NS	8
Nickel	< 0.01 U	104	< 1 U	0.04 B	130	5
Selenium	0.0002 B	1247	2.71	0.0016	195	3.39
Silver	0.0003 B	171	32	0.00005 B	1152	36
Uranium	< 0.0001 U	NS	< 1 U	< 0.0001 U	NS	0.42
Vanadium	< 0.005 U	NS	6.1	< 0.005 U	NS	6.1
Zinc	0.28	4889	552	5.77	877	**2040 +**
Inorganics						
Cyanide	< 0.005 U	8	< 0.4 U	< 0.005 U	8	< 0.2 UH
Nitrogen, ammonia	N/A	----	24	< 0.3 U	----	12 B

Qualifiers are defined as follows:
B Analyte detected at a value between Method Detection Limit and Practical Quantitation Limit
U Analyte was not detected at the Method Detection Limit
H Holding time was exceeded
---- RMC could not be calculated because one or more analyses were not performed
N/A Not analyzed
NS No aquatic life standard (chronic) has been established for this parameter
Shaded value in bold indicates level exceeds leaching RMC
+ Value exceeds criterion by 1 to 10 times; low risk 1-2 and moderate risk 2-10
++ Value exceeds criterion by 10 to 100 times; high risk
+++ Value exceeds criterion by more than 100 times; extremely high risk

Table 4.1: Identification and Summary of Potential ARARs Specific to the Matterhorn Mill Site Removal Action
Matterhorn Mill Site (San Miguel County, Colorado)

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR Status
Chemical-Specific Requirements			
National Primary Drinking Water Regulation	40 CFR Part 141	Health-based standards (MCLs) for public water systems	Relevant and Appropriate
National Secondary Drinking Water Regulation	40 CFR Part 143	Welfare-based standards (secondary MCLs) for public water systems	Relevant and Appropriate
Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Sets standards for air emissions	Relevant and Appropriate
Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61	Regulates emission of hazardous chemical to the atmosphere	Relevant and Appropriate
Basic Standards and Methodologies for Surface Water	5 CCR 1002-31	Establishes basic standards and methodologies for surface water in Colorado	Applicable
Stream Classifications and Numeric Standards for Gunnison and Dolores River Basins	5 CCR 1002-35	Establishes Colorado stream classifications and numeric standards for Gunnison and Lower Dolores River Basins	Applicable
Colorado Effluent Limitations	5 CCR 1002-62	Establishes standards, concentrations, and effluent limitations for specifically identified pollutants that any person may discharge to any specific class of state waters	Applicable
Colorado Primary Drinking Water Standards	5 CCR 1003-1	Establishes standards to protect the quality of drinking water supplied to the public and the public health.	Relevant and Appropriate
Colorado Groundwater Standards	5 CCR 1002-8 and 5 CCR 1002-41	Establishes statewide standards and a system for classifying groundwater and adopting water quality standards for such classifications to protect beneficial uses of groundwater	Applicable
Location-Specific Requirements			
National Historic Preservation Act	16 USC § 470; 36 CFR Part 800; 40 CFR Part 6.310(b)	Requires federal agencies to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places and to minimize harm to any National Historic Landmark adversely or directly affected by an undertaking	Applicable
Archaeological and Historic Preservation Act	16 USC § 469; 40 CFR 6.301(c)	Establishes procedures to provide preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a federal construction project or a federally-licensed activity or program	Applicable
Historic Sites, Buildings and Antiquities Act	36 CFR § 62.6(d)	Requires federal agencies to consider the existence and location of landmarks on the National Register of Natural Landmarks to avoid undesirable impacts on such landmarks	Applicable
Archaeological Resources Protection Act	16 USC §§ 470aa-47011	Regulates removal of archaeological resources from public or tribal lands	Applicable
Protection of Wetlands Order	40 CFR Part 6	Avoid adverse impacts to wetlands	Applicable
Native Species	EO 13112	Requires use of native species	To Be Considered
Fish and Wildlife Coordination Act	16 USC § 661 et seq.; 40 CFR Part 6.302(g)	Requires consultation when federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources	Applicable

Table 4.1: Identification and Summary of Potential ARARs Specific to the Matterhorn Mill Site Removal Action
Matterhorn Mill Site (San Miguel County, Colorado)

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR Status
Floodplain Management Order	40 CFR Part 6	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	Applicable
Section 404, Clean Water Act	33USC §§ 1251 et seq.; 33 CFR Part 330	Regulates discharge of dredge or fill materials into water of the U.S.	Applicable
Endangered Species Act	16 USC §§ 1531-1543; 40 CFR Part 6.302(h) 50 CFR Part 402	Requires action to conserve endangered species with critical habitat upon which species depend. Requires consultation with Department of Interior	Applicable
Review of Historic Structures	Sec. 9-8-404, UCA	Requires state agencies to "take into account" how their activities will affect historic structures	Applicable
Colorado Mined Land Reclamation Board Regulations	2 CCR 407-1 Rule 3	Establishes reclamation performance standards	Relevant and Appropriate
Colorado Historic Preservation Regulations	8 CCR 1504-7	Coordinates, encourages, and preserves Colorado's archaeological and paleontological resources	Applicable
Action-Specific Requirements			
National Environmental Policy Act	42 USC § 4332	Requires federal agencies to integrate environmental values into their decision-making process by considering the environmental impacts of their proposed actions	Not ARAR
National Pollution Discharge Elimination System	40 CFR Parts 121, 122, 125	Requires permits for the discharge of pollutants from any point source into waters of the U.S.	Applicable
Effluent Limitation	40 CFR Part 440, pursuant to 33 USC § 1311	Sets standards for discharge of treated effluent to water of the U.S.	Applicable
RCRA Subtitle C	40 CFR Part 261.4(b)(7) and RCRA Section 3001(b) (Beville Amendment)	Regulates disposal of hazardous materials. Applicable for disposal of listed wastes and sludges and relevant and appropriate for hazardous mine waste	Applicable
Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976	40 CFR Part 257, Subpart A: § 257.1-1 Floodplains, paragraph (a); § 257.3-7 Air, paragraph (b)	Regulates the storage and handling of hazardous waste	Applicable
Hazardous Materials Transportation Act	49 USC § 1801-1813; 40 CFR 107, 171-177	Regulates the transportation of hazardous waste	Applicable
Guidelines for the Land Disposal of Solid Waste	40 CFR Part 241, pursuant to 42 USC § 6901 et seq.	Regulates the land disposal of solid waste	Applicable
Identification and Listing of Hazardous Waste	40 CFR Part 261, pursuant to 42 USC § 6921	Establishes the procedures and process for listing and determining hazardous waste	Applicable
Standards Applicable to Generation of Hazardous Waste	40 CFR Part 262, pursuant to 42 USC § 6922	Establishes standards for the generation of hazardous waste	Applicable
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263, pursuant to 42 USC § 6823	Regulates the transportation of hazardous waste	Applicable
Hazardous Waste Permit Program	40 CFR Part 270	Establishes procedures for obtaining US EPA permit for hazardous waste management program	Relevant and Appropriate
Toxic Pollutant Effluent Standards	40 CFR Part 129, pursuant to 33 USC § 1317	Establishes standards or sets prohibitions for certain hazardous constituents	Relevant and Appropriate

Table 4.1: Identification and Summary of Potential ARARs Specific to the Matterhorn Mill Site Removal Action
Matterhorn Mill Site (San Miguel County, Colorado)

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR Status
Occupational Safety and Health Act	29 USC § 655	Defines standards for employees' protection during initial site characterization and analysis, monitoring activities, materials, handling activities, training and emergency response	Applicable
Colorado Discharge Permit System Regulations	5 CCR 1002-61	Applies to all operations discharging to waters of the State from a point source	Relevant and Appropriate
Colorado Regulations Pertaining to Solid Waste Sites and Facilities	6 CCR 1007-2	Establishes regulations for solid waste sites and facilities in Colorado	Applicable
Colorado Hazardous Waste Regulations	6 CCR 1007-3, pursuant to CRS § 25-15-101 et.seq.	Establishes the procedures and process for generating, handlling, transporting or disposing of hazardous waste	Applicable; subject to Bevill Exemption
Colorado Fugitive Dust Control Plan/Opacity Regulation No. 1	5 CCR1001-3, pursuant to CRS § 25-7-101 et.seq.	Regulation of fugitive emissions	Applicable
Colorado Environmental Covenants Law	CRS §§ 25-15-317 to 327	Establishes environmental covenants and notices of environmental use restrictions	Applicable
Colorado Rule Pertaining to the Administration and Enforcement of the Colorado Noxious Week Act	8 CCR1206-2, pursuant to CRS §§ 35-5.5-101	Control of noxious weeds	Applicable
Colorado Wildlife Commission Regulations	2 CCR 406, pursuant to CRS § 33-2-101 et. seq.	Wildlife conservation, including threatened and endangered species	Applicable

Table 4.2: Removal Action Goals for Tailings and Contaminated Soil
Matterhorn Mill Site (San Miguel County, CO)

Parameter	Removal Action Goal	Source
Metals (mg/Kg)		
Antimony, Total	3	BLM RMC
Arsenic, Total	9.3	Background Soil
Cadmium, Total	3	BLM RMC
Chromium, Total	----	no criterion
Copper, Total	250	BLM RMC
Iron, Total	55,000	EPA RSL
Lead, Total	400	BLM RMC & EPA RSL
Manganese, Total	960	BLM RMC
Mercury, Total	2	BLM RMC
Molybdenum, Total	390	EPA RSL
Nickel, Total	135	BLM RMC
Selenium, Total	35	BLM RMC
Silver, Total	35	BLM RMC
Uranium, Total	230	EPA RSL
Vanadium, Total	390	EPA RSL
Zinc, Total	2,000	BLM RMC
Inorganics (mg/Kg)		
Cyanide, Total	22	EPA RSL
Nitrogen, ammonia	----	no criterion

Table 5.1: Retained Technologies Based on Preliminary Screening
Matterhorn Mill Site (San Miguel County, Colorado)

Technology		Process Option	Basis for Retention
Institutional Controls	Access Restrictions	Restrict Entry, Fencing, Signage	Potentially effective when used in conjunction with other technologies and readily implementable.
		Land Use Controls	Potentially effective when used in conjunction with other technologies and readily implementable
Engineering Source Controls	Surface Controls	Consolidation	Potentially effective option for management of mill wastes, tailings, and contaminated soil as a single unit; readily implementable.
		Erosion Protection	Potentially effective at reducing migration of surface materials via wind and surface water; readily implementable.
		Run-on and Run-off Controls	Potentially effective at reducing migration of surface materials via surface water and minimizing infiltration of waste materials; readily implementable.
		Revegetation	Potentially effective at reducing fluvial and wind erosion, minimizing infiltration within reclaimed areas, and stabilizing soil cover; imported soil and amendments likely required to support revegetation efforts; readily implementable provided sufficient soil available from a nearby source.
		Grading	Potentially effective at reducing fluvial erosion and stabilizing consolidated waste materials; readily implementable.
	Subsurface Control	Physical Barrier Between Clean Cover Soil and Underlying Contaminated Materials	Potentially effective at isolating contaminated materials from overlying clean cover soil and reducing potential for erosional scouring of contaminated materials; readily implementable.
	Excavation & Disposal	On-Site Disposal	Potentially effective at reducing direct contact with waste materials; readily implementable provided sufficient soil available from on-site or nearby source.
	Containment	Soil Cover	Potentially effective at reducing direct contact with waste materials; readily implementable provided sufficient soil available from on-site or nearby source.

Table 5.2: Cost Estimate Summary
Matterhorn Mill Site (San Miguel County, Colorado)

Cost Category[1]	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Total Capital Cost	**$ -**	**$ 158,029**	**$ 152,129**	**$ 574,753**	**$ 568,853**
Operation & Maintenance					
Year 1	**$ -**	15,000	15,000	15,000	15,000
Year 2	**$ -**	15,000	15,000	15,000	15,000
Year 3	**$ -**	15,000	15,000	15,000	15,000
NPV (O&M)	**$ -**	**$ 40,849**	**$ 40,849**	**$ 40,849**	**$ 40,849**
TOTAL NPV	**$ -**	**$ 198,878**	**$ 192,978**	**$ 615,602**	**$ 609,702**

[1] Cost Categories are defined as follows:
Total Capital Cost includes construction labor, materials, management, and associated indirect costs.
Annual Operation and Maintenance Cost includes post-reclamation inspection and maintenance and collection and analysis of water-quality samples.
Net Present Value calculated as present worth of annual operation and maintenance cost (assuming an interest rate of 5 percent over the 3-year period) plus the total capital cost.

Table 6.1: Comparative Analysis Summary
Matterhorn Mill Site (San Miguel County, Colorado)

Criterion	Alternative 1	Alternative 2		Alternative 3	
		2A	2B	3A	3B
Effectiveness	Low (1)	High (2)	High (2)	High (2)	High (2)
Implementability	Low (1)	Moderate (1)	High (2)	Low (2)	Moderate (2)
Cost	Low (1)	Moderate (2)	Moderate (1)	High (3)	High (2)

Note: Numerical ratings defined as (1) - low end of narrative rank; (2) middle of narrative rank; (3) high end of narrative rank.

Appendix A

PHOTOGRAPHS

Photo 1: Sample Station SW-1

Photo 2: Sample Station SW-2

Photo 3: Sample Station SW-3

Photo 4: Settling Pond and Sample Station SW-4

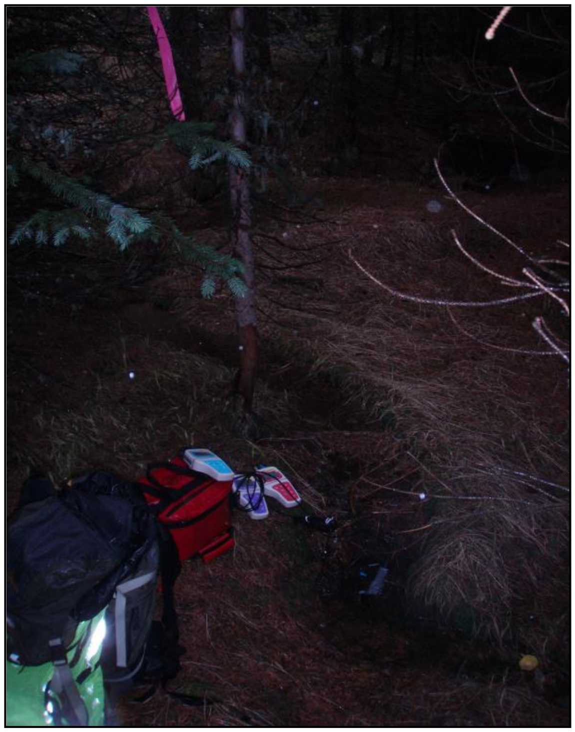


Photo 5: Sample Station SW-5

Photo 6: Small Pond

Photo 7: Tailings Pile - North

Photo 8: Tailings Pile - South

Photo 9: Background Area

Photo 10: Tailings Pond Test Pit

Photo 11: Test Pit TP 5 – Tailings within Settling Pond

Photo 12: Test Pit TP 6 – Possible Repository Site

Appendix B

FIELD SAMPLING FORMS AND TEST PIT LOGS

(Note: The surface-water sampling sheets provided in this appendix include only page 1 of 2; page 2 [equipment calibration] sheets are not presented)

Surface-Water Monitoring Field Form

Station ID: SBSW-1	**Date:** 10-04-06	**Observer:** BDS
Location: LAKE FORK	**Start Time:** 1325	**Sampling**
Site Description: ~400 FT UPSTREAM	**End Time:** 1344	**Team:** BDS
OF SAN B. MILLSITE BELOW BARE STEEP SLOPE S. OF MILL		**Lead Signature:** BD Smith
Project: SAN BERNARDO MILL	**Instruments:** 10, 310	**Date:** 10 / 04 / 06

Sampling Information

Surface-water Type: (stream) / lake / pond / spring / seep /mine drainage / NPDES outfall / other: ______

Sampling Location: (bank) / wading / boat / bridge / other: ______

Sampling Site: pool / (riffle) / eddy / backwater / open / channel / braided / other: ______

Stream/Channel/Pool Width: ~14' (ft)/m **Mean Depth:** ≤ 1 (ft)/m

Water Color: (clear) / brown / green / blue / grey / other: ______

Weather: SKY- clear / (scattered) / broken / cloudy / overcast. PRECIP- none / light / mod. / heavy / snow / rain
WIND- calm / (breeze) / gusty / moderate / strong / est. wind speed/direction: ______ / ______
TEMP- cold / cool / (mild) / warm / hot / est. air temperature: ______ Comments: ______

Field Measurements

Parameter	Reading	Time	Instrument	Comments
Air Temp °C	17°C	1344	THERM.	
Water Temp °C	9.8 / 10.1°C	1331	310 / 10	9.8°C w/ 310
pH (s.u.)	7.78	1331	310	pH 10: 9.75 @ 10.1°C
Conductivity (µmhos/cm)	241 µ	1331	10	
DO (mg/L)	8.48	~~[illegible]~~ 1331	310	7.42% @ 9.5°C
Eh (mV)	126.4	1344	310	
Alkalinity (mg/L)				
Turbidity (n.t.u.)				
Discharge ((ft3/s), gpm)				(measured/(estimated)) ~100 cfs
Gage ht. (ft)				

GPS: N 37° 50.865, W 107° 53.104 ± 19 FT 9642' AMSL

Measurement: In Situ or Container

Number and type of filters used: 0.45µ. Sample @ 1340

Surface-Water Monitoring Field Form

Station ID: SB SW-2	**Date:** 10-4-06	**Observer:** BDS
Location: LAKE FORK	**Start Time:** 12:28	**Sampling**
Site Description: MAIN CHANNEL	**End Time:** 12:40	**Team:** BDS
LAKE FORK ~200 FT DOWNST OF NW TAILS AT MILLSITE		**Lead Signature:** BD Smith
Project: SAN BERNARDO MILL	**Instruments:** 10, 310	**Date:** 10 / 04 / 06

Sampling Information

Surface-water Type: (stream) / lake / pond / spring / seep /mine drainage / NPDES outfall / other: ______

Sampling Location: (bank) / wading / boat / bridge / other: ______

Sampling Site: pool / riffle / (eddy) / backwater / open / channel / braided / other: ______

Stream/Channel/Pool Width: ~8' (ft)/m **Mean Depth:** ~1' (ft)/m

Water Color: (clear) / brown / green / blue / grey / other: ______

Weather: SKY- clear / (scattered) / broken / cloudy / overcast. PRECIP- none / light / mod. / heavy / snow / rain
WIND- calm / (breeze) / gusty / moderate / strong / est. wind speed/direction: ____ / ____
TEMP- cold / cool / (mild) / warm / hot / est. air temperature: ____ Comments: ____

Field Measurements

Parameter	Reading	Time	Instrument	Comments
Air Temp °C	19.2	1235	THERM.	
Water Temp °C	9.6	1235	10	
pH (s.u.)	7.50	1247	310	9.73 pH w/ pH/con 10, 310 = 9.72
Conductivity (µmhos/cm)	273 µ	1235	10	
DO (mg/L)	8.45	1235	310	73.2% @ 9.1°C
Eh (mV)	119.3	1235	310	
Alkalinity (mg/L)				
Turbidity (n.t.u.)				
Discharge (ft3/s, gpm)				(measured/(estimated))
Gage ht. (ft)				

GPS: N 37° 51.049 W/107° 53.191 ±16 FT ~8743' AMSL

Measurement: (In Situ) or Container

Number and type of filters used: 0.45µ Sample AT 1245

Surface-Water Monitoring Field Form

Station ID: SBSW-3	**Date:** 10-04-06	**Observer:** BDS
Location: POND	**Start Time:** 1405	**Sampling**
Site Description: SMALL BERMED POND NW OF NW-MOST TAILS POND	**End Time:** 1430	**Team:** BDS
		Lead Signature: BD Smith
Project: SAN BERNARDO MILL	**Instruments:** 10, 310	**Date:** 10 / 04 / 06

Sampling Information

Surface-water Type: stream / lake / (pond) / spring / seep /mine drainage / NPDES outfall / other: ______

Sampling Location: (bank) / wading / boat / bridge / other: ______

Sampling Site: (pool) / riffle / eddy / backwater / open / channel / braided / other: ______

Stream/Channel/Pool Width: 35-40 (ft)/m **Mean Depth:** 20 (ft)/m

Water Color: (clear) / brown / green / blue / grey / other: ______

Weather: SKY- clear / (scattered) / broken / cloudy / overcast. PRECIP- (none) / light / mod. / heavy / snow / rain
WIND- calm / (breeze) / gusty / moderate / strong / est. wind speed/direction: ______ / ______
TEMP- cold / cool / (mild) / warm / hot / est. air temperature: 19°C Comments: ______

Field Measurements

Parameter	Reading	Time	Instrument	Comments
Air Temp °C	~19°C	1430	THERM.	
Water Temp °C	8.9	1417		10/310
pH (s.u.)	3.~~84~~70	1435	310 @ 9.3°C	4.90 w/ pH 10 9.2°C.
Conductivity (µmhos/cm)	980 →	1417		Climbing to 1235 @ 1430
DO (mg/L)	0.44	1417		7.7% @ 8.2 °C
Eh (mV)	486	1430		
Alkalinity (mg/L)				
Turbidity (n.t.u.)				
Discharge (ft3/s, gpm)				(measured/(estimated)) OUTFLOW 0 cfs
Gage ht. (ft)				

GPS N 37° 51.009, W 107° 53.162 ± 20' ~9389' AMSL

Measurement: In Situ or Container IN SITU

Number and type of filters used: 0.45µ. Sample @ 1430. DUPLICATE IS "SBSW-0" AT "1400"

Surface-Water Monitoring Field Form

Station ID: SBSW-4	Date: 10-05-06	Observer: BDS
Location: "SETTLING POND"	Start Time: 0842	Sampling
Site Description: NW-MOST TAILS	End Time: 0915	Team: BDS
POND FROM MILL BLDG. JUST W. OF MAIN TAILS		Lead Signature: B.D. Smith
Project: SAN BERNARDO MILL	Instruments:	Date: 10 / 05 / 06

Sampling Information

Surface-water Type: stream / lake / pond (circled) / spring / seep /mine drainage / NPDES outfall / other:

Sampling Location: bank (circled) / wading / boat / bridge / other: SHALLOW PONDED WATER/RUNOFF IN SWALE IN NW. TAILS 'POND'

Sampling Site: pool (circled) / riffle / eddy / backwater / open / channel / braided / other:

Stream/Channel/Pool (circled) Width: ~10 ft (circled)/m **Mean Depth**: 0.3 ft (circled)/m

Water Color: clear / brown / green / blue / grey / other: BWN-YEL

Weather: SKY- clear / scattered / broken / cloudy / overcast (circled). PRECIP- none (circled) /light (circled) / mod. / heavy / snow / rain
WIND- calm (circled) / breeze / gusty / moderate / strong / est. wind speed/direction: /
TEMP- cold / cool (circled) / mild / warm / hot / est. air temperature: 7 Comments:

Field Measurements

Parameter	Reading	Time	Instrument	Comments
Air Temp °C	7			
Water Temp °C	6.9	0855	310	
pH (s.u.)	2.92	0855	310	
Conductivity (µmhos/cm)	986µ	0855	10	@ 7.7°C UP TO 1001µS/cm
DO (mg/L)	5.68	0855	DO310	47.0% @ 7.0°C,
Eh (mV)	-116	0915		
Alkalinity (mg/L)				BEGINS TO RAIN AS FINISH
Turbidity (n.t.u.)				Up Sampling...
Discharge (ft3/s, gpm)				(measured/estimated)
Gage ht. (ft)				

GPS: N 37° 50.978 W/107° 53.160 ±29' ~9265' AMSL

Measurement: In Situ or Container

Number and type of filters used: 0.45µ. Sample @ 0905

Surface-Water Monitoring Field Form

Station ID: ~~SBL~~ SBSW-5	Date: 10-05-06	Observer: BDS
Location: SPRING TOE OF SLOPE	Start Time: 1019	Sampling
Site Description: SMALL WELL-DEVELOPED CHANNEL ON SMALL WOODED FLOOD PLAIN	End Time: 1045	Team: BDS
		Lead Signature:
Project: SAN BERNARDO MILL	Instruments:	Date: 10 / 05 / 06

Sampling Information

Surface-water Type: stream / lake / pond / (spring) / seep /mine drainage / NPDES outfall / other:

Sampling Location: (bank) / wading / boat / bridge / other:

Sampling Site: (pool) / riffle / eddy / backwater / open / channel / braided / other:

Stream/Channel/(Pool) Width: < 1 (ft)/m **Mean Depth:** ~.7 (ft)/m

Water Color: (clear) / brown / green / blue / grey / other:

Weather: SKY- clear / scattered / broken / cloudy / (overcast). PRECIP- none / light / (mod) / heavy / snow / rain
WIND- (calm) breeze / gusty / moderate / strong / est. wind speed/direction: /
TEMP- cold / (cool) / mild / warm / hot / est. air temperature: 7.8 Comments:

Field Measurements

Parameter	Reading	Time	Instrument	Comments
Air Temp °C	7.8	1045		
Water Temp °C	6.3 / 5.9	1030	10 / 310	
pH (s.u.)	4.04	1030	310	5.9°C 310 6.1U pH on 10
Conductivity (µmhos/cm)	820	1030	310	6.3°C = 10
DO (mg/L)	7.91	1030	DO 310	e 5.5°C 62.6%
Eh (mV)	313	1047	310	
Alkalinity (mg/L)				
Turbidity (n.t.u.)				
Discharge (ft3/s, (gpm))	1 GPM			(measured/(estimated))
Gage ht. (ft)				

GPS: NO RECEPTION

Measurement: (In Situ) or Container

Number and type of filters used: 0.45µ Sample AT 1030

Soil/Mine-Waste Sampling Form

Sample No.: SB T-1

Mine Site: SAN BERNARDO

Claim No.:

Date: 10-04-06

Sampler(s): WGM

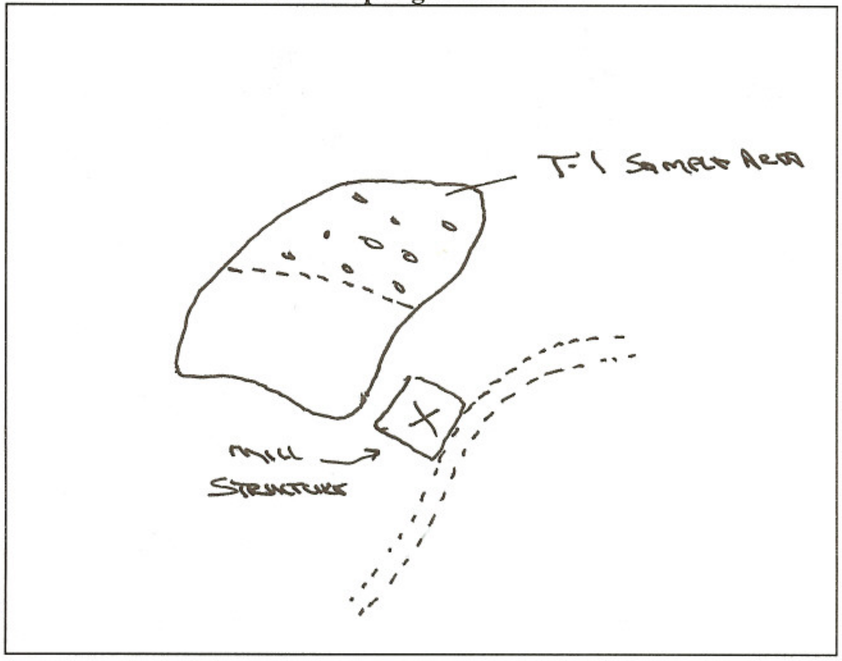
General Site Location: OFF HIGHWAY S OF OPHIR LOOP

Current Conditions/Weather: CLOUDY WINDY, WARM

Sampling Method: GRAB

Sample Type (circle one): Discrete / Composite (Composite circled)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
SB T-2	10/4/06	1245	0-6	SEE SKETCH	YW/BR - GRY/BRN
SS 1:					F-VF SILTY SAND W/
SS 2:					2D SILTY; GR/WH CLAY
SS 3:					UP TO 15%; MOIST
SS 4:	T-1 AREA CONSISTS OF MORE REDUCED				
SS 5:	GRY/BR SANDS THAN T-2 AREA W/ OXIDIZED				
SS 6:	ZONES LIMITED TO UPPR 2"; ALSO AREAS				
SS 7:	CONTAIN GR/WH CLASTIC - VERY PLASTIC &				
	MOIST				

Soil/Mine-Waste Sampling Form

Sample No.: SB T-2

Mine Site: SAN BERNARDO

Claim No.:

Date: 10-04-06

Sampler(s): WGM

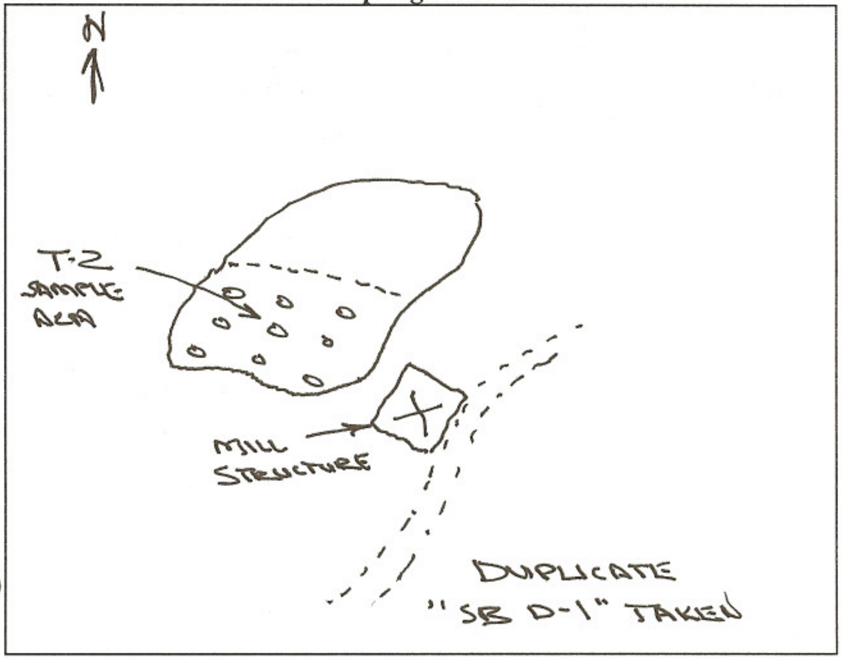
General Site Location: OFF HILLWAY S. OF OPHIR LOOP

Current Conditions/Weather: CLOUDY SLIGHT WIND, WARM

Sampling Method: GRAB ~~COMPOSITE~~ + CLAY

Sample Type (circle one): Discrete / (Composite)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
SB T-2	10-04-06	1225	0-6"	SEE SKETCH	PREDOMINANTLY YW/BR F-VF SILTY SAND; 20% SILT; SOME 10% GR/WH CLAY; MOIST; HEAVY FE STAINING
SS 1:					
SS 2:					
SS 3:					
SS 4:					
SS 5:					
SS 6:					
SS 7:					

T-2 AREA CONSISTS OF F-VF SAND OF VARIED COLOR (RD-RD/BR & YW/BR WHERE OXIDIZED - PRIMARILY UPPER 2"-4") GR/BR WHERE MORE REDUCED - MOSTLY AT DEPTH > 2"-4"); WHITE CLAY UNDERLY SAND AT 4"-6" IN PLACES - PLASTIC AND MOIST

Soil/Mine-Waste Sampling Form

Sample No.: SBT-3

Mine Site: SAN BERNARDO

Claim No.:

Date: 10-5-06

Sampler(s): WGM

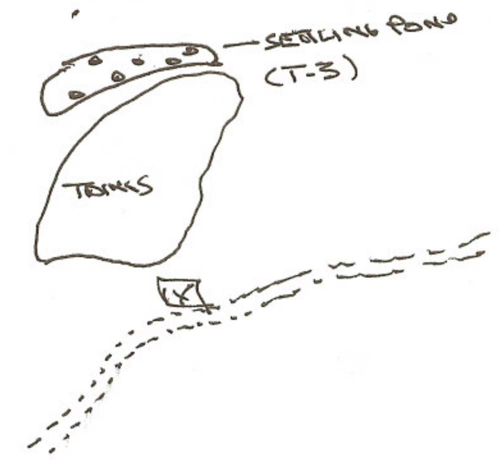
General Site Location: SETTLING POND

Current Conditions/Weather: CLOUDY, COOL

Sampling Method:

Sample Type (circle one): Discrete / **Composite** (circled)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
SBT-3	10/5/06	0840	0-6"	SEE SKETCH	YW/BRN CLAYEY
SS 1:					SAND (ML) w/ 20%
SS 2:					CLAY; F-VF SAND;
SS 3:					ABD LIMONITE STAINING
SS 4:					LOOSE; WET
SS 5:					[TAILINGS] SOME
SS 6:					ORGANIC MATTER ON
SS 7:					SURFACE.

Soil/Mine-Waste Sampling Form

Sample No.: SB SED-1

Mine Site: SAN BERNARDO

Claim No.: ______

Date: 10-14-06

Sampler(s): WGM

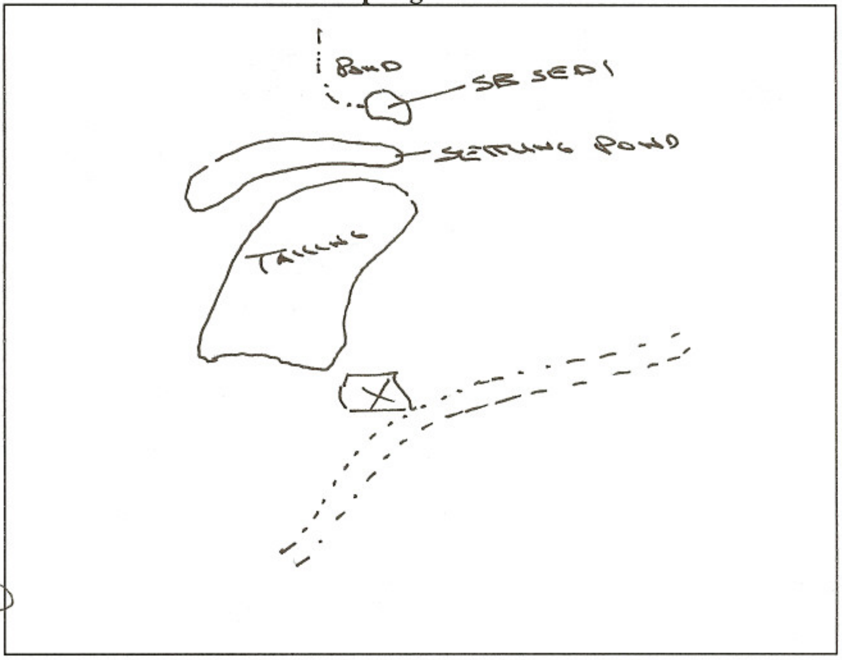
General Site Location: LOWER POND

Current Conditions/Weather: CLOUDY WARM

Sampling Method: GRAB

Sample Type (circle one): Discrete / **Composite** (circled)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
	10/14/06	1400	0-2"	AROUND POND	DK RD/BL SILTY
SS 1:					SAND (40%) + CLAYEY
SS 2:					SAND (60%); VF SAND;
SS 3:					HEAVY FE STAINING;
SS 4:					AND ORGANIC MATTER
SS 5:					SATURATED
SS 6:					
SS 7:					

Soil/Mine-Waste Sampling Form

Sample No.: SB BERM

Mine Site: SAN BERNARDO

Claim No.:

Date: 10/5/06

Sampler(s): WEM

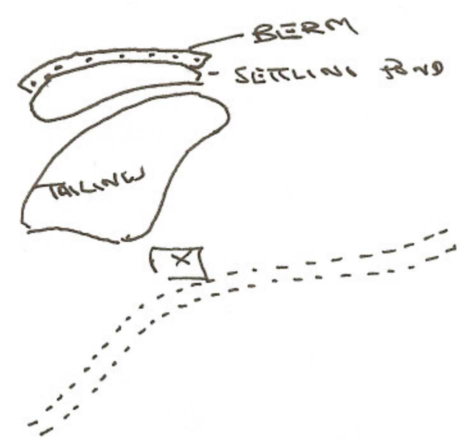
General Site Location: BERM ALONG WEST PERIMETER OF SETTLING POND

Current Conditions/Weather: CLOUDY, COOL

Sampling Method: GRAB

Sample Type (circle one): Discrete / **Composite** (circled)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
SB BERM	10/5/06	09:05	0-6"	SEE SKETCH	DK RD/BR CLAYEY/
SS 1:					SILTY SAND (ML) W/
SS 2:					30% CLAY; 20% SILT
SS 3:					F SAND; LOOSE;
SS 4:					ABD. ORGANIC MATTER
SS 5:					(ROOTS / GRASSES);
SS 6:					MOIST; SOME ROCK
SS 7:					FRAGMENTS AT 4".
					(NATIVE SOIL)

Soil/Mine-Waste Sampling Form

Sample No.: SB-SBKG

Mine Site: SAN BERNARDO

Claim No.:

Date: 10/5/06

Sampler(s): HBE WGM

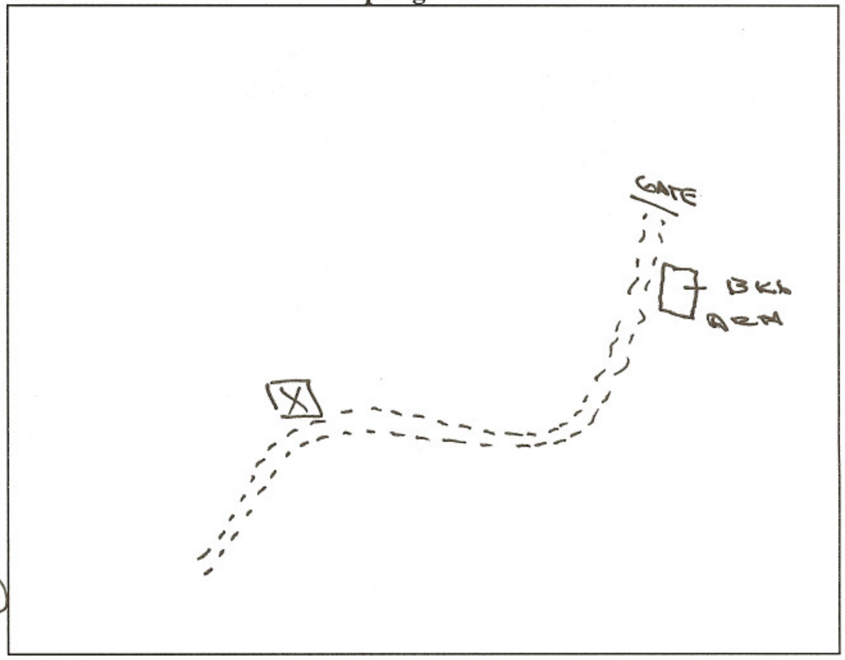
General Site Location: UPHILL OF ACCESS RD LEADING TO QUARRY

Current Conditions/Weather: COLD, RAIN

Sampling Method: GRAB

Sample Type (circle one): Discrete / Composite (circled)

Site Sketch/Sampling Locations



Discrete Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description

Composite Sample Information:

Sample ID	Date	Time	Sampling Interval	Sample Location	Sample Description
SB-SBKG	10/5/06	1125	0-6"	SEE SKETCH	DK BRN - RD/BR
SS 1:					SILTY CLAYEY SOIL
SS 2:					(ML) w/ 20% SILT,
SS 3:					30% CLAY; F-GRAINED
SS 4:					SAND; ABD. ORGANIC
SS 5:					MATTER (ROOTS);
SS 6:					LOOSE; MOIST
SS 7:					

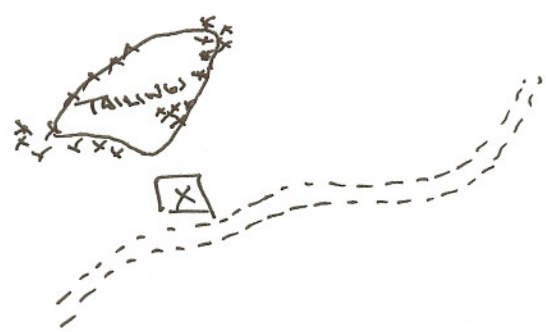
VEGETATION SAMPLING DATA SHEET

SAMPLE: SB-VEG-T

SITE NAME SAN BERNARDO	LOCATION
DATE 10-5-06	LATITUDE
TIME 0940	LONGITUDE
PROJECT SAN BERNARDO MILL	
SAMPLER(s) WOM	

VEGETATION TYPE	Indicate the type of vegetation sampled ☒ Grass ☐ Forb ☐ Shrub ☐ Other (________)
SAMPLE COLLECTION	Indicate the type of sampling equipment used ☒ Clipper ☐ Core ☐ Other ______ Indicate the type of sample ☒ Composite No. of subsamples 30+ ☐ Discrete Indicate the type and number of samples collected ☒ Chemical Analysis No. 1 Preservative NO ☐ Plant Identification No. ___ Preservative ______

SITE SKETCH/SAMPLE LOCATION



GENERAL COMMENTS	LITTLE TO NO VEG. ON TAILINGS AREA; SAMPLES COLLECTED AROUND PERIMETER IN AREAS WHERE GRASSES GROWING IN TAILINGS MATERIAL

VEGETATION SAMPLING DATA SHEET

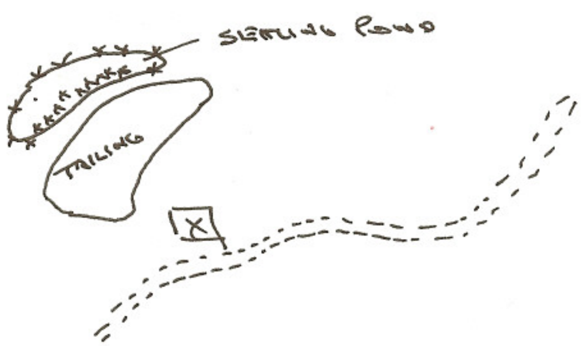
SAMPLE: SB VEG·POND

SITE NAME SAN BERNARDO	LOCATION
DATE 10/5/06	LATITUDE
TIME 1015	LONGITUDE
PROJECT SAN BERNARDO MILL	
SAMPLER(s) WJOM	

VEGETATION TYPE	Indicate the type of vegetation sampled [x] Grass [ ] Forb [ ] Shrub [ ] Other (________)

SAMPLE COLLECTION	Indicate the type of sampling equipment used [x] Clipper [ ] Core [ ] Other ________ Indicate the type of sample [x] Composite No. of subsamples 30+ [ ] Discrete Indicate the type and number of samples collected [x] Chemical Analysis No. 1 4OUP Preservative NO [ ] Plant Identification No. ____ Preservative ________

SITE SKETCH/SAMPLE LOCATION



GENERAL COMMENTS	GRASS GROWING ON SED (POND MOSTLY DRY) IN LIMITED AREAS & AROUND PERIMETER OF FEATURE DUPLICATE TAKEN "SB VEG-D"

VEGETATION SAMPLING DATA SHEET

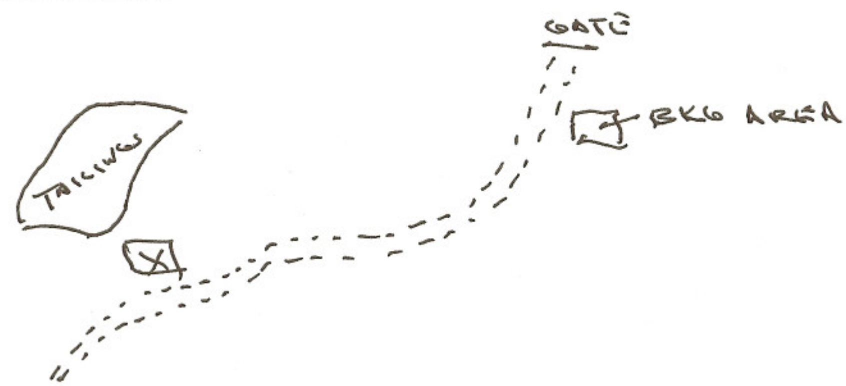
SAMPLE SB-BKG VEG

SITE NAME SAN BERNARDO	LOCATION
DATE 10/5/06	LATITUDE
TIME 1125	LONGITUDE
PROJECT SAN BERNARDO MILL	
SAMPLER(s) WGM	

VEGETATION TYPE	Indicate the type of vegetation sampled ☒ Grass ☐ Forb ☐ Shrub ☐ Other (___________________)

SAMPLE COLLECTION	Indicate the type of sampling equipment used ☒ Clipper ☐ Core ☐ Other _______________ Indicate the type of sample ☒ Composite No. of subsamples 3-4 ☐ Discrete Indicate the type and number of samples collected ☒ Chemical Analysis No. 1 Preservative NO ☐ Plant Identification No. _____ Preservative _______________

SITE SKETCH/SAMPLE LOCATION



GENERAL COMMENTS	

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: BILL MERRILL	Address: 743 HORIZON CT · SUITE 330
Company: AAK	GRAND JCT, CO 81506
E-mail: bill.wwl@bresnan.net	Telephone: (970) 242-0170 (970) 270-6217 CELL

Copy of Report to:

Name:	E-mail:
Company:	Telephone:

Invoice to:

Name: Same	Address: Same
Company:	
E-mail:	Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

PROJECT INFORMATION

Quote #: SW (SAN BERNARDO); SOIL

Project/PO #: SAN BERNARDO

Reporting state for compliance testing:

Sampler's Name: RDS, WFM

Are any samples NRC licensable material? No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers								
SBSW-1	10/4/06; 1340	SW	7	SEE	ATTACHED	QUOTE	: SW				
SBSW-2	10/4/06; 1245	SW	7		"	"	"				
SBSED-1	10/4/06; 1400	SO	1	"	"		"	: SOIL			
SBSW-0	10/4/06; 1400	SW	7	"	"		"	: SW			
SBSW-3	10/4/06; 1430	SW	7	"	"		"	: SW			

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

HOLDING TIME LIMITS ON SW SAMPLES!

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Bruce S. Smith	10/04/06 15:30		

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: BILL MERRILL	Address: 743 HORIZON CT · SUITE 330
Company: AAK	GRAND JUNCTION, CO 81506
E-mail: bill.wwl@bresnan.net	Telephone: (970) 242-0170

Copy of Report to:

Name: SAME	E-mail:
Company:	Telephone:

Invoice to:

Name: SAME	Address:
Company:	
E-mail:	Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

PROJECT INFORMATION

Quote #:

Project/PO #: SW ; SOIL ; SOIL-1312 ; RINSE ; VEG

Reporting state for compliance testing:

Sampler's Name:

Are any samples NRC licensable material?

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers								
SBSW-4	10/5/06; 0905	SW	7	SEE ATTACHED QUOTE "SW"							
SBSW-5	10/5/06; 1030	SW	7		"		"		"		
RINSE-S	10/05/06; 1620	SW	4	"	"		"				
RINSE-V	10/05/06; 1630	SW	4								
SBT-3	10/05/06; 0840	SO	1						"SOIL"		
SBT-2	10/04/06; 1225	SO	1						"SOIL"		
SB-BERM	10/05/06; 0905	SO	1						"SOIL"		
SB-SBKG	10/05/06; 1125	SOIL	1						"SOIL"		
SB-D1	10/04/06; 1300	SO	1						"SOIL"		
SBT-1	10/04/06; 1245	SO	1				"SOIL" AND		"SOIL-1312"		

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

SBT-1 TO BE ANALYZED FOR TOTAL AND SPLP METALS PER QUOTES

PAGE 1 OF 2

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Bruce D Smith	10/05/06; 1715		

FRMAD050.03.05.02 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: BILL MERRILL	Address: 743 HORIZON CT. SUITE 33U
Company: AAK	GRAND JCT, CO 81506
E-mail: BILL.WWL@BRESNAN.NET	Telephone: (970) 242-0170

Copy of Report to:

Name:	E-mail:
Company:	Telephone:

Invoice to:

Name:	Address:
Company:	
E-mail:	Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

PROJECT INFORMATION

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name:

Are any samples NRC licensable material?

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers								
SB VEG-T	10/5/06 0940	VEG	1	SEE	ATTACHED		QUOTE	"VEG"			
SB VEG-POND	10/5/06 1015	VEG	1	"		"		"		"	
SB VEG-BKG	10/5/06 1125	VEG	1	"		"		"		"	
SB VEG-D	10/5/06 1200	VEG	1	"		"		"		"	

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PAGE 2 OF 2

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Bruce D Smith	10/05/06; 1715		

FRMAD050.03.05.02 White - Return with sample. Yellow - Retain for your records.

PROJECT Matterhorn Mine

JOB NO. ______ DATE October 16, 2009

LOG OF TEST BORING NO. TP # 1

RIG TYPE CASE 580 Extendahoe
BORING TYPE Test Pit
SURFACE ELEV. NK
DATUM NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft.3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0 – 0.8'							SM	Tailings SAND	silty SAND, predominately fine, some medium, angular, non-plastic, liminetic, orange-yellow
		⊠	U	NA	100.3	18.3			
0.8' – 4.2'							SM	Tailings SLIME	silty SAND, predominately fine to very fine, uniform, angular, low plasticity, occasional saturated zones (4" - 6" thick), gray
4.2' – 6.2' (5)							SM	Tailings SAND	silty SAND, predominately fine, trace medium, angular, non-plastic, moist, dark yellowish brown
6.2'									Refusal @ 6.2' on bedrock
10								NOTE: Installed 1" diameter PVC to base of pit, backfilled with spoils, lower 4' slotted, wrapped in filter fabric, approximate 4' stick-up.	
15									
20									
25									

SAMPLE TYPE
A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sample - SPT
U - 3" O.D. 2" I.D. drive tube sample
T - 3" O.D. thin wall Shelby Tube

FIELD ENGINEER GREG SMITH

Geo • Smith ENGINEERING, LLC

PROJECT Matterhorn Mine

JOB NO. ____________ DATE October 16, 2009

LOG OF TEST BORING NO. TP # 2

RIG TYPE CASE 580 Extendahoe
BORING TYPE Test Pit
SURFACE ELEV. NK
DATUM NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft 3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0							SM	**Tailings SAND**	**silty SAND, predominately fine to medium, angular, dry, non-plastic, gray with 1" to 2" thick orange-yellow liminetic beds lower portion.** **Note: sidewalls caving** 4.5'
5							SM-SC	**Native**	**silty clayey SAND, fine to medium, moist, low plasticity, considerable organics, fiberous, (lower 6" peat), dark brown.** 5.2'
									Refusal @ 5.2' on bedrock
10									
15									
20									
25									

SAMPLE TYPE

A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sampler - SPT
U - 3" O.D. 2" I.D. drive tube sampler
T - 3" O.D. thin-wall Shelby tube

FIELD ENGINEER GREG SMITH

PROJECT: Matterhorn Mine

JOB NO.: ______ DATE: October 16, 2008

LOG OF TEST BORING NO. TP # 3

RIG TYPE: CASE 580 Extendahoe
BORING TYPE: Test Pit
SURFACE ELEV.: NK
DATUM: NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft 3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0							SM	Tailings SAND	silty SAND, predominately fine, angular, non-plastic, light yellowish tan
1.0'							SM	Tailings SAND	silty SAND, predominately fine, some medium, angular, non-plastic, orange-yellow to brown
4.0'							SM	Tailings SLIME	silty SAND, predominately fine to very fine, uniform, angular, low plasticity, very moist, dark gray
5.0'							SM	Tailings SAND	silty SAND, predominately fine, some medium, angular, non-plastic, orange-brown
8.0'							SM-SC	Native	silty clayey SAND, fine to medium, moist, low plasticity, considerable organics, fiberous, (lower 6" peat), dark brown.
9.0'									Refusal @ 9.0' on bedrock

Depth scale: 0, 5, 10, 15, 20, 25

SAMPLE TYPE
A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sample - SPT
U - 3" O.D. 2" I.D. drive tube sample
T - 3" O.D. thin wall Shelby tube

FIELD ENGINEER: GREG SMITH

PROJECT: Matterhorn Mine

JOB NO.:

DATE: October 16, 2008

LOG OF TEST BORING NO. TP # 4

RIG TYPE: CASE 580 Extendahoe
BORING TYPE: Test Pit
SURFACE ELEV.: NK
DATUM: NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft 3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0 – 1.6'	—						SM	Tailings SAND	silty SAND, predominately fine, some medium, uniform, angular, non-plastic, orange to brown. white tailings lens 1.5 - 2.25'
1.6' – 6.2'	—	X	U	NA	89.0	15.9	SM	Tailings SLIME	silty SAND, predominately fine to very fine, uniform, angular, non-plastic, gray
6.2'									Refusal @ 6.2' on bedrock

Depth scale: 0, 5, 10, 15, 20, 25

SAMPLE TYPE
A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sampler - SPT
U - 3" O.D. 2" I.D. drive tube sampler
T - 3" O.D. thin-wall Shelby tube

FIELD ENGINEER: GREG SMITH

PROJECT: Matterhorn Mine

JOB NO.: DATE: October 16, 2008

LOG OF TEST BORING NO. TP # 5

RIG TYPE: CASE 580 Extendahoe
BORING TYPE: Test Pit
SURFACE ELEV.: NK
DATUM: NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft.3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0 – 3.0'		X	A				ML	Tailings SLIME	SILT with SAND, predominately very fine sand, non-plastic, greenish-yellow with interbedded lenses to 2" thick SAND, fine, non-plastic, moist, orange-brown. 3.0'
3.0' – 5.0'							SM-SC	Native	silty clayey SAND, fine to medium, moist, low plasticity, some angular cobbles with depth, considerable organics @ base of pit, fiberous, (lower 6" peat), dark brown. 5.0'
5.0'									Refusal @ 5.0' on bedrock

Depth scale: 0, 5, 10, 15, 20, 25

NOTE: Installed 1" diameter PVC to base of pit, backfilled with spoils, lower 3' slotted, wrapped in filter fabric, approximate 3' stick-up.

SAMPLE TYPE
A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sample - SPT
D - 3" O.D. 2" I.D. drive tube sample
T - 3" O.D. thin-wall Shelby tube

FIELD ENGINEER: GREG SMITH

PROJECT: Matterhorn Mine

JOB NO. ______ DATE: October 16, 2008

LOG OF TEST BORING NO. TP # 6

RIG TYPE: CASE 580 Extendahoe
BORING TYPE: Test Pit
SURFACE ELEV.: NK
DATUM: NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft.3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0 – 1.0							SM-SC	"O" and "A" USDA soil layers	silty clayey SAND, fine to medium, moist, low plasticity, organic layer upper 2", considerable roots (fine to ½" diameter), dark brown.
1.0 – 2.25							SM-SC	"B" USDA soil layer	silty clayey SAND, fine to medium, low plasticity, dark brown.
2.25									Refusal @ 2.25' on broken bedrock

Depth scale: 0, 5, 10, 15, 20, 25

SAMPLE TYPE
A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sample - SPT
U - 3" O.D. 2" I.D. drive tube sample
T - 3" O.D. thin-walled Shelby tube

FIELD ENGINEER: GREG SMITH

PROJECT: Matterhorn Mine

JOB NO.:

DATE: October 16,2008

LOG OF TEST BORING NO. TP # 7

RIG TYPE: CASE 580 Extendahoe

BORING TYPE: Test Pit

SURFACE ELEV.: NK

DATUM: NA

Depth in feet	Graphical Log	Sample	Sample Type	SPT Blows per foot	Dry Density in Lbs. per ft 3	Moisture Content (% dry wt.)	USCS	Remarks	Visual Classification
0							SM-SC	possibly imported roadbase	silty clayey SAND with gravel and cobbles, fine to medium sand, low to moderate plasticity, dark brown.
1.5									Refusal @ 1.5' on bedrock
5									
10									
15									
20									
25									

SAMPLE TYPE

A - Auger Cuttings
S - 2" O.D. 1.38" I.D. drive sample - SPT
U - 3" O.D. 2" I.D. drive tube sample
T - 3" O.D. thin-wall Shelby tube

FIELD ENGINEER: GREG SMITH

Appendix C

COST ESTIMATE DETAIL

Cost Estimate - Removal Action Alternative 2A
Matterhorn Mill Site (San Miguel County, Colorado)

Item	Description of Work	Units	Quantity	Unit Price	Total
1	Mobilization/demobilization	LS	1	6500	$ 6,500.00
2	Permits and Plans (Site Safety and Health Plan, Stormwater Mgmt Plan, etc.)	LS	1	7200	$ 7,200.00
3	Temporary institutional controls to restrict access to work areas during implementation of alternative	LS	1	2500	$ 2,500.00
4	Permanent institutional controls to secure the mill building and prevent unauthorized access to the inside of the structure.	LS	1	1500	$ 1,500.00
5	Improved access road leading from mill bench to the tailings areas	Linear ft	1000	10	$ 10,000.00
6	Compact tailings within tailings pond with vibrating compactor to densify tailings and mitigate future settlement	Square yd	3,222	1	$ 3,222.00
7	Install safety controls as necessary to ensure worker safety inside the mill building	LS	1	5000	$ 5,000.00
8	Remove mill wastes from inside the mill building and place on tailings pond	Cubic yd	150	6	$ 900.00
9	Stabilize mill structure as necessary to avoid impacts during removal of tailings around the exterior of the mill building	LS	1	5000	$ 5,000.00
10	Remove tailings from around the exterior of the mill building and place on tailings pond	Cubic yd	250	4	$ 1,000.00
11	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
12	Excavate tailings at settling pond and place on tailings pond	Cubic yd	660	10	$ 6,600.00
13	Excavate soil comprising soil berm and place on tailings pond	Cubic yds	240	10	$ 2,400.00
14	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
15	Deliver and place clean fill in settling pond/soil berm excavations and grade to match natural topography	Cubic yd	990	19.25	$ 19,057.50
16	Purchase and plant seed on reclaimed surface at settling pond/soil berm	acre	0.253	5500	$ 1,388.89
17	Purchase and Install physical barrier (nonwoven geotextile) on reshaped tailings pond	Square yd	3,222	3.23	$ 10,407.06
18	Deliver and place 2-ft thick soil cover on physical barrier	Cubic yd	2,150	19.25	$ 41,387.50

Cost Estimate - Removal Action Alternative 2A
Matterhorn Mill Site (San Miguel County, Colorado)

19	Install drainage run-on/run-off drainage controls at containment cell	Linear ft	800	23	$ 18,400.00
20	Purchase and plant seed on soil cover	acre	0.666	5500	$ 3,661.62
21	Purchase install gate	Each	1	1904	$ 1,904.00
				Total	**$ 158,028.57**

Cost Estimate - Removal Action Alternative 2B
Matterhorn Mill Site (San Miguel County, Colorado)

Item	Description of Work	Units	Quantity	Unit Price	Total
1	Mobilization/demobilization	LS	1	6500	$ 6,500.00
2	Permits and Plans (Site Safety and Health Plan, Stormwater Mgmt Plan, etc.)	LS	1	7200	$ 7,200.00
3	Temporary institutional controls to restrict access to work areas during implementation of alternative	LS	1	2500	$ 2,500.00
4	Permanent institutional controls to secure the mill building and prevent unauthorized access to the inside of the structure.	LS	1	1500	$ 1,500.00
5	Improved access road leading from mill bench to the tailings areas	Linear ft	1000	10	$ 10,000.00
6	Compact tailings within tailings pond with vibrating compactor to densify tailings and mitigate future settlement	Square yd	3,222	1	$ 3,222.00
7	Stabilize mill structure as necessary to avoid impacts during removal of tailings around the exterior of the mill building	LS	1	5000	$ 5,000.00
8	Remove tailings from around the exterior of the mill building and place on tailings pond	Cubic yd	250	4	$ 1,000.00
9	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
10	Excavate tailings at settling pond and place on tailings pond	Cubic yd	660	10	$ 6,600.00
11	Excavate soil comprising soil berm and place on tailings pond	Cubic yds	240	10	$ 2,400.00
12	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
13	Deliver and place clean fill in settling pond/soil berm excavations and grade to match natural topography	Cubic yd	990	19.25	$ 19,057.50
14	Purchase and plant seed on reclaimed surface at settling pond/soil berm	acre	0.253	5500	$ 1,388.89
15	Purchase and Install physical barrier (nonwoven geotextile) on reshaped tailings pond	Square yd	3,222	3.23	$ 10,407.06
16	Deliver and place 2-ft thick soil cover on physical barrier	Cubic yd	2,150	19.25	$ 41,387.50
17	Install drainage run-on/run-off drainage controls at containment cell	Linear ft	800	23	$ 18,400.00
18	Purchase and plant seed on soil cover	acre	0.666	5500	$ 3,661.62
19	Purchase install gate	Each	1	1904	$ 1,904.00
				Total	**$ 152,128.57**

Cost Estimate - Removal Action Alternative 3A
Matterhorn Mill Site (San Miguel County, Colorado)

Item	Description of Work	Units	Quantity	Unit Price	Total
1	Mobilization/demobilization	LS	1	6500	$ 6,500.00
2	Permits and Plans (Site Safety and Health Plan, Stormwater Mgmt Plan, etc.)	LS	1	7200	$ 7,200.00
3	Temporary institutional controls to restrict access to work areas during implementation of alternative	LS	1	2500	$ 2,500.00
4	Permanent institutional controls to secure the mill building and prevent unauthorized access to the inside of the structure.	LS	1	1500	$ 1,500.00
5	Improved access road leading from mill bench to the tailings areas	Linear ft	1000	10	$ 10,000.00
6	Construct access road from tailings area to repository site	Linear ft	400	10	$ 4,000.00
7	Clear and grub repository site	acre	0.666	1000	$ 665.75
8	Excavate disposal cell to bedrock (assumes volume same as the volume of tailings in tailings pond)	Cubic yd	9,360	12	$ 112,320.00
9	Install safety controls as necessary to ensure worker safety inside the mill building	LS	1	5000	$ 5,000.00
10	Remove mill wastes from inside the mill building and place and compact in disposal cell	Cubic yd	150	6	$ 900.00
11	Stabilize mill structure as necessary to avoid impacts during removal of tailings around the exterior of the mill building	LS	1	5000	$ 5,000.00
12	Remove tailings from around the exterior of the mill building and place and compact in disposal cell	Cubic yd	250	4	$ 1,000.00
13	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
14	Excavate tailings at tailings pond and place and compact in disposal cell	Cubic yd	9,360	10	$ 93,600.00
15	Excavate tailings at settling pond and place on tailings pond	Cubic yd	660	10	$ 6,600.00
16	Excavate soil comprising soil berm and place on tailings pond	Cubic yd	240	10	$ 2,400.00
17	Confirmation sampling at tailings pond, settling pond and soil berm following excavation	Sample	25	500	$ 12,500.00

Cost Estimate - Removal Action Alternative 3A
Matterhorn Mill Site (San Miguel County, Colorado)

18	Deliver and place clean fill in tailings pond, settling pond/soil berm excavations and grade to match natural topography	Cubic yd	11286	19.25	$ 217,255.50
19	Purchase and plant seed on reclaimed surface at settling pond/soil berm	acre	0.918	5500	$ 5,050.51
20	Purchase and Install physical barrier (nonwoven geotextile) on reshaped disposal cell	Square yd	3,222	3.23	$ 10,407.78
21	Deliver and place 2-ft thick soil cover on physical barrier	Cubic yd	2,150	19.25	$ 41,387.50
22	Install drainage run-on/run-off drainage controls at containment cell	Linear ft	800	23	$ 18,400.00
23	Purchase and plant seed on soil cover	acre	0.666	5500	$ 3,661.62
24	Purchase install gate	Each	1	1904	$ 1,904.00
				Total	**$ 574,752.65**

Cost Estimate - Removal Action Alternative 3B
Matterhorn Mill Site (San Miguel County, Colorado)

Item	Description of Work	Units	Quantity	Unit Price	Total
1	Mobilization/demobilization	LS	1	6500	$ 6,500.00
2	Permits and Plans (Site Safety and Health Plan, Stormwater Mgmt Plan, etc.)	LS	1	7200	$ 7,200.00
3	Temporary institutional controls to restrict access to work areas during implementation of alternative	LS	1	2500	$ 2,500.00
4	Permanent institutional controls to secure the mill building and prevent unauthorized access to the inside of the structure.	LS	1	1500	$ 1,500.00
5	Improved access road leading from mill bench to the tailings areas	Linear ft	1000	10	$ 10,000.00
6	Construct access road from tailings area to repository site	Linear ft	400	10	$ 4,000.00
7	Clear and grub repository site	acre	0.666	1000	$ 665.75
8	Excavate disposal cell to bedrock (assumes volume same as the volume of tailings in tailings pond)	Cubic yd	9,360	12	$ 112,320.00
9	Stabilize mill structure as necessary to avoid impacts during removal of tailings around the exterior of the mill building	LS	1	5000	$ 5,000.00
10	Remove tailings from around the exterior of the mill building and place and compact in disposal cell	Cubic yd	250	4	$ 1,000.00
11	Confirmation sampling at settling pond and soil berm following excavation	Sample	10	500	$ 5,000.00
12	Excavate tailings at tailings pond and place and compact in disposal cell	Cubic yd	9,360	10	$ 93,600.00
13	Excavate tailings at settling pond and place on tailings pond	Cubic yd	660	10	$ 6,600.00
14	Excavate soil comprising soil berm and place on tailings pond	Cubic yd	240	10	$ 2,400.00
15	Confirmation sampling at tailings pond, settling pond and soil berm following excavation	Sample	25	500	$ 12,500.00
16	Deliver and place clean fill in tailings pond, settling pond/soil berm excavations and grade to match natural topography	Cubic yd	11286	19.25	$ 217,255.50
17	Purchase and plant seed on reclaimed surface at settling pond/soil berm	acre	0.918	5500	$ 5,050.51

Cost Estimate - Removal Action Alternative 3B
Matterhorn Mill Site (San Miguel County, Colorado)

18	Purchase and Install physical barrier (nonwoven geotextile) on reshaped disposal cell	Square yd	3,222	3.23	$ 10,407.78
19	Deliver and place 2-ft thick soil cover on physical barrier	Cubic yd	2,150	19.25	$ 41,387.50
20	Install drainage run-on/run-off drainage controls at containment cell	Linear ft	800	23	$ 18,400.00
21	Purchase and plant seed on soil cover	acre	0.666	5500	$ 3,661.62
22	Purchase install gate	Each	1	1904	$ 1,904.00
				Total	**$ 568,852.65**