USACE Contract No. W912DQ-15-D-3013
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Final
Focused Feasibility Study Report

U.S. Army Corps of Engineers
Omaha District

Interim Remedial Actions
Bonita Peak Mining District Superfund Site
San Juan County, Colorado

May 2018

CDM Smith

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Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMI	benthic macroinvertebrate
BMP	best management practice
BPMD	Bonita Peak Mining District
CCR	Colorado Code of Regulations
CDM Smith	CDM Federal Programs Corporation
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COPC	chemical of potential concern
CDPS	Colorado Discharge Permit System
CRS	Colorado Revised Statutes
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFRRO	Federal Facilities Restoration and Reuse Office
FFS	focused feasibility study
FR	Federal Remediation Technologies Roundtable
FS	feasibility study
GRA	general response action
HQ	hazard quotient
HRS	Hazard Ranking System
IC	institutional control
IRA	interim remedial action
IROD	interim record of decision
Ma	million years ago
MIW	mining-influenced water
MLRB	Colorado Mined Land Reclamation Board
µg/dL	micrograms per deciliter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NPS	National Park Service
O&M	operation and maintenance
PPE	personal protective equipment
PRAO	preliminary remedial action objective
PRG	preliminary remediation goal
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation

RI/FS	remedial investigation/feasibility study
Site	BPMD Superfund Site
TBC	to-be-considered information
TechLaw	TechLaw, Inc.
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
°F	degrees Fahrenheit

Executive Summary

Introduction

This focused feasibility study (FFS) report for the Bonita Peak Mining District (BPMD) Superfund Site (Site) was prepared by CDM Federal Programs Corporation (CDM Smith) for the U.S. Army Corps of Engineers (USACE) Omaha District on behalf of the U.S. Environmental Protection Agency (EPA) Region 8. This FFS was prepared as part of Task Order No. DK04 under USACE Contract No. W912DQ-15-D-3013 and was developed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300.430(e)) and EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). In addition, the cost estimates for each remedial alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000).

The Hazard Ranking System (HRS) documentation record for the Site (EPA 2016a) indicated there are 48 mining-related sources where ongoing characterization and risk evaluation is needed to determine whether and what actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may be appropriate. The Site-wide remedial investigation (RI) and risk assessments are ongoing and will provide information to guide Site-wide objectives. EPA is taking an adaptive management approach to the Site, and data and observations from the initial characterization identified 26 mining-related sources (including two dispersed campsites) with contaminant migration issues that could be initially addressed through interim remedial actions (IRAs) while the Site-wide RI is ongoing.

This FFS report presents the results of the development and detailed evaluation of remedial alternatives to address specific contaminant migration issues at the mining-related sources identified in the initial characterization and could be addressed by an IRA.

Remedial Approach for IRAs in this FFS

EPA has adopted an adaptive management strategy for the Site. EPA follows two parallel process pathways using this adaptive management strategy:

- continue the Site-wide RI
- evaluate, select, and conduct IRAs

EPA is investigating the source, nature, and extent of contamination posing unacceptable risks to human health and the environment across the Site during the RI as part of the first adaptive management pathway. EPA is currently collecting data to support evaluation of contributors of sources for contaminant loading of receiving waterways and identifying areas where additional data is required to evaluate the Site. The second adaptive management pathway (i.e., evaluate, select, and conduct IRAs) is the subject of this FFS. The actions evaluated in this FFS are intended to address identified source areas to reduce risk contaminant migration and have secondary benefit of reducing variability during the ongoing RI. The IRAs would result in valuable "lessons learned" for future feasibility studies addressing the larger and more complex loading sources at mining-related sources later.

EPA has elected to prepare this FFS to evaluate a limited number of remedial alternatives for specific contaminant migration issues. Because the contemplated alternatives are limited in scope, the remedial technology/process option screening and alternative screening steps suggested for a comprehensive FS are not needed. Information supporting this FFS include a preliminary RI memorandum and human health/ecological risk information memoranda completed concurrently with this FFS, which are included as Appendices A and B, respectively. This supporting information was used to characterize conditions with respect to mining-related sources with identified contaminant migration issues, determine the nature of contamination at the mining-related sources related to these migration issues, and summarize unacceptable risks to human health and the aquatic ecological receptors posed by the migration of the contaminated media at these mining-related sources, to the degree they have been identified.

After the FFS is completed, EPA will issue a proposed plan that summarizes the FFS and other supporting documents for the IRAs and describe EPA's preferred remedy to mitigate unacceptable human health and ecological risks posed by the specific contaminant migration issues from mining-related sources discussed in the FFS. The public comment period is designed to allow the public adequate opportunity to provide formal input to EPA before a final decision is made.

EPA will then make its final cleanup decisions for the IRAs and publish those decisions in an interim record of decision (IROD) for the IRAs. The IROD documents the selected remedy and provides a general path forward for the identified IRAs. However, implementation of the IRAs will include design and review of IROD requirements specific to each mining-related source prior to construction and coordinating with appropriate agencies depending on the land status at each mining-related source.

Site Location and Description

The Site is centered in southwestern Colorado in San Juan County. The Site listing identifies 48 mining-related sources. Within the Site, there are three main drainages (Mineral Creek, Cement Creek, and Upper Animas River), which flow into the Animas River at Silverton, Colorado. The 48 mining-related sources were identified as sources or potential sources for contaminated media affecting the three main drainages (EPA 2016d).

The three main drainages within San Juan County contain over 400 abandoned or inactive mines, where large- to small-scale mining operations occurred (EPA 2016d). The focus of this FFS is solely the evaluation of remedial alternatives related to contaminant migration issues at the mining-related sources identified in the initial characterization that could be addressed by IRAs.

This FFS uses two primary characteristics, definable by location, to group mining-related sources for identification and evaluation: road accessibility and ecoregions (as they relate to elevation). Road accessibility and ecoregions were chosen because they have significant impacts on the detailed evaluation of remedial alternatives in this FFS.

Source and Nature of Contamination

Contaminated media evaluated in this FFS include solid media (i.e., mine waste, contaminated sediment, and contaminated soil) and aqueous media (i.e., mining-influenced water [MIW] and surface water). Adverse impacts are associated with contamination migration, which results from the transformation of solid phase contaminants, specifically metals and metalloids, into forms that are easily transported through the environment, such as by wind or water.

IRAs are contemplated at the Site to remediate five specific contaminant migration issues in accordance with the remedial strategy. These issues include:

- mine portal MIW discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes
- mining-impacted recreation staging areas

Mine Portal MIW Discharges

This contaminant migration issue occurs at mining-related sources where MIW is discharged from a mine portal or opening that is partially obstructed by environmental media or debris that was not specifically placed or installed previously, such as a bulkhead or other impervious migration barrier. This issue also occurs where there is a clear interaction between discharged mine portal MIW and mine wastes that exceed ecological risk-based screening levels, as discussed in Appendix A.

These interactions are a contaminant migration issue because the discharge onto adjacent mine wastes could increase the potential for erosion or mass wasting of chemicals of potential concern (COPCs) in particulate form and/or cause leaching of COPCs from the mine wastes. Obstructions to MIW discharges from mine portals also have the potential to impound MIW, sediments, and precipitates within unstable mine workings that could then be released in an uncontrolled manner to surface water.

Mining-Related Source/Stormwater Interactions

This contaminant migration issue occurs at mining-related sources where upgradient stormwater generated from falling or stored precipitation (e.g., snowmelt) interacts with mine waste that exceeds ecological risk-based screening levels or interacts with (enters) a mine portal.

These interactions are a contaminant migration issue because co-mingling of stormwater and mining-related sources transport COPCs to surface water either from generation of additional MIW and/or erosion and transport of COPCs in particulate form.

Mine Portal Pond Sediments

This contaminant migration issue occurs at mining-related sources where sediments that exceed ecological risk-based screening levels have been deposited within the horizontal extent of mine portal ponds.

These interactions are a contaminant migration issue because mine portal ponds with significant sediment accumulation have reduced operational capacity (e.g., storage space), which affects MIW detention time for settling of sediments and precipitates. Reduced capacities in the mine portal ponds also increase the likelihood for "short circuiting", where MIW bypasses the pond or passes to the next pond in the series without sufficient retention time. The accumulated sediments in ponds also have the potential for uncontrolled release of COPCs (both in particulate form and MIW) to surface water during storm events.

In-Stream Mine Wastes

This contaminant migration issue occurs at mining-related sources where mine wastes entirely within a stream or comprising both banks of a channel exceed ecological risk-based screening levels.

These interactions are a contaminant migration issue because the mine waste impedes stream flow and releases COPCs to surface water either from generating additional MIW and/or eroding and transporting COPCs in particulate form.

Mining-Impacted Recreation Staging Areas

This contaminant migration issue occurs at mining-related sources used for camping related to staging for recreational uses (e.g., established campgrounds or dispersed campsites) within 1,000 feet of U.S. Highway 550 (Mineral Creek), San Juan County Road 110 (Cement Creek), and San Juan County Road 2 (Upper Animas River) and adjacent to a pond or stream. A dispersed campsite is an area that is suitable for camping or where camping is known to occur but may not be a formal campground. These mining-related sources have mine waste or contaminated soil that exceed applicable human health risk-based levels for arsenic or lead presented in Appendix B, Part 1.

These interactions are a contaminant migration issue because recreation staging uses that are sedentary, such as camping, result in repeated surface disturbances that could result in potential exposures of recreational human receptors to arsenic or lead.

Mining-Related Sources

Mineral Creek Drainage Basin

The Mineral Creek drainage includes seven mining-related sources, five of which are being evaluated in this FFS for IRAs. A summary of the mining-related sources by category and contaminant migration issues is presented in Exhibit ES-1.

Exhibit ES-1 Category and Contaminant Migration Issues of Mining-Related Sources within Mineral Creek Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Longfellow Mine	CAS					X
Junction Mine	CAS	X		X		X
Koehler Tunnel	CAS	X		X		X
Brooklyn Mine	NAS	X	X	X		
Bandora Mine	NAS	X	X			

MIW: mining-influenced water

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS – nonconventional access-subalpine

Cement Creek Drainage Basin

The Cement Creek drainage basin includes 14 mining-related sources, six of which are being evaluated in this FFS for IRAs. A summary of the mining-related sources by category and contaminant migration issues identified is presented in Exhibit ES-2.

Exhibit ES-2 Category and Contaminant Migration Issues of Mining-Related Sources within Cement Creek Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Grand Mogul Mine	NAA		X		X	
Natalie/Occidental Mine	NAS	X				
Henrietta Mine	NAS	X				
Mammoth Tunnel	CAS	X		X		
Anglo Saxon Mine	CAS	X		X		
Yukon Tunnel	CAS	X	X			

MIW: mining-influenced water

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS – nonconventional access-subalpine

Upper Animas River Drainage Basin

The Upper Animas River drainage basin includes 27 mining-related sources, 13 of which are being evaluated in this FFS for IRAs. The two dispersed campsites (identified as Campground 4 and Campground 7) evaluated in this FFS are also located within the Upper Animas River drainage basin and are also considered mining-related sources. A summary of the mining-related sources by category and contaminant migration issues identified is presented in Exhibit ES-3.

Exhibit ES-3 Category and Contaminant Migration Issues of Mining-Related Sources within Upper Animas River Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Boston Mine	NAA				X	
London Mine	NAA	X				
Ben Butler Mine	NAA		X			
Mountain Queen Mine	NAA	X	X			
Vermillion Mine	NAA	X	X			
Sunbank Group Mine	NAA	X	X	X		
Frisco/Bagley Tunnel	NAS	X		X		
Columbus Mine	NAS	X	X			
Campground 7	NAS					X
Silver Wing Mine	NAS	X	X	X		
Tom Moore Mine	NAS	X				
Ben Franklin Mine	NAA	X	X			
Terry Tunnel	NAA	X				
Pride of the West	NAS	X				
Campground 4	CAS					X

MIW: mining-influenced water

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS – nonconventional access-subalpine

Human Health and Ecological Risks

Potential human receptors as identified in Appendix B, Part 1 consist of campers (children). Potential ecological receptors as identified in Appendix B, Part 2 consist of aquatic receptors (primarily fish and benthic macroinvertebrate [BMI] communities).

Human exposure pathways for which interim risks were quantitatively evaluated in Appendix B, Part 1 focused on the incidental ingestion and inhalation of soil and mine waste during camping. Note that potential risks to recreational and occupational receptor populations from all exposure media and pathways will be evaluated in the final Site human health risk assessment.

Ecological exposure pathways for which risks were quantitatively evaluated in Appendix B, Part 2 included ingestion and direct contact of aquatic receptors with surface water.

Human Health Risk Information

Appendix B, Part 1 presents the derivation and application of risk-based thresholds for human health for lead and arsenic in soil/waste rock based on a camping scenario within the mining districts. Lead and arsenic were selected for evaluation as COPCs for the IRAs because concentrations are notably elevated at several locations within the mining districts. The camping scenario was selected for the human health evaluations because the camper is anticipated to be the most sedentary of receptors (i.e., not moving about being exposed to a variety of soil/mine waste sources, in contrast with hiker, hunter, fisherman, all-terrain vehicle rider/guide, and road worker receptors), which allows an evaluation of smaller exposure areas such as individual campgrounds. The risk-based levels for lead and arsenic are exceeded by samples at the mining-related sources where recreational receptors are anticipated to access the Site (Appendix B, Part 1). Based on these findings, a possibility exists that adverse health effects may occur from exposures to lead and arsenic in the contaminated soils and waste rock.

Ecological Risk Information

The ecological risk evaluation focuses on aquatic ecological risk, primarily risks to fish. It has been noted that BMI communities in most reaches are also currently at risk; many of the factors limiting BMI communities are similar to those limiting fish communities.

While aquatic life is unlikely to be directly exposed to mine-related surface water drainages (i.e., mine portal discharges) prior to entering the receiving stream, they can significantly increase in-stream metals concentrations, subsequently contributing to risks to fish. Hazard quotients (HQs) were computed by comparing surface water concentrations with Colorado's hardness-based chronic aquatic life water quality criteria (concentration/criteria). There are few locations where maximum individual metal HQ values are less than one (COPCs evaluated include aluminum, cadmium, copper, and zinc), with many locations in both adit drainages and downstream surface waters demonstrating HQs greater than 100. Thus, HQ values are far elevated above water quality criteria at many locations. The health of aquatic ecosystems within the Animas River and its tributaries are currently limited by high concentrations of toxic metals emanating from a wide range of mining-related and natural sources distributed throughout the greater Animas River watershed such that aquatic life is precluded in some locations. In other locations within the Site, metals-tolerant organisms (e.g., brook trout) are currently able to persist.

Applicable or Relevant and Appropriate Requirements

Identification and evaluation of applicable or relevant and appropriate requirements (ARARs) are integral components of the feasibility study (FS) process to determine whether remedial alternatives can protect human health and the environment. There are three primary types of ARARs: chemical-, location-, and action-specific. An ARAR can be classified in one or a combination of all three types of ARAR categories.

Chemical-specific requirements address chemical or physical characteristics of compounds or substances on sites. These values establish acceptable amounts or concentrations of contaminants that may be found in, or discharged to, the ambient environment.

Location-specific requirements are restrictions placed on the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographical or physical positions of sites rather than the nature of contaminants at sites.

Action-specific requirements are usually technology-based or activity-based requirements or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants. A given cleanup activity will trigger an action-specific requirement. Such requirements do not themselves determine the cleanup alternative but define how chosen cleanup methods should be performed.

Appendix C lists potential ARARs with brief descriptions for evaluating remedial alternatives in this FFS. The ARARs are organized according to whether they are potential federal or State of Colorado ARARs. The ARARs or group of related ARARs included in Appendix C are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR and how/to what extent the ARAR is expected to be pertinent to potential activities to be conducted as part of remedial alternatives. The tables in Appendix C also identify whether the ARAR is chemical-, location-, and/or action-specific. Final ARARs will be determined in the IROD.

Preliminary Remedial Action Objectives

Preliminary remedial action objectives (PRAOs) are typically developed by evaluating several sources of information including results of the risk assessments and ARARs/to-be-considered information (TBC). These inputs are the basis for determining whether adequate protection of human health and the environment is achieved for a remedial alternative.

The scope of the PRAOs in this FFS is intended to address human health or ecological risks only for the five contaminant migration issues identified in this FFS. The PRAOs are not intended to address all potential human health and/or ecological risks because the information (i.e., RI and human health/ecological risk information) supporting the FFS is preliminary and the actions to be taken are interim. The final remedial decisions for these mining-related sources will address all known unacceptable human health and ecological risks.

The following PRAO was identified for the IRAs to address known ecological risks:

1. Reduce transport from mine waste, contaminated soil, and contaminated sediment into surface water of COPCs that contribute to unacceptable ecological risks.

The following PRAOs were identified for the IRA to address known human health risks:

2. Reduce human exposure through ingestion and inhalation to mine waste and contaminated soils containing lead that results in greater than a 5 percent chance of exceeding a blood lead level of 5 micrograms per deciliter (μg/dL) during camping activities.

3. Reduce human exposure through ingestion to mine waste and contaminated soils containing arsenic that exceeds risk-based levels for acute exposures during camping activities.

PRAO 1 applies to the following contaminant migration issues, which address known aquatic ecological risks:

- mine portal MIW discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes

PRAOs 2 and 3 apply to the following contaminant migration issue, which addresses known human health risks:

- mining-impacted recreation staging areas

At the conclusion of these IRAs, EPA will measure the extent by which ecological and human health risks associated with contributions from these mining-related sources have been reduced by the actions. These data will provide information about the effectiveness of the IRAs and are intended to help inform future remedial decisions at the Site.

Preliminary Remediation Goals

PRGs are concentration-based goals for individual chemicals for specific medium and land use combinations at CERCLA sites (EPA 1991b). PRGs are typically presented as chemical- and media-specific values that when met achieve the PRAOs. PRGs are discussed in the NCP (40 CFR 300.430(e)(2)(i)). Identification and selection of the PRGs are typically based on PRAOs, the current and reasonably anticipated future land uses, and the potential ARARs.

PRGs typically are used as a preliminary value in the FFS to guide evaluations of remedial alternatives. These PRGs are initial guidelines; they do not set remediation levels nor do they establish a requirement for removal of contamination to meet these risk-based PRGs. Final remediation (cleanup) levels will be selected by EPA in the IROD following review and evaluation of Site data and information including Site risks, anticipated effectiveness of potential cleanup alternatives, and other remedy selection criteria such as public and state preferences.

Human Health PRGs

Human health PRGs for lead and arsenic in mine wastes and contaminated soil at recreational staging areas are presented in Appendix B, Part 1. Achievement of the PRGs through implementation of remedial alternatives would result in acceptable risks to human health from camping.

However, use of the PRGs to determine the extent of remediation at mining-impacted recreation use areas is not appropriate because the camping exposure scenario does not encompass the entirety of the mining-related sources evaluated for this contaminant migration issue in the FFS. Rather than use PRGs to delineate the extent of remediation for mining-impacted recreation use areas, physical information such as but not limited to topography and soil types (i.e. relatively flat areas free of large boulders and cobbles) would be used to define the relevant exposure area for camping and thus the horizontal extent of remediation. Once the extent of remediation encompasses the horizontal extent of exposure areas for camping, the PRGs would then be used to determine the resulting conditions in mine waste and soil meet the PRAOs for human health risk from lead and arsenic.

Ecological Remedial Clearance Criteria

The ecological PRAO includes reducing COPCs that contribute to unacceptable ecological risks from contaminated media being addressed under the scope of the IRAs. While it is possible to derive media-based PRGs for the contaminants addressed as part of the IRAs, the derivation is complicated by the preliminary nature of the RI and risk assessment information that focus on specific COPCs and specific receptors and exposure pathways rather than a comprehensive list of contaminants, pathways, and receptors. The ecological PRAO is focused on source migration control that would contribute to, but not necessarily result in, acceptable risks for ecological receptors. For these reasons, media-based PRGs have not been established for the IRAs addressing unacceptable ecological risks. In lieu of PRGs, the IRAs are anticipated to be guided based on remedial clearance criteria.

Remedial clearance criteria define the conditions that must be met for the remedial components or approaches to be deemed complete for purposes of the IRAs. Because the focus of remedial alternatives addressing unacceptable ecological risks is source isolation and contaminant migration control, there are not chemical-based criteria directly applied to contaminated source media (e.g. mine wastes and mine portal pond sediment) to determine completion. Rather, clearance criteria for each IRA will be established for MIW and/or surface water to determine through performance evaluation monitoring that contributions of COPCs migrating from these contaminated source media have been reduced, thus meeting the PRAO.

Identification and Screening of General Response Actions, Remedial Technologies, and Process Options

General response actions (GRAs) are broad, medium-specific remedial approaches used to satisfy the PRAOs for the IRAs. The list of GRAs considered for remediation are aligned with the relatively simple scope of the contaminant migration issues addressed by the IRAs and include:

- no action (required by the NCP)
- institutional controls (ICs)
- containment
- removal, transport, disposal

The remedial technologies and process options presented in Exhibit ES-4 have substantial potential and applicability as standalone remedies, or have remedial benefits if combined with other remedial technologies, to achieve the PRAOs in this FFS. Although other remedial technologies and process options within the identified GRAs (e.g., offsite disposal) could also be successful and were considered, they were ultimately not identified for the relatively simple scope of contaminant migration issues identified in this FFS. These process options are assembled into remedial alternatives to address the five contaminant migration issues.

Exhibit ES-4 Identified Remedial Technologies and Process Options for the Development of Remedial Alternatives

General Response Action	Remedial Technology	Process Option	Description of Option
No Action	None	None	No action would be taken. The contaminated media remain in their existing condition.
ICs	Non-Engineered Controls	Governmental controls, proprietary controls, enforcement tools with IC components, and/or informational devices	ICs would be implemented as needed to maintain integrity of the proposed remedies.

Exhibit ES-4 (continued)

General Response Action	Remedial Technology	Process Option	Description of Option
Containment	Surface Source Controls	Grading	Contaminated solid media would be contoured to promote drainage and facilitate other technologies and process options.
Containment	Surface Source Controls	Soil/rock exposure barrier	Contaminated solid media would be covered with a layer of uncontaminated soil or rock with sufficient thickness to reduce erosion and eliminate surface exposure of contaminated media.
	Hydraulic Isolation, Diversion, and Separation Measures	French drain and/or interception trench	Interceptor trenches or French drains would be constructed to collect and route mine portal MIW discharge and/or stormwater migrating as surface flow or interflow around contaminated solid media to prevent co-mingling of uncontaminated and contaminated solid/aqueous media.
		Open channel	Open channels would be constructed to collect and route mine portal MIW discharge and/or stormwater around contaminated solid media to prevent co-mingling of uncontaminated and contaminated solid/aqueous media.
		Collection/diversion piping or liner	Collection/diversion piping or liner would be used to divert mine portal MIW discharge and/or stormwater around contaminated solid media.
		Berms	Berms would be constructed around contaminated solid media to prevent co-mingling of solid and aqueous media and minimize erosion and transport.
Removal, Transport, and Disposal	Removal	Mechanical removal (excavation)	Contaminated media would be excavated using mechanical methods. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
		Pneumatic removal (vacuum excavation)	Contaminated media would be excavated using vacuum hoses, vacuum trucks, or other pneumatic conveyance systems. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
	Transport	Mechanical transport (hauling/conveying)	Excavated contaminated media would be transported by truck or other mechanical conveyance method to a disposal/management location. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
		Pneumatic transport (vacuum extraction)	Excavated contaminated media would be piped using a vacuum system to a disposal/management location. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
	Disposal	Interim local waste management	Excavated contaminated media would be temporarily managed locally until permanent disposal solutions are selected.

Development of Alternatives

Remedial alternatives were assembled by combining the remedial technologies and process options to address the five contaminant migration issues as follows:

A. Remedial alternatives for mine portal MIW discharges:

- Alternative A1: No Action

- Alternative A2: Diversion/Isolation

B. Remedial alternatives for mining-related source/stormwater interactions:

- Alternative B1: No Action
- Alternative B2: Stormwater Diversion/Isolation

C. Remedial alternatives for mine portal pond sediments:

- Alternative C1: No Action
- Alternative C2: Excavation and Interim Local Waste Management

D. Remedial alternatives for in-stream mine wastes:

- Alternative D1: No Action
- Alternative D2: Excavation and Interim Local Waste Management

E. Remedial alternatives for mining-impacted recreation staging areas:

- Alternative E1: No Action
- Alternative E2: Containment/Isolation

Detailed Analysis of Alternatives

During detailed analysis, each alternative is assessed using the two threshold criteria, five balancing criteria, and two modifying criteria, referred to herein as "NCP evaluation criteria". The nine NCP alternative evaluation criteria are categorized into three groups during detailed evaluation of the remedial alternatives as detailed in Exhibit ES-5.

Exhibit ES-5 Criteria Priorities

Group	Criteria	Definition
Threshold criteria	▪ Overall protection of human health and the environment ▪ Compliance with ARARs	Must be satisfied for remedial alternative to be selected
Balancing criteria	▪ Long-term effectiveness and permanence ▪ Reduction of toxicity, mobility, or volume through treatment ▪ Short-term effectiveness ▪ Implementability ▪ Cost	Technical criteria evaluated among those alternatives satisfying the threshold criteria
Modifying criteria	▪ State acceptance ▪ Community acceptance	Not evaluated in this FFS; will be evaluated after comments are received on the FFS and proposed plan

Analysis of each alternative against the threshold and balancing criteria is completed, and the results of the detailed analysis for each remedial alternative are then arrayed to perform a comparative analysis of the alternatives and identify the key tradeoffs between them. The two modifying criteria, which are also NCP evaluation criteria, are not analyzed for remedial alternatives in this FFS due to the rationale provided in Exhibit ES-5.

Comparative Analysis

Each remedial alterative that underwent detailed analysis was then compared to each other using the two threshold and five balancing evaluation criteria. The results of the individual detailed analysis for each remedial alternative are presented in Exhibit ES-6; presentation of this information aids in understanding a comparative analysis of the alternatives and identifying the key tradeoffs between them.

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Exhibit ES-6 Summary of Comparative Analysis of Alternatives

Remedial Alternative	Threshold Criteria		Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)[1]
Mine Portal MIW Discharges Alternatives							
Alternative A1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative A2 – Diversion/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate	None	Moderate	Moderate	$2,411,000
Mining-Related Source/Stormwater Interactions Alternatives							
Alternative B1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative B2 – Stormwater Diversion/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate to High	Moderate to High	$1,889,000
Mine Portal Pond Sediments Alternatives							
Alternative C1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative C2 – Excavation and Interim Local Waste Management	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate	None	Moderate to High	Moderate	$3,384,000
In-Stream Mine Wastes Alternatives							
Alternative D1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative D2 – Excavation and Interim Local Waste Management	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate to High	Moderate	$624,000
Mining-Impacted Recreation Staging Areas Alternatives							
Alternative E1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative E2 – Containment/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate	Moderate	$1,668,000

Notes:
1. Present value costs and quantitative ratings are subject to change. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.
2. Alternatives A1, B1, C1, D1, and E1 represent the No Action alternatives required by the NCP.

Legend for Qualitative Ratings System:

Threshold Criteria (Overall Protection of Human Health and the Environment)	Threshold Criteria (Compliance with ARARs)	Balancing Criteria (Excluding Cost)
Not Adequate	None	None
Adequate	Will comply	Low
	Will comply, but may require CERCLA ARAR waiver(s)	Low to Moderate
		Moderate
		Moderate to High
		High

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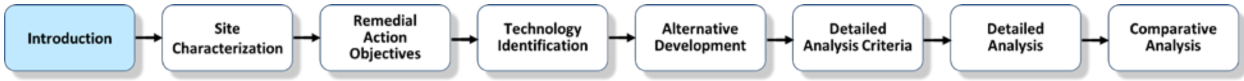

Section 1

Introduction

1.1 Purpose

This focused feasibility study (FFS) report for the Bonita Peak Mining District (BPMD) Superfund Site (Site) was prepared by CDM Federal Programs Corporation (CDM Smith) for the U.S. Army Corps of Engineers (USACE) Omaha District on behalf of the U.S. Environmental Protection Agency (EPA) Region 8. This FFS was prepared as part of Task Order No. DK04 under USACE Contract No. W912DQ-15-D-3013 and was developed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300.430(e)) and EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). In addition, the cost estimates for each remedial alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000).

The Hazard Ranking System (HRS) documentation record for the Site (EPA 2016a) indicated there are 48 mining-related sources where ongoing characterization and risk evaluation is needed to determine whether and what actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may be appropriate. The Site-wide remedial investigation (RI) and risk assessments are ongoing and will provide information to guide Site-wide objectives. EPA is taking an adaptive management approach to the Site, and data and observations from the initial characterization identified 26 mining-related sources (including two dispersed campsites) with contaminant migration issues that could be initially addressed through interim remedial actions (IRAs) while the Site-wide RI is ongoing.

This FFS report presents the results of the development and detailed evaluation of remedial alternatives to address specific contaminant migration issues at the mining-related sources identified in the initial characterization and could be addressed by IRAs. As discussed further in Section 2.2, these specific contaminant migration issues include:

- mine portal mining-influenced water (MIW) discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes
- mining-impacted recreation staging areas

1.2 Remedial Approach for IRAs in this FFS

The following subsection describes the adaptive management strategy and the relationship of that strategy to the IRAs for the specific contaminant migration issues identified in Section 1.1 that are evaluated within this FFS. In addition, this subsection describes how the list of mining-related sources were selected for this FFS.

1.2.1 Development of Adaptive Management Strategy for the Site

While ongoing characterization is needed for the Site-wide RI, a review of initial data has identified multiple types of contaminant migration issues that could benefit from IRAs.

EPA has adopted an adaptive management strategy for the Site. EPA is presently following two parallel process pathways using this adaptive management strategy:

- continue the Site-wide RI
- evaluate, select, and conduct IRAs

EPA is investigating the source, nature, and extent of contamination posing unacceptable risks to human health and the environment across the Site during the RI as part of the first adaptive management pathway. EPA is currently collecting data to support evaluation of contributors of sources for contaminant loading of receiving waterways and identifying areas where additional data is required to evaluate the Site.

The second adaptive management pathway (i.e., evaluate, select, and conduct IRAs) is the subject of this FFS and is further described in the following subsections.

1.2.2 Rationale for IRAs at the Site

Interim actions are defined in *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA 1999) as those that are limited in scope and address contaminated areas or media that will also be addressed by a final remedial action. Reasons for taking interim actions include the need to:

- Take quick action to protect human health and the environment from an imminent threat in the short term, while a final remedial solution is being developed; or
- Institute temporary measures to stabilize a site and/or prevent further migration of contaminants or further environmental degradation.

Under the adaptive management strategy for the Site, IRAs are being evaluated in this FFS to target specific contaminant migration issues from mining-related sources (including campgrounds) for interim remediation. The final remedial decisions for these mining-related sources will be made in a final record of decision.

EPA completed an initial characterization of mining-related sources where IRAs might be beneficial based on technical work and data already collected. This initial characterization identified 26 mining-related sources (including two dispersed campsites) where IRAs may be appropriate to reduce contributions from these mining-related sources that add to unacceptable human health and ecological risks in the Animas River watershed at the Site in advance of comprehensive remedial action. The actions evaluated in this FFS are intended to address identified mining-related sources to reduce risk contaminant migration and have secondary benefit of reducing variability during the ongoing RI. The IRAs would result in valuable "lessons learned" for future feasibility studies addressing the larger and more complex loading sources at mining-related sources later.

1.2.3 Preliminary Documentation Supporting IRAs

IRAs are not specifically discussed in EPA's guidance for conducting RIs and feasibility studies (FSs) under CERCLA (EPA 1988). However, two other EPA guidance documents do address IRAs and the documents needed to support them. These include *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA 1999) and *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (EPA 1991a).

EPA guidance on the NCP indicates that interim actions do not require completed baseline risk assessments nor completed RI reports but must have sufficient documentation to support the rationale for IRAs to fulfill the NCP's Administrative Record requirements. These guidance documents indicate that data sufficient to support IRA decisions in an interim record of decision (IROD) can be extracted from an ongoing Site-wide RI and evaluated in an FFS that includes a short analysis of a limited number of alternatives.

EPA has elected to prepare this FFS to evaluate a limited number of remedial alternatives for specific contaminant migration issues. Because the contemplated alternatives are limited in scope, the remedial technology/process option screening and alternative screening steps suggested for a comprehensive FS are not needed. Information supporting this FFS include a preliminary RI memorandum and human health/ecological risk information memoranda completed concurrently with this FFS, which are included as Appendices A and B, respectively. This supporting information was used to characterize conditions with respect to mining-related sources with identified contaminant migration issues, determine the nature of contamination at the mining-related sources related to these migration issues, and summarize unacceptable risks to human health and aquatic ecological receptors posed by the migration of the contaminated media at these mining-related sources, to the degree they have been identified.

1.3 Remedial Steps Following the FFS

After the FFS is completed, EPA will issue a proposed plan that summarizes the FFS and other supporting documents (discussed in Section 1.2.3) for the IRAs and describe EPA's preferred remedy to mitigate unacceptable human health and ecological risks posed by the specific contaminant migration issues from mining-related sources discussed in the FFS. When the proposed plan is issued, there will be a public comment period of at least 30 days during which EPA will hold a public meeting to introduce the EPA's preferred remedy and allow the public to comment on the proposed plan and the supporting documents such as the FFS. Public comments may also be provided to EPA in writing via mail or email. This process is designed to allow the public adequate opportunity to provide formal input to EPA before a final decision is made. EPA will consider all public comments. These comments and EPA's associated responses will be compiled into a responsiveness summary.

EPA will then make its final cleanup decisions for the IRAs and publish those decisions in an IROD for the IRAs. The responsiveness summary will be an attachment to the IROD. The IROD documents the selected remedy and provides a general path forward for the identified IRAs. However, implementation of the IRAs will include design and review of IROD requirements specific to each mining-related source prior to construction and coordinating with appropriate agencies depending on the land status at each mining-related source.

1.4 Organization

The progress between major process steps of the FFS is graphically illustrated in the header at the beginning of each section. This report is organized as follows:

- Section 1 – Introduction. Discusses the purpose of the report and the report organization.
- Section 2 – Site Characterization. Describes the characteristics of the Site including the site description and background; a summary of the source and nature of contamination at mining-related sources with migration issues to be addressed by the IRAs; and a summary of unacceptable human health and ecological risks posed by contaminant migration issues to be addressed by the IRAs.
- Section 3 – Remedial Action Objectives. Describes the five contaminant migration issues to be addressed by IRAs and associated preliminary remedial action objectives (PRAOs) and preliminary remediation goals (PRGs). Potential applicable or relevant and appropriate requirements (ARARs) that were considered in developing PRAOs and identifying and evaluating remedial alternatives are also discussed.
- Section 4 – Identification of General Response Actions, Remedial Technologies, and Process Options for Alternative Development. Describes the general response actions (GRAs), remedial technologies, and process options considered for this FFS for development of remedial alternatives.
- Section 5 – Development of Alternatives. Identifies and describes the remedial alternatives for evaluation in the FFS.
- Section 6 – Definition of Criteria Used in the Detailed Analysis of Remedial Alternatives. Describes the NCP criteria used to evaluate the identified remedial alternatives for detailed analysis in Section 7.
- Section 7 – Detailed Analysis of Remedial Alternatives. Presents the individual detailed analysis of the remedial alternatives based on NCP evaluation criteria.
- Section 8 – Comparative Analysis of Alternatives. Summarizes the comparative analysis based on NCP evaluation criteria to compare and contrast the remedial alternatives.
- Section 9 – References. Lists the references and documents referred to in this FFS.
- Appendix A – Preliminary Remedial Investigation Memorandum
- Appendix B – Risk Assessment Information

  - Part 1.1 Interim Chronic Lead Risk Evaluation
  - Part 1.2 Human Health Acute Arsenic Screening Levels
  - Part 2 Ecological Risk Technical Memorandum
- Appendix C – Potential Applicable and Relevant and Appropriate Requirements
- Appendix D – Effectiveness Evaluation Considerations for FFS Remedial Alternatives
- Appendix E – Detailed Evaluation of Alternatives
- Appendix F – Cost Estimate

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Section 2
Site Characterization

This section provides an overview of the physical characteristics and the contaminant sources and transport within the Site. Complete details of the site characteristics and the nature of the contamination are presented in the preliminary RI report (Appendix A) and supporting risk assessment information (Appendix B, Parts 1 and 2).

2.1 Site Description and Background

Physical characteristics of the Site are presented in this section, including site location, topography, history, land use, population, climate, geology, surface water, and hydrogeology. Figure 2-1 shows the general location of the Site. Additional details can be found in the preliminary RI report in Appendix A.

2.1.1 Site Location and Topography

The Site is centered in southwestern Colorado in San Juan County. The Site listing identifies 48 mining-related sources which span across five different U.S. Geological Survey (USGS) 7.5-Minute Topographic Quadrangles including Handies Peak, Howardsville, Ironton, Ophir, and Silverton (USGS 2016a through 2016e). Within the Site, there are three main drainages (Mineral Creek, Cement Creek, and Upper Animas River), which flow into the Animas River at Silverton as shown in Figures 2-2, 2-3, and 2-4. The 48 mining-related sources were identified as sources or potential sources for contaminated media affecting the three main drainages (EPA 2016a). In addition, two dispersed campsites have been identified that contain contaminated media.

Mineral Creek originates at the top of Red Mountain Pass and flows approximately 9.3 miles before entering the Animas River southwest of Silverton. Cement Creek is approximately 8 miles long, flowing from north to south before the confluence with the Animas River at Silverton (Herron et al. 1998). The Upper Animas River begins approximately 14 miles northeast of Silverton. After the three main drainages combine as the Animas River, it flows south from Silverton to Durango, Colorado, crosses into New Mexico, and joins the San Juan River in Farmington, New Mexico.

Formed from Pleistocene glaciation and Holocene erosion, the terrain of the western San Juan Mountains is steep and rugged (USGS 2007a). The elevation ranges from approximately 9,500 feet National Geodetic Vertical Datum of 1929 (NGVD29) at the Mayflower Tailings to 12,800 feet NGVD29 at the Mountain Queen Mine, the highest mining-related source at the Site.

2.1.2 Site Mining History

The three main drainages within the Site contain over 400 abandoned or inactive mines, where large- to small-scale mining operations occurred. San Juan County is comprised of 10 historic mining districts (Colorado Geological Survey 2017). Historic mining districts within the Mineral Creek, Cement Creek, and Upper Animas River drainages (referred to as "the mining districts") include Animas, Animas Forks, Cement Creek, Eureka, Ice Lake Basin, and Mineral Point. Early mining activities began in the 1870s with slow initial production of ore due to the high cost and difficult access to the mines. In the late 1870s and early 1880s, the completion of roads, railroads, and construction of a smelter in Durango encouraged mining operations. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement (TechLaw, Inc. [TechLaw] 2017). Furthermore, improvements to methods of concentrating low-grade ore in both the 1890s and late 1910s were implemented at the Sunnyside Mine to increase recovery of metals (Burbank and Luedke 1969). Falling metal prices in the 1890s lead to a decrease in mining and numerous smaller operations were forced to close. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basin whenever prices were favorable (TechLaw 2017). The major mining operations in the Eureka district included the Sunnyside and Gold King Mines (Burbank and Luedke 1969). Sunnyside Mine shut down in 1930, reopened briefly in 1937–38, and then remained inactive until new ownership resumed operation of the mine in 1959 (Burbank and Luedke 1969; EPA 2016a). By the 1970s, only one year-round active mine (Sunnyside Mine) remained in the county, which closed permanently in 1991 (TechLaw 2017; EPA 2016a).

2.1.2.1 Listing on the National Priorities List

The Site was proposed for addition to the National Priorities List (NPL) in April 2016, and the listing became effective in September 2016 (EPA 2016b).

2.1.3 Surrounding Land Use and Population

The Census 2010 population for San Juan County, Colorado was approximately 700 people (U.S. Census Bureau 2010). Historically, mining was the main industry in the area; therefore, there are many inactive and abandoned mines within the three watersheds. Tourism including skiing and recreation, retail, and construction are now the most common industries (DATA USA 2015, City-Data.com 2016).

The land within the Site is divided into several different ownership/management types including private mining claims, private property, parcels managed by the Bureau of Land Management (BLM), and areas managed by the U.S. Forest Service (USFS). Mining-related sources evaluated in this FFS are located on private mining claims except for the Brooklyn Mine, which is a mixed ownership mining-related source (private-public lands) where many surface features are on public land managed by the USFS.

2.1.4 Climate

The portions of the Site within San Juan County have a subalpine to alpine climate with snowy, cold winters and cool summers. In the subalpine climate region, the minimum and maximum mean temperatures for January and July are 2 degrees Fahrenheit (°F)/32°F and 40°F/74°F, respectively (Chapman et al. 2006). In the alpine climate region, the minimum and maximum mean temperatures for January and July are minus 8°F/24°F and 36°F/72°F, respectively (Chapman et al. 2006).

Long-term climate data, including precipitation, for Silverton, Colorado has been collected by a participating National Weather Service Cooperative Observing Program weather station. The National Oceanic and Atmospheric Administration (NOAA) has a record of climate data for the Silverton, Colorado station dating back to 1905 (NOAA 2018). The weather station is currently located at a latitude of 37.809 North and a longitude of 107.663 West. In 2016, the Silverton station recorded annual precipitation of approximately 19 inches (NOAA 2018). The greatest amount of snowfall is between November and April, with an average snowfall of 12 feet per year (EPA 2016c).

2.1.5 Geology

The geology of the Site within San Juan County is relevant to the assessment of the hydrogeological framework and understanding of potential source materials present. Therefore, this section focuses on the description of the bedrock geology. Additional details on ore mineralization and Site soils can be found in the preliminary RI report in Appendix A. Other aspects of the Site geology were described by Yager and Bove (USGS 2007a), Burbank and Luedke (1969), and Bernhard Free et al. (1989).

2.1.5.1 Stratigraphy

The Site is centered in the western San Juan Mountains in the area of the Silverton and San Juan calderas. The younger Silverton caldera is situated within the older San Juan caldera, forming between approximately 28 and 27 million years ago (Ma) (USGS 2007a). During and after the caldera formation period, volcanotectonic events occurred that introduced extensive Tertiary-aged volcanic rock and extensive mineralization within fractured host rock (USGS 2007b). Volcanic formations of the San Juan volcanic field cover land north and east of the Silverton caldera. Comprised of pyroclastic rocks and lava flows, the San Juan volcanic field lies on the Paleozoic and Mesozoic rock formation (Free et al. 1989).

The general stratigraphy in the region consists of Precambrian crystalline basement, Paleozoic to Tertiary sedimentary rocks, Tertiary volcanic rocks, and Quaternary deposits (USGS 2007a).

- Precambrian rocks underlie the Site but are only exposed at the surface south of Silverton along the Animas River and Cunningham Creek (USGS 2007b). These generally consist of amphibolite, schist, and gneiss. Mineral phases in these rocks have high acid-neutralizing capacity and influence water-rock interactions (USGS 2007a).

- Paleozoic, Mesozoic, and Tertiary sedimentary rocks are primarily exposed south of Silverton along the Animas River and west in the basins draining South Fork Mineral Creek (USGS 2007a). These units are of varying thicknesses and compositions including conglomerates, sandstones, siltstones, shales, limestones, and other types of sedimentary rocks as discussed in Yager and Bove (USGS 2007a).

- Tertiary volcanic rocks comprise the bulk of the exposed rocks in the region. Tertiary volcanism began approximately 35 Ma with deposition of the San Juan Formation via lava flows, eruptions forming the San Juan and Silverton calderas and subsequent collapse, and additional lava flows depositing the Silverton Volcanics Group (USGS 2007a). An extensive system of faults and veins characterize the San Juan and Silverton calderas.
  - Most of the Site is located in the collapsed Silverton caldera within the Silverton Volcanic Group (Free et al. 1989, Herron et al. 2000). Three main volcanic units compose the caldera fill (Free et al. 1989):
    - The Eureka Tuff is the lowest formation in the Silverton Volcanic Group and is a lithic rhyolitic ashflow tuff.
    - The Burns Formation is fairly uniform and most commonly composed of rhyodacite, ridged quartz-latic flows, and flow breccias and tuffs (Burbank and Luedke 1969, Free et al. 1989).
    - The Henson Formation is the uppermost formation in the Silverton Volcanic Group, primarily andestitic pyroclastites. An irregular fracture system formed in this member, characterized by layers of volcanic breccias, lapillite, and tuffite.
- Quaternary surficial deposits are the result of glaciation and weathering of bedrock in the headwaters of subbasins. The surficial deposits are either acid generating or acid neutralizing depending on their bedrock source (USGS 2007a).

2.1.6 Surface Water Hydrology

The Animas River watershed extends from the mountainous terrain in San Juan County, Colorado, south into the San Juan River in Northern New Mexico (URS Operating Services 2012). The three major tributaries of the Animas River in San Juan County include Mineral Creek, Cement Creek, and the Upper Animas River. Cement Creek enters the Upper Animas River on the east side of Silverton, Colorado. About 1 mile downstream from that confluence, Mineral Creek enters the Upper Animas River south of town. Stream flow for the three major tributaries at USGS gaging stations are summarized below, and the stream gaging station locations are shown on Figure 2-1.

- Mineral Creek Drainage Basin, USGS gaging station 09359010 (USGS 2018a)
  - The highest discharge occurs in June, with a monthly average flow of 389 cubic feet per second (cfs).
  - The lowest discharges occur throughout January and February, with monthly average flows of 21 to 22 cfs, respectively.
- Cement Creek Drainage Basin, USGS gaging station 09358550 (USGS 2018b)
  - The highest discharge occurs in June, with a monthly average flow of 131 cfs.

  - The lowest discharges occur throughout January and February, with monthly average flows of 13 cfs for both months.

- Upper Animas River Drainage Basin, USGS gaging station 09358000 (USGS 2018c)
  - The highest discharge occurs in June, with a monthly average flow of 503 cfs.
  - The lowest discharges occur throughout January and February, with monthly average flows of 24 to 26 cfs, respectively.

- Upper Animas River Drainage Basin, USGS gaging station 09359020 (USGS 2018d)
  - The highest discharge occurs in June, with a monthly average flow of 1,050 cfs.
  - The lowest discharges occur throughout January and February, with monthly average flows of 60 and 64 cfs, respectively.

2.1.7 Subsurface Hydrogeology

Years of mining and the installation of bulkheads has significantly influenced bedrock groundwater elevations within the Site. Historically, groundwater flowed along fractures and faults, with minimal leakage through bedrock, likely due to low primary permeability. With the advent of underground mining, bedrock groundwater that once followed natural fractures instead followed the new path of least resistance—the networks of tunnels in the underground mine workings. Thus, drainage and haulage tunnels form preferential flow paths for bedrock groundwater. It is understood that water emanating from adits originated from the bedrock groundwater systems at the Site, but the IRAs contemplated would not address sources of contamination within the bedrock groundwater systems or within mine workings. Thus, bedrock groundwater will not be discussed further in this FFS.

The presence and/or extent of perched groundwater in overburden material or alluvial groundwater is not currently known at the mining-related sources described in this FFS and no groundwater analytical data are available for these mining-related sources. Thus, it is unknown whether perched overburden groundwater or alluvial groundwater is present at the mining-related sources and whether any perched overburden groundwater or alluvial groundwater has been previously or currently impacted by mining-related sources.

2.2 Source and Nature of Contamination

This section incorporates the primary mechanisms that lead to release of contaminants from mining-related sources and related impacted media, migration routes of contaminants in the environment, exposure pathways, and human/ecological receptors.

Contaminated media are present at the specific mining-related sources discussed in Section 2.3 and pose contaminant migration issues that could be addressed as part of IRAs. The contaminated media evaluated in this FFS include solid media (i.e., mine waste, contaminated sediment, and contaminated soil) and aqueous media (i.e., MIW and surface water). Further information about these contaminated media, including definitions, can be found in Section 3.1 of Appendix A.

Contaminants at the mining-related sources, specifically metals and metalloids (which have properties of metals and non-metals, such as arsenic), are present in solid phase materials at the Site (e.g., mine waste rock, tailings, soil, and bedrock outcrops) and in MIW. Adverse impacts are associated with transformation of solid phase metals and metalloids into forms that are mobile and potentially harmful to humans and ecological receptors. Crushing and grinding during mining and mineral processing may cause metals to mobilize in the form of very fine-grained particulates that can be physically transported by wind or water. Interaction with water and oxygen with sulfide minerals, especially pyrite, can result in generation of MIW and partial or complete dissolution of metals and/or metalloids from the solid phase, which provides a mechanism for contaminant migration into surface water, and potentially groundwater where it exists. These processes increase the mobility of contaminants in the environment and, therefore, increase the potential for impacts to receptors. Further information about the fate and transport mechanisms for contamination within these contaminated media is discussed in Section 3.2 of Appendix A.

The specific contaminant migration issues posed by contaminated solid and aqueous environmental media described in the following subsections contribute to unacceptable human health and ecological risks at mining-related sources. The specific mining-related sources evaluated in this FFS are identified in Section 2.3.

2.2.1 Mine Portal MIW Discharges

This contaminant migration issue occurs at mining-related sources where MIW is discharged from a mine portal or opening that is partially obstructed by environmental media or debris that was not specifically placed or installed previously, such as a bulkhead or other impervious migration barrier. This issue also occurs where there is a clear interaction between discharged mine portal MIW and mine wastes that exceed ecological risk-based screening levels, as discussed in Appendix A.

These interactions are a contaminant migration issue because the discharge onto adjacent mine wastes could increase the potential for erosion or mass wasting of chemicals of potential concern (COPCs) in particulate form and/or cause leaching of COPCs from the mine wastes. Obstructions to MIW discharges from mine portals also have the potential to impound MIW, sediments, and precipitates within unstable mine workings that could then be released in an uncontrolled manner to surface water.

2.2.2 Mining-Related Source/Stormwater Interactions

This contaminant migration issue occurs at mining-related sources where upgradient stormwater generated from falling or stored precipitation (e.g., snowmelt) interacts with mine waste that exceeds ecological risk-based screening levels or interacts with (enters) a mine portal.

These interactions are a contaminant migration issue because co-mingling of stormwater and mining-related sources transport COPCs to surface water either from generation of additional MIW and/or erosion and transport of COPCs in particulate form.

2.2.3 Mine Portal Pond Sediments

This contaminant migration issue occurs at mining-related sources where sediments that exceed ecological risk-based screening levels, as discussed in Appendix A have been deposited within the horizontal extent of mine portal ponds. Sediment within mine portal ponds is partially formed when metals settle out of mine portal MIW discharge through either the formation of iron oxy-hydroxides and subsequent co-precipitation (such as the case with arsenic), or through the physical settling of undissolved metals.

These interactions are a contaminant migration issue because mine portal ponds with significant sediment accumulation have reduced operational capacity (e.g., storage space), which affects MIW detention time for settling of sediments and precipitates. Reduced capacities in the mine portal ponds also increase the likelihood for "short circuiting", where MIW bypasses the pond or passes to the next pond in the series without sufficient retention time. The accumulated sediments in ponds also have the potential for uncontrolled release of COPCs (both in particulate form and MIW) to surface water during storm events.

2.2.4 In-Stream Mine Wastes

This contaminant migration issue occurs at mining-related sources where mine wastes entirely within a stream or comprising both banks of a channel exceed ecological risk-based screening levels, as discussed in Appendix A.

These interactions are a contaminant migration issue because the mine waste impedes stream flow and releases COPCs to surface water either from generating additional MIW and/or eroding and transporting COPCs in particulate form.

2.2.5 Mining-Impacted Recreation Staging Areas

This contaminant migration issue occurs at mining-related sources used for camping related to staging for recreational uses (e.g., established campgrounds or dispersed campsites) within 1,000 feet of U.S. Highway 550 (Mineral Creek), San Juan County Road 110 (Cement Creek), and San Juan County Road 2 (Upper Animas River) and adjacent to a pond or stream. A "dispersed" campsite is an area that is suitable for camping or where camping is known to occur but may not be a formal campground. These mining-related sources have mine waste or contaminated soil that exceed applicable human health risk-based levels for arsenic or lead presented in Appendix B, Part 1.

These interactions are a contaminant migration issue because recreation staging uses that are sedentary such as camping result in repeated surface disturbances that result in potential exposures of recreational human receptors to arsenic or lead.

2.3 Mining-Related Sources for FFS Evaluation

Drainage basins within San Juan County contain over 400 abandoned or inactive mines, where large- to small-scale mining operations occurred (EPA 2016d). The focus of this FFS is solely the evaluation of remedial alternatives related to contaminant migration issues at the mining-related sources identified in the initial characterization that could be addressed by IRAs. These contaminant migration issues are defined in Section 2.2.

This FFS uses two primary characteristics, definable by location, to group mining-related sources for identification and evaluation: road accessibility and ecoregions (as they relate to elevation). Road accessibility and ecoregions were chosen because they have significant impacts on the detailed evaluation of remedial alternatives in this FFS. Additional information on these two characteristics include:

- Road accessibility: Most mining-related sources are accessible via U.S. Highway 550 (paved surfacing) or San Juan County roads (gravel surfacing). The level of maintenance varies among these gravel county roads and is based on volume and speed of traffic, weather conditions, erosion, and elevation (San Juan County 2018). The FFS considers three main roads to be readily accessible (i.e., conventional access): U.S. Highway 550 (Mineral Creek), San Juan County Road 110 (Cement Creek), and San Juan County Road 2 (Upper Animas River). After conventional access ends on these named roads or a secondary road starts from them, the county roads may become narrower and are typically only accessible using a four-wheel drive vehicle (i.e., nonconventional access). The assumption in this FFS is that San Juan County Road 110 has conventional access from Silverton to the Gladstone area and that San Juan County Road 2 has conventional access from Silverton to the Eureka area.

- Ecoregion: Designations are based on the ecoregions of Colorado, which are made up of areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Chapman et al. 2006). Environmental factors that help group the ecoregions include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The two ecoregions covering the mining-related sources at the Site are Volcanic Subalpine Forests and Alpine Zone. These will be referred to as "subalpine" and "alpine," respectively, within this FFS, for simplicity. The elevation range for subalpine mining-related sources is between 9,000 and 12,000 feet in elevation, and the elevation range for alpine mining-related sources is from 10,000 to greater than 14,400 feet in elevation (Chapman et al. 2006). Additional references indicate a more precise division between the subalpine and alpine ecoregions (referred to as "zones") at an elevation of 11,500 feet (Agnew 2005, BLM 2018, National Park Service [NPS] 2018). For purpose of this FFS, the subalpine and alpine zones will be separated at an elevation of 11,500 feet.

Using the two characteristics previously discussed, mining-related sources within the Site have been organized into four categories for FFS evaluation as follows:

- Conventional access-alpine
- Conventional access-subalpine
- Nonconventional access-alpine
- Nonconventional access-subalpine

2.3.1 Mineral Creek Drainage Basin

The Mineral Creek drainage includes seven mining-related sources, five of which are being evaluated in this FFS for IRAs. The locations within the Mineral Creek drainage basin of these mining-related sources are shown on Figure 2-2. A summary of the mining-related sources by category and contaminant migration issues is presented in Exhibit 2-1.

Exhibit 2-1 Category and Contaminant Migration Issues of Mining-Related Sources within Mineral Creek Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Longfellow Mine	CAS					X
Junction Mine	CAS	X		X		X
Koehler Tunnel	CAS	X		X		X
Brooklyn Mine	NAS	X	X	X		
Bandora Mine	NAS	X	X			

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS – nonconventional access-subalpine

Detailed descriptions, figures identifying relevant features and sample locations, and sample results for the mining-related sources evaluated in this FFS within the Mineral Creek drainage basin can be found in Sections 4.2 through 4.4 of Appendix A. Brief descriptions are as follows:

- The Longfellow Mine, Junction Mine, and Koehler Tunnel are all co-located at the headwaters of Mineral Creek. Mine portal MIW discharges from both the Junction Mine's adit and Koehler Tunnel combine into a pond. Waste rock samples at these three locations exceeded the human health risk-based level for arsenic. The area is used as a launch point for recreational tours and is frequently visited.

- The Brooklyn Mine is located on the east side of Mineral Creek within Brown's Gulch. Existing mine portal MIW discharge is piped from the Level 2 adit to a constructed channel lined with Burns Formation rock, which then discharges downgradient of the mine waste. In addition, two ponds are located east of the primary mine area. The topography of the area is such that stormwater from upgradient of the Brooklyn Mine passes over mine waste.

- The Bandora Mine is located along South Fork Mineral Creek. There are two flowing adits. Mine portal MIW discharge from the main flowing adit (which is collapsed) flows into a diversion channel and then downslope east of the main mine waste dump. However, breaks in the discharge channel allow MIW to flow over mine waste. Stormwater from upgradient of the Bandora Mine passes over mine waste due to the local topography.

2.3.2 Cement Creek Drainage Basin

The Cement Creek drainage basin includes 14 mining-related sources, six of which are being evaluated in this FFS for IRAs. The mining-related sources specific to the IRAs are shown on Figure 2-3. A summary of the mining-related sources by category and contaminant migration issues identified is presented in Exhibit 2-2.

Exhibit 2-2 Category and Contaminant Migration Issues of Mining-Related Sources within Cement Creek Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Grand Mogul Mine	NAA		X		X	
Natalie/Occidental Mine	NAS	X				
Henrietta Mine	NAS	X				
Mammoth Tunnel	CAS	X		X		
Anglo Saxon Mine	CAS	X		X		
Yukon Tunnel	CAS	X	X			

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS –nonconventional access-subalpine

Detailed descriptions, figures identifying relevant features and sample locations, and sample results for the mining-related sources evaluated in this FFS within the Cement Creek drainage basin can be found in Sections 4.5 through 4.7 of Appendix A. Brief descriptions are as follows:

- The Grand Mogul Mine is in the Ross Basin about 0.5 miles east of the Mogul Mine. Three piles of mine waste from the workings of the Grand Mogul Mine are located on the north side of Cement Creek. The main and most eastern adit is collapsed. A large shaft or stope covered with metal grate is located at the second (center) waste rock pile. A perennial tributary cuts through the smallest (west) waste rock pile. The topography of the area is such that stormwater from upgradient of the mine waste piles flows over them. Gullies are present on the waste rock piles and the piles have a moderate degree of erosion.

- The Natalie/Occidental Mine is approximately one mile southeast of Gladstone along the South Fork of Cement Creek. Mine portal MIW discharge from the adit flows southwest over soil and adjacent to waste rock before entering the creek.

- The Henrietta Mine is located on the south side of Prospect Gulch, with at least six levels into the mine. Presently, the 700 Level adit flows only during high-flow conditions and is diverted into a drainage channel that flows on the southeastern side of the waste rock. Access to this adit is partially blocked by waste rock.

- The Mammoth Tunnel is located along Cement Creek near the mouth of Georgia Gulch. Mine portal MIW discharges from a pipe protruding from the collapsed adit. The MIW flow is channelized and flows down the mine waste in a lined channel into two settling ponds.

- The Anglo Saxon Mine is located along Cement Creek approximately 3 miles upstream from Silverton. This mine consists of two adits: a main adit close to the road, and the Porcupine Gulch adit located 400 feet up Porcupine Gulch from the main adit. Mine portal MIW discharge from the main adit flows across a moderately eroded waste pile, and cascades down to a culvert underneath the road to a constructed settling pond before continuing to Cement Creek.

- The Yukon Tunnel is located along Cement Creek approximately 2.5 miles upstream from Silverton. Mine portal MIW discharge is directed within the adit into a pipe which discharges to the north of a large waste rock pile in Illinois Gulch adjacent to the mine. The topography of the area is such that stormwater from upgradient of Yukon Tunnel passes over mine waste.

2.3.3 Upper Animas River Drainage Basin

The Upper Animas River drainage basin includes 27 mining-related sources, 13 of which are being evaluated in this FFS for IRAs. The two dispersed campsites (identified as Campground 4 and Campground 7) evaluated in this FFS are also located within the Upper Animas River drainage basin and are also considered mining-related sources. The mining-related sources specific to the IRAs are shown on Figure 2-4. A summary of the mining-related sources by category and contaminant migration issues identified is presented in Exhibit 2-3.

Exhibit 2-3 Category and Contaminant Migration Issues of Mining-Related Sources within Upper Animas River Drainage Basin

Mining-Related Source	Category	Mine Portal MIW Discharges	Mining-Related Source/ Stormwater Interactions	Mine Portal Pond Sediments	In-Stream Mine Wastes	Mining-Impacted Recreation Staging Areas
Boston Mine	NAA				X	
London Mine	NAA	X				
Ben Butler Mine	NAA		X			
Mountain Queen Mine	NAA	X	X			
Vermillion Mine	NAA	X	X			
Sunbank Group Mine	NAA	X	X	X		
Frisco/Bagley Tunnel	NAS	X		X		
Columbus Mine	NAS	X	X			
Campground 7	NAS					X
Silver Wing Mine	NAS	X	X	X		
Tom Moore Mine	NAS	X				
Ben Franklin Mine	NAA	X	X			
Terry Tunnel	NAA	X				
Pride of the West	NAS	X				
Campground 4	CAS					X

Category: CAA – conventional access-alpine; CAS – conventional access-subalpine; NAA – nonconventional access-alpine; NAS – nonconventional access-subalpine

Detailed descriptions, figures identifying relevant features and sample locations, and sample results for the mining-related sources evaluated in this FFS within the Upper Animas River drainage basin can be found in Sections 4.8 through 4.13 of Appendix A. Brief descriptions are as follows:

- The Boston Mine is located along the northwest side of Houghton Mountain above the trans-basin diversion ditch within Burrows Creek (a tributary to the Upper Animas River).

Burrows Creek flows adjacent to the waste rock in a channel, and there is evidence of mine waste and contaminated soil eroding and sloughing off into the channel.

- The London Mine is on the north side of Burrows Creek along the north side of Houghton Mountain. There are two adits: one has a 3-foot by 3-foot grate, partially blocked by waste rock, and the other is collapsed. Flow is observed from each adit. There are also two large waste rock piles and seeps are present around the base of each.
- The Ben Butler Mine is located on the north side of Burrows Creek on the south slope of Denver Hill, approximately 1,200 feet north of the London Mine. There are no direct roads to access the mining-related source. There are two shafts and three stopes at the site, which are all filled with water. The topography of the area is such that stormwater from upgradient of Ben Butler Mine passes over mine waste. A 200-yard-long vegetation kill zone extends downslope from the waste dump towards Burrows Creek.
- The Mountain Queen Mine is located on the east side of Hurricane Peak at the headwaters of California Gulch, with a shaft near the top of California Pass and a draining adit east of the shaft. The adit opening is covered with a grate, and rock fall occurred recently above the grate. The mine portal MIW discharge from this adit flows around both sides of the waste rock pile located at the adit and into California Gulch. The topography of the area is such that stormwater from upgradient of the adit flows over the mine waste located at the adit.
- The Vermillion Mine is located in a large gentle swale high on the north side of California Gulch near the southwestern flank of Houghton Mountain. There is one draining adit at the Vermillion Mine site. The adit discharge flows south over soil before infiltrating into the waste rock pile. The drainage continues to flow approximately 2,000 feet south and southeast where it enters the West Fork Animas River. The topography of the area is such that stormwater from upgradient of Vermillion Mine flows over mine waste.
- The Sunbank Group Mine is located within Placer Gulch. The main adit is sealed with a concrete block; however, flow is coming out of the top of the concrete block and from seeps upgradient of the adit block. Adit discharge is directed into a series of settling ponds immediately adjacent to Placer Gulch. The ponds appear to no longer be functional and adit drainage no longer flows sequentially through the ponds prior to discharging into Placer Gulch. An existing stormwater diversion is located upgradient of the main waste rock pile.
- The Frisco/Bagley Tunnel is located approximately 0.5 miles west of Animas Forks on the north side of California Gulch. A rock and mortar closure with a grate is installed at the adit portal located on top of the waste rock pile on the north side of the road. The mine portal MIW discharge is channelized southwest across a waste rock pile, and red staining is highly visible throughout the channels, which flow into California Gulch. A small settling pond is present within the channel. Additional adit flow ponds on top of the waste rock pile during periods of high flow.
- The Columbus Mine is located across the stream in California Gulch from Animas Forks. It has a single discharging adit from which mine portal MIW discharge infiltrates into the

waste rock file and then emerges at the base. There are a series of seeps below both levels of waste rock that may be from the adit discharge.

- Campground 7 is located approximately 1.1 miles south of Animas Forks, on the west side of the Upper Animas River at the road fork below a bridge crossing the Upper Animas River. Campground 7 is considered a dispersed campsite—an area that is suitable for camping or where camping is known to occur but may not be a formal campground. It is near the former location of the Eclipse Smelter according to USGS (Church et al. 2007). A sample of soil/waste rock from this location exceeded the human health risk-based level for lead. It is accessible to the public and used for recreational purposes.

- The Silver Wing Mine is located on the east side of the Upper Animas River, south of Animas Forks. Adit flow is directed into a settling pond and was formerly directed through bioreactor tanks prior to discharge to the Upper Animas River. The bioreactor tanks are not functional, and flow currently bypasses the former tanks and is piped to the river. The topography of the area is such that stormwater from upgradient of Silver Wing Mine passes over mine waste.

- The Tom Moore Mine is located approximately 0.5 miles south of the Silver Wing Mine. There is no maintained road access. There is one discharging adit from which mine portal MIW discharge flows over the waste rock pile and into the Upper Animas River.

- The Ben Franklin Mine is located immediately below the confluence of the headwaters of Eureka Gulch. A barbed wire fence is present surrounding a stope. Currently, stream flow has been diverted through a culvert across the road to the main channel of Eureka Gulch to avoid flowing through the stope. The mine adit shows signs of seasonal discharge.

- Terry Tunnel is located approximately 0.25 miles southeast of the Ben Franklin Mine. It is bulkheaded and buried, and most mine portal MIW discharge flows out of the bulkheaded tunnel into a drainage ditch that directs water around the reclaimed waste rock pile. MIW also seeps out below the bulkheaded tunnel and pools on the mine waste below the tunnel.

- The Pride of the West Mine is located on the east side of Cunningham Gulch. The primary adit has a metal frame cover and is chained and padlocked. The primary adit's mine portal MIW discharges through a channel on top of a large waste rock pile, through a culvert, and down a gully on the waste rock pile into the stream. Two additional, non-flowing, grated adits are located north of the flowing adit.

- Campground 4 is located near the Animas River adjacent to a spur off County Road 2 below Howardsville, approximately 900 feet below the Howardsville bridge over the Upper Animas River. Campground 4 is considered a dispersed campsite—an area that is suitable for camping or where camping is known to occur but may not be a formal campground. It was identified as a mine tailings area by Colorado Division of Minerals and Geology, described as Mill Tailings Site #20 in Herron et al. (2000). A sample of soil/waste rock from this location exceeded the human health risk-based level for lead. It is accessible to the public and used for recreational purposes.

2.4 Human Health and Ecological Risks

2.4.1 Potential Receptors

Potential human receptors as identified in Appendix B, Part 1 consist of campers (children). Potential ecological receptors as identified in Appendix B, Part 2 consist of aquatic receptors (primarily fish and benthic macroinvertebrate [BMI] communities).

2.4.2 Exposure Pathways

Human exposure pathways for which interim risks were quantitatively evaluated in Appendix B, Part 1 focused on the incidental ingestion and inhalation of soil and mine waste during camping. Note that potential risks to recreational and occupational receptor populations from all exposure media and pathways will be evaluated in the final human health risk assessment for the Site.

Ecological exposure pathways for which risks were quantitatively evaluated in Appendix B, Part 2 included ingestion and direct contact of aquatic receptors with surface water.

2.4.3 Human Health Risk Information

Appendix B, Part 1 presents the derivation and application of risk-based thresholds for human health for lead and arsenic in soil/waste rock based on a camping scenario within the mining districts. Lead and arsenic were selected for evaluation as COPCs for the IRAs because concentrations are notably elevated at several locations within the mining districts. Therefore, levels for lead and arsenic have been developed for consideration in the identification of areas that may warrant IRA based on potential human health risks. These levels are to be considered preliminary and subject to change pending finalization of the Site human health risk assessment.

Appendix B, Part 1 includes two different human health evaluations: one based on lead exposures (Part 1.1) and one based on arsenic exposures (Part 1.2). Part 1.1 presents an interim evaluation of risks from chronic lead exposure during camping and presents interim lead risk-based levels for the purposes of supporting IRA decisions in dispersed[1] camping areas. Part 1.2 presents the derivation of acute screening levels for arsenic based on a camping scenario and compares these screening levels to measured arsenic concentrations soil and waste rock samples collected in the mining districts.

The camping scenario was selected for the human health evaluations because the camper is anticipated to be the most sedentary of receptors (i.e., not moving about being exposed to a variety of soil/mine waste sources, in contrast with hiker, hunter, fisherman, all-terrain vehicle [ATV] rider/guide, and road worker receptors), which allows an evaluation of smaller exposure areas, such as individual campgrounds. The camping scenario was also selected because the camper receptor has the highest exposure to soil compared to the other recreational receptors (e.g., hiker, hunter, recreational ATV rider) due primarily to incidental ingestion of soil. Focus was placed on exposure to children, because they are often more vulnerable to pollutants than adults and soil ingestion is higher due to increased frequency of contact through hand-to-mouth or

[1] A “dispersed” campsite is an area that is suitable for camping or where camping is known to occur but may not be a formal campground. Soil from the USFS South Mineral Campground (CMP14) was not included in this evaluation because it will be evaluated as a different type of camping exposure area in the final Site human health risk assessment.

object-to-mouth activity. Exposure parameters for the IRA risk-based levels were based on child-specific camping soil ingestion rates.

As presented in the interim human health risk evaluations included in Appendix B, Part 1, a possibility exists that adverse health effects may occur from exposures to lead or arsenic in the contaminated soils and waste rock within the mining districts. Based on the chronic evaluation of lead exposures during camping (Part 1.1), there are two dispersed campsites where interim actions are recommended to address potentially unacceptable human health chronic exposures from lead in soil: Campground 4 and Campground 7 (see Figure 2.4). Based on the acute evaluation of arsenic exposures during camping (Part 1.2), there are no dispersed campsites with measured arsenic concentrations above the 14-day acute arsenic screening level. However, there are three locations (the Longfellow Mine, Junction Mine, and Koehler Tunnel; see Figure 2.2) where waste rock concentrations are higher than the 2-day acute arsenic screening level. Therefore, interim actions are recommended at these three locations to address potentially unacceptable acute human health exposures from arsenic in waste rock.

2.4.4 Ecological Risk Information

The ecological risk evaluation presented in Appendix B, Part 2 focuses on aquatic ecological risk, primarily risks to fish. It has been noted that BMI communities in most reaches are also currently at risk, and many of the factors limiting BMI communities are like those limiting fish communities.

Fish have recently been documented in several other reaches of the Animas River and tributaries as a part of qualitative habitat surveys conducted by the USGS in 2016. These locations include trout populations in Cunningham Creek near its mouth, in the South Fork of Mineral Creek near its mouth, in Mineral Creek between Mill Creek and the Middle Fork of Mineral Creek, and in Mineral Creek below the South Fork of Mineral Creek (see Figure 2 in Appendix B, Part 2).

While aquatic life is unlikely to be directly exposed to mine-related surface water drainages (i.e., mine portal discharges) prior to entering the receiving stream, they can significantly increase instream metals concentrations, subsequently contributing to risks to fish. An evaluation of the hazard quotients (HQs) is presented in Table 1 and Figures 3 through 5 in Appendix B, Part 2. HQs were computed by comparing surface water concentrations with Colorado's hardness-based chronic aquatic life water quality criteria (concentration/criteria). Table 1 in Appendix B, Part 2 reveals there are few locations where maximum individual metal HQ values are less than one (COPCs evaluated include aluminum, cadmium, copper, and zinc), with many locations in both adit drainages and downstream surface waters demonstrating HQs greater than 100. If the value of an HQ is less than or equal to one, risk of unacceptable adverse effects in exposed organisms is deemed acceptable. If the HQ exceeds one, the risk of adverse effects in exposed organisms may be of concern, with the probability and/or severity of adverse effect tending to increase as the value of the HQ increases. HQ values should be interpreted as estimates rather than highly precise values because the values are predictions and are subject to the uncertainties inherent in both the estimates of exposure and the estimates of toxicity benchmarks. Recognizing this, surface water measurements are far elevated above water quality criteria at many locations. The health of aquatic ecosystems within the Animas River and its tributaries are currently limited by high concentrations of toxic metals emanating from a wide range of mining-related and natural sources distributed throughout the greater Animas River watershed such that aquatic life is precluded in some locations. In other locations within the Site, metals-tolerant organisms (e.g., brook trout) are currently able to persist.

Section 3

Remedial Action Objectives

Section 300.430(e) of the NCP requires the remedial alternative development process be initiated by developing remedial action objectives (RAOs) specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Remediation goals establish acceptable exposure levels that are protective of human health and the environment. PRGs are initially developed using readily available information, such as ARARs, which are then modified as necessary with new information and become remediation goals upon remedy selection.

3.1 Overview

This section presents the ARARs, PRAOs, PRGs, and the remedial clearance criteria that are tentatively identified to address the specific contaminant migration issues being considered in this FFS. Final ARARs, RAOs, and remedial goals will be developed from evaluations presented within this FFS and set forth in the IROD.

3.2 Contaminant Migration Issues for FFS Evaluation

IRAs are contemplated at the Site to remediate five specific contaminant migration issues in accordance with the remedial strategy discussed in Section 1. These specific contaminant migration issues, as defined in Section 2.2, include:

- mine portal MIW discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes
- mining-impacted recreation staging areas

3.3 Applicable or Relevant and Appropriate Requirements

Identification and evaluation of ARARs are integral components of the FS process to determine whether remedial alternatives can protect human health and the environment. The following paragraphs were developed from EPA's *Introduction to Applicable or Relevant and Appropriate Requirements* (EPA 1998); they give an overview of why ARARs must be identified and evaluated as part of the CERCLA process.

CERCLA and the NCP establish a standardized process through which EPA responds to spills and clean up the nation's most dangerous hazardous waste sites. While the CERCLA response process sets acceptable risk-based goals for cleanups, it does not impose specific restrictions on the various activities (e.g., treatment, storage, and disposal of wastes; construction and use of remediation equipment; and release of contaminants into air, soil, and water) that may occur during a response. EPA instead relies on other federal and state environmental laws and regulations to govern response activities through the ARARs selection process.

A site-specific risk assessment is the foundation on which the selection of a CERCLA remedy is based. ARARs fill in the substantive gaps in CERCLA's risk-based response framework to adequately address protection of human health and the environment. The response may also incorporate environmental policies or proposals that are not ARARs but do address site-specific concerns. Such to-be-considered information (TBC) may also be used in determining the cleanup levels necessary to protect human health and the environment.

3.3.1 ARARs Identification Process

ARARs are designated as either "applicable" or "relevant and appropriate," according to EPA guidance, and may stem from either federal or state law. ARARs must be identified on a site-specific basis and involve a two-part analysis. A determination must first be made on whether a given requirement is applicable. If it is not applicable, then a second determination must be made on whether it is both relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA 1988). Compliance with ARARs is a threshold criterion that any selected remedy must meet unless a legal waiver, as provided by CERCLA Section 121(d)(4), is invoked.

Determining exactly which laws and regulations will affect a CERCLA response is somewhat different than determining the effect of laws and regulations on activities that take place outside the boundaries of a site remediated under CERCLA. For onsite activities, CERCLA requires compliance with both applicable requirements (i.e., those that would apply to a given circumstance at any site or facility) and those that EPA deems to be relevant and appropriate (even though they do not apply directly), based on the unique conditions at a site.

3.3.1.1 Consideration of State Requirements as ARARs

State requirements are potential ARARs for CERCLA response actions as long as they meet the following eligibility criteria:

- state law or regulation
- environmental or facility siting law or regulation
- promulgated (of general applicability and legally enforceable)
- substantive (not procedural or administrative)
- more stringent than federal requirements
- identified in a timely manner
- consistently applied

Many state requirements listed as potential ARARs are promulgated with identical or nearly identical requirements to federal law pursuant to delegated environmental programs administered by federal agencies and the state. The preamble to the NCP provides that such a situation results in citation to the state provision and treatment of the provision as a federal requirement.

3.3.1.2 TBC Identification Process

In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular contaminant release (40 CFR 300.400(g)(3)). These sources are referred to as "TBC".

The NCP preamble states, however, that provisions in the TBC category "should not be required as cleanup standards, because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs." Although not enforceable requirements, these documents are important sources of information that EPA and the state may consider during selection of the remedy, especially regarding the evaluation of public health and environmental risks, or which will be referred to, as appropriate, in selecting and developing cleanup actions (40 CFR 300.400(g)(3), 40 CFR 300.415(I)).

3.3.1.3 Other Regulatory Requirements Not Considered ARARs

There are other laws and regulations that require substantive compliance for onsite responses but do not constitute ARARs for the IRAs because they are not specifically related to environmental cleanup or facility siting. One example would be Occupational Safety and Health Administration general construction safety regulations.

3.3.2 Categories of ARARs

Environmental laws and regulations fit (more or less) into three categories:

- those that pertain to certain chemicals
- those that restrict activities at a given location
- those that control specific actions

Thus, there are three primary types of ARARs: chemical-, location-, and action-specific. An ARAR can be classified in one or a combination of all three types of ARAR categories.

Chemical-specific requirements address chemical or physical characteristics of compounds or substances at sites. These values establish acceptable amounts or concentrations of contaminants that may be found in, or discharged to, the ambient environment.

Location-specific requirements are restrictions placed on the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographical or physical positions of sites rather than the nature of contaminants at sites.

Action-specific requirements are usually technology-based or activity-based requirements or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants. A given cleanup activity will trigger an action-specific requirement. Such requirements do not themselves determine the cleanup alternative, but define how chosen cleanup methods should be performed.

3.3.3 CERCLA Permit Exemption

CERCLA Section 121(e)(1), 42 United States Code (U.S.C.) 9621(e)(1), states, "No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section." The onsite activities must, however, comply with substantive permit requirements. The term "onsite" is defined in the NCP as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (40 CFR 300.5).

The FFS assumes all mining-related sources are onsite. Other areas of the Site near mining-related sources where contaminated media have come to be located and would be necessary for implementation of the IRAs (e.g., borrow areas) are also considered onsite for the purpose of permit exemption. While no permits will be obtained for any response actions conducted onsite, EPA will evaluate the substantive requirements that would otherwise be included in any such permit and determine which substantive provisions must be complied with.

3.3.4 Identification of Potential ARARs for Remedial Alternatives

Appendix C lists potential ARARs with brief descriptions for evaluating remedial alternatives in this FFS. The ARARs are organized according to whether they are potential federal or State of Colorado ARARs. The ARARs, or group of related ARARs, included in Appendix C are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR, and how/to what extent the ARAR is expected to be pertinent to potential activities to be conducted as part of remedial alternatives. The tables in Appendix C also identify whether the ARAR is chemical-, location-, and/or action-specific. Final ARARs will be determined in the IROD after a remedy is selected as a performance standard for remedial design and subsequent IRAs.

3.4 Anticipated Future Land Uses

The current and anticipated future land uses for the mining-related sources evaluated in this FFS for IRAs are an important consideration for the development of PRAOs. The condition of the mining-related sources after implementation of the IRAs must be considered in evaluating reasonable future land uses or activities and the related protection to human health and the environment that is provided.

The assumption in this FFS is that recreation will remain the predominant future land use for both public property (i.e., USFS-managed lands) and private property that have mining-related sources remediated as part of the IRAs. Properties identified as mining-related recreation use areas used for camping are exclusively evaluated for unacceptable human health risks, as discussed in Appendix B, Part 1.

3.5 Preliminary Remedial Action Objectives

PRAOs are typically developed by evaluating several sources of information including results of the risk assessments and ARARs/TBC. These inputs are the basis for determining whether adequate protection of human health and the environment is achieved for a remedial alternative.

The scope of the PRAOs in this FFS is intended to address human health or ecological risks only for the five contaminant migration issues identified in Section 3.2. The PRAOs are not intended to address all potential human health and/or ecological risks because the information (i.e., RI and human health/ecological risk information) supporting the FFS is preliminary and the actions to be taken are interim. The final remedial decisions for these mining-related sources will address all known unacceptable human health and ecological risks.

The following PRAO was identified for the IRAs to address known ecological risks:

1. Reduce transport from mine waste, contaminated soil, and contaminated sediment into surface water of COPCs that contribute to unacceptable ecological risks.

The following PRAOs were identified for the IRA to address known human health risks:

2. Reduce human exposure through ingestion and inhalation to mine waste and contaminated soils containing lead that results in greater than a 5 percent chance of exceeding a blood lead level of 5 micrograms per deciliter (μg/dL) during camping activities.

3. Reduce human exposure through ingestion to mine waste and contaminated soils containing arsenic that exceeds risk-based levels for acute exposures during camping activities.

PRAO 1 applies to the following contaminant migration issues, which address known aquatic ecological risks:

- mine portal MIW discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes

PRAOs 2 and 3 apply to the following contaminant migration issue, which addresses known human health risks:

- mining-impacted recreation staging areas

At the conclusion of these IRAs, EPA will measure the extent by which ecological and human health risks associated with contributions from these mining-related sources have been reduced by the actions. These data will provide information about the effectiveness of the IRAs and are intended to help inform future remedial decisions at the Site.

3.6 Preliminary Remediation Goals

PRGs are concentration-based goals for individual chemicals for specific medium and land use combinations at CERCLA sites (EPA 1991b). PRGs are typically presented as chemical- and media-specific values that when met achieve the PRAOs. PRGs are discussed in the NCP (40 CFR 300.430(e)(2)(i)). Identification and selection of the PRGs are typically based on PRAOs, the current and reasonably anticipated future land uses, and the potential ARARs.

PRGs typically are used as a preliminary value in the FFS to guide evaluations of remedial alternatives. These PRGs are initial guidelines; they do not set remediation levels nor do they establish a requirement for removal of contamination to meet these risk-based PRGs. Final remediation (cleanup) levels will be selected by EPA in the IROD following review and evaluation of Site data and information including Site risks, anticipated effectiveness of potential cleanup alternatives, and other remedy selection criteria such as public and state preferences.

The following subsections describe the development of PRGs, as appropriate, and remedial clearance criteria to address human health risks and ecological risks, respectively.

3.6.1 Human Health PRGs

Human health PRGs for lead and arsenic in mine wastes and contaminated soil at recreational staging areas are presented in Appendix B, Part 1. Achievement of the PRGs through implementation of remedial alternatives would result in acceptable risks to human health from camping.

However, use of the PRGs to determine the extent of remediation at mining-impacted recreation use areas is not appropriate because the camping exposure scenario does not encompass the entirety of the mining-related sources evaluated for this contaminant migration issue in the FFS. Rather than use PRGs to delineate the extent of remediation for mining-impacted recreation use areas, physical information such as but not limited to topography and soil types (i.e. relatively flat areas free of large boulders and cobbles) would be used to define the relevant exposure area for camping and thus the horizontal extent of remediation. Once the extent of remediation encompasses the horizontal extent of exposure areas for camping, the PRGs would then be used to determine the resulting conditions in mine waste and soil meet the PRAOs for human health risk from lead and arsenic.

3.6.2 Ecological Remedial Clearance Criteria

As stated in Section 3.5, the ecological PRAO includes reducing COPCs that contribute to unacceptable ecological risks from contaminated media being addressed under the scope of the IRAs. While it is possible to derive media-based PRGs for the contaminants addressed as part of the IRAs, the derivation is complicated by the preliminary nature of the RI and risk assessment information that focus on specific COPCs and specific receptors and exposure pathways rather than a comprehensive list of contaminants, pathways, and receptors. The ecological PRAO is focused on source migration control that would contribute to, but not necessarily result in, acceptable risks for ecological receptors. For these reasons, media-based PRGs have not been established for the IRAs addressing unacceptable ecological risks. In lieu of PRGs, the IRAs are anticipated to be guided based on remedial clearance criteria.

Remedial clearance criteria define the conditions that must be met for the remedial components or approaches to be deemed complete for purposes of the IRAs. Because the focus of remedial alternatives addressing unacceptable ecological risks is source isolation and contaminant migration control, there are not chemical-based criteria directly applied to contaminated source media (e.g. mine wastes and mine portal pond sediment) to determine completion. Rather, clearance criteria for each IRA will be established for MIW and/or surface water to determine through performance evaluation monitoring that contributions of COPCs migrating from these contaminated source media have been reduced, thus meeting the PRAO.

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Section 4

Identification of General Response Actions, Remedial Technologies, and Process Options Considered During Alternative Development

This section presents an identification of GRAs, remedial technologies, and process options that, when combined into remedial alternatives, are capable of remediating the contaminant migration issues that pose unacceptable risks to human health and the environment.

As discussed in Section 1, the two-step screening process of GRAs, remedial technologies, and process options indicated in the RI/FS guidance (EPA 1988) was excluded from the streamlined approach for the FFS. The GRAs, remedial technologies, and process options were identified based on their documented use to remediate similar contaminant migration issues at other CERCLA mine sites.

The identification process consists of the following general steps:

- Identify GRAs for the five contaminant migration issues that will satisfy the PRAOs identified in Section 3.4.
- Compile remedial technologies and process options for each GRA that are viable for remediation of these contaminant migration issues using the informational sources discussed in Section 4.2.

4.1 General Response Actions

GRAs are broad, medium-specific remedial approaches used to satisfy the PRAOs for the IRAs. The list of GRAs considered for remediation are aligned with the relatively simple scope of the contaminant migration issues addressed by the IRAs and include:

- no action (required by the NCP)
- institutional controls (ICs)
- containment
- removal, transport, disposal

No action leaves contaminated media in their existing condition with no control or cleanup planned. In accordance with the NCP, this GRA must be considered as a stand-alone remedial alternative to provide a baseline against which other options can be compared.

ICs involve non-engineered measures, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action. ICs are typically designed to work by limiting land and/or resource use or by providing information that helps modify or guide human behavior at a site ICs are not intended to substitute for engineering aspects of a selected remedy and do not physically address contaminants.

Containment involves physical measures applied to contaminated media to control the release of contaminants and/or prevent direct contact or exposure to the contaminants.

Removal, transport, disposal involve a complete or partial removal (e.g., excavation) of contaminated media followed by transportation and disposal at another location.

4.2 Remedial Technologies and Process Options

Remedial technologies and process options that are capable of addressing each of the contaminated media posing contaminant migration issues are identified and organized under each GRA category listed in Section 4.1.

The primary source of information used to identify remedial technologies and process options is the Federal Remediation Technologies Roundtable (FRTR) *Remediation Technologies Screening Matrix and Reference Guide, Version 4.0* (FRTR 2007). Other sources of information used to identify remedial technologies and process options include previous studies and work conducted by federal and state agencies performing response action work at the Site, relevant EPA guidance, published literature and vendor information, stakeholder input, and engineering judgment based on other mine waste remediation projects with inorganic contamination.

The remedial technologies and process options presented in Exhibit 4-1 have substantial potential and applicability as standalone remedies, or have remedial benefits if combined with other remedial technologies, to achieve the PRAOs in this FFS. Although other remedial technologies and process options within the identified GRAs (e.g., offsite disposal) could also be successful and were considered, they were ultimately not identified for the relative simple scope of contaminant migration issues identified in this FFS. These process options are assembled into remedial alternatives and discussed in Section 5 to address the five contaminant migration issues.

Exhibit 4-1 Identified Remedial Technologies and Process Options for the Development of Remedial Alternatives

General Response Action	Remedial Technology	Process Option	Description of Option
No Action	None	None	No action would be taken. The contaminated media remain in their existing condition.
ICs	Non-Engineered Controls	Governmental controls, proprietary controls, enforcement tools with IC components, and/or informational devices	ICs would be implemented as needed to maintain integrity of the proposed remedies.
Containment	Surface Source Controls	Grading	Contaminated solid media would be contoured to promote drainage and facilitate other technologies and process options.
		Soil/rock exposure barrier	Contaminated solid media would be covered with a layer of uncontaminated soil or rock with sufficient thickness to reduce erosion and eliminate surface exposure of contaminated media.
	Hydraulic Isolation, Diversion, and Separation Measures	French drain and/or interception trench	Interceptor trenches or French drains would be constructed to collect and route mine portal MIW discharge and/or stormwater migrating as surface flow or interflow around contaminated solid media to prevent co-mingling of uncontaminated and contaminated solid/aqueous media.
		Open channel	Open channels would be constructed to collect and route mine portal MIW discharge and/or stormwater around contaminated solid media to prevent co-mingling of uncontaminated and contaminated solid/aqueous media.
		Collection/diversion piping or liner	Collection/diversion piping or liner would be used to divert mine portal MIW discharge and/or stormwater around contaminated solid media.
		Berms	Berms would be constructed around contaminated solid media to prevent co-mingling of solid and aqueous media and minimize erosion and transport.
Removal, Transport, and Disposal	Removal	Mechanical removal (excavation)	Contaminated media would be excavated using mechanical methods. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
		Pneumatic removal (vacuum excavation)	Contaminated media would be excavated using vacuum hoses, vacuum trucks, or other pneumatic conveyance systems. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
	Transport	Mechanical transport (hauling/conveying)	Excavated contaminated media would be transported by truck or other mechanical conveyance method to a disposal/management location. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
		Pneumatic transport (vacuum extraction)	Excavated contaminated media would be piped using a vacuum system to a disposal/management location. Dewatering (using gravity and/or amendments) at the mining-related source may be required to implement this process option.
	Disposal	Interim local waste management	Excavated contaminated media would be temporarily managed locally until permanent disposal solutions are selected.

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Section 5

Development and Description of Alternatives

5.1 Overview

In this section, remedial action alternatives (herein referred to as "remedial alternatives") are assembled by combining the remedial technologies and process options presented in Section 4. Remedial alternatives are developed from either stand-alone process options or combinations of the process options, as appropriate, to achieve the PRAOs.

The remedial alternatives for this FFS span a range of categories defined by the NCP as follows:

- No action/no further action alternative.
- Alternatives that address the threats but involve little or no treatment; PRAOs would be met by prevention or control of exposure through actions such as containment and/or institutional and access controls.

5.2 Supplemental Information Affecting Development of Remedial Alternatives

Additional information was considered to supplement the remedial technologies and process options identified in Section 4 and better refine the remedial alternatives. The types of information and assumptions considered when developing the scope of the remedial alternatives for this FFS included:

- Focus on specific contaminant migration issues – Five contaminant migration issues are the focus of remedial alternative identification and development for the IRAs. The PRAOs and related PRGs identified in Section 3 focus on addressing unacceptable human health and aquatic ecological risks from the five contaminant migration issues identified in Section 3.2 including mine portal MIW discharges, mining-related source/stormwater interactions, mine portal pond sediments, in-stream mine wastes, and mining-impacted recreation staging areas. Other contamination issues at the Site that potentially pose unacceptable human and ecological risks would be addressed during future remedial action as discussed in Section 1.2.
- Exclusion of measures specific to protecting groundwater – Groundwater is defined in 5 Colorado Code of Regulations (CCR) 1002-41 as "subsurface waters in a zone of saturation which are or can be brought to the surface of the ground or to surface waters through wells, springs, seeps or other discharge areas". As discussed in Section 2.1.7, the presence and quality of groundwater is not known below the mining-related sources. Thus, remedial measures that result in incidental discharge to the subsurface are assumed to have limited potential impacts to groundwater and are not specifically addressed in this FFS.

- Inclusion of supplemental remedial components – Section 4 identified remedial technologies and process options that were assembled to develop alternatives to remediate the identified contaminated media that pose contaminant migration issues. However, there are supplemental remedial components and activities necessary to implement the IRAs but were not explicitly identified as part of the process options. These supplemental remedial components include, but are not limited to, development of borrow, access road improvements, and dust control. Additional information about these secondary components is detailed in Section 5.4.1.

- Consideration of previous response action work at the Site – Previous studies and response action work conducted by federal and state agencies or private stakeholders at the Site were considered when developing and refining the alternatives.

- Alternative analysis assumptions – These assumptions provide additional alternative definition and considerations required to apply the evaluation criteria consistently and to develop an order-of-magnitude cost estimate (i.e., having a desired accuracy of +50 percent to -30 percent). Since these considerations affect the outcome of detailed analysis of alternatives rather than the generalized scope of the alternatives, they are discussed in Section 7.

5.3 Development of Remedial Alternatives

Remedial alternatives to address the five contaminant migration issues identified in Section 3.2 were assembled by combining the remedial technologies and process options presented in Section 4. Table 5-1 (A through E) provides matrices that indicate how the remedial technologies and representative process options identified in Section 4 were combined in consideration of the supplemental information discussed in Section 5.2 to create the limited number of remedial alternatives for each contaminant migration issue for IRA in this FFS.

Alternative descriptions may discuss generalized rather than specific remedial technology approaches. These generalized remedial technology approaches allow flexibility in consideration of innovative process options approaches that could be considered within a remedial technology category. This flexibility allows for more than one process option to be evaluated for site-specific bench-scale or pilot testing. The most successful process option could then be selected and designed for full-scale implementation.

For alternative identification and evaluation, “representative” or “selected” process options were selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives. An example of “representative” selection of process options is associated with the GRA of removal. Although multiple types of removal process options are identified and could be considered during remedial design, only mechanical excavation is selected as being representative for purposes of remedial alternative identification and description.

5.4 Description of Remedial Alternatives

The remedial alternatives assembled for the five contaminant migration issues include:

A. Remedial alternatives for mine portal MIW discharges:

- Alternative A1: No Action
- Alternative A2: Diversion/Isolation

B. Remedial alternatives for mining-related source/stormwater interactions:

- Alternative B1: No Action
- Alternative B2: Stormwater Diversion/Isolation

C. Remedial alternatives for mine portal pond sediments:

- Alternative C1: No Action
- Alternative C2: Excavation and Interim Local Waste Management

D. Remedial alternatives for in-stream mine wastes:

- Alternative D1: No Action
- Alternative D2: Excavation and Interim Local Waste Management

E. Remedial alternatives for mining-impacted recreation staging areas:

- Alternative E1: No Action
- Alternative E2: Containment/Isolation

The following subsections provide generalized descriptions of the remedy components for remedial alternatives to address each contaminant migration issue identified in Section 3.2.

5.4.1 Common Elements Between Remedial Alternatives

This subsection identifies the key common elements that would be required as part of all remedial alternatives (other than No Action alternatives). These elements are discussed here to limit repetition and to allow subsequent descriptions of the remedial alternatives to focus on the scope of activities and components required to address the contaminant migration issues, achieve the PRAOs, and comply with ARARs for the IRAs as identified in Section 3.

Examples of common elements include, but are not limited to, the following:

Pre-Construction Common Elements

- Pre-construction surveys including topographic surveys (i.e., property boundary surveys), cultural resources surveys, habitat surveys, noxious weed surveys, wetland delineations, and other surveys as identified in Appendix C for compliance with potential ARARs, would be conducted as necessary prior to implementing remedial actions at mining-related sources.

- Erosion and sediment control measures would be implemented, as necessary, to protect nearby areas.

Construction Common Elements

- It is assumed that a designated uncontaminated borrow source(s) (outside of mining-related sources) for constructing remedial components and access roads would be generated and transported from a public or private property at an onsite (i.e., within the Site) location. It is assumed that the suitable borrow location(s) would have sufficient volume to provide the required materials for each of the alternatives.

- Dust suppression would be maintained to eliminate contaminant migration during alternatives implementation. Water-based dust suppression is assumed to be conducted in most situations, but chemical-based dust suppression could be considered during construction for some specific applications like haul road maintenance.

- Access road improvements would be implemented, as necessary, to provide access to mining-related sources that are targeted for IRAs, using standard construction equipment. It is assumed that improvements would primarily be made for access from county roads and that these roads would be restored to their pre-construction condition following completion of the IRAs.

- Site rehabilitation/reclamation would be conducted following construction only to physically stabilize areas disturbed during IRA activities from subsequent erosion and sedimentation.

Post-Construction Common Elements

- ICs involve non-engineered measures, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action. These include governmental controls, enforcement tools with IC components, proprietary controls, and informational devices. These controls or combinations of controls would be implemented as needed, at federally managed lands (e.g., portions of Brooklyn Mine on lands managed by USFS) and voluntarily or pursuant to an enforcement action at private properties to maintain integrity of the proposed remedial components. The use of environmental covenants under state law at private properties, a specific type of proprietary control, is required for all IRAs to protect remedy components and to reduce human health risks for mining-impacted recreation staging areas.

Annual or Periodic Monitoring Common Elements

- Remedy performance monitoring would generally consist of sample collection and analysis. The specifics of the remedy performance monitoring for each alternative are detailed in the following sections.

- Maintenance would be performed as necessary to maintain the integrity of the remedial components. The specifics of maintenance for each alternative are detailed in the following sections.

- While the Site-wide risk assessment is ongoing, it is assumed that these proposed actions will not result in unlimited use and unrestricted exposure land use scenarios. Therefore, five-year reviews are assumed to be conducted for the mining-related sources included in the IRAs in conjunction with sources addressed by other response actions as part of Site-wide activities.

In addition to these common elements, each remedial alternative has primary remedial components specific to that alternative. The following subsections provide descriptions of the primary remedy components specific to each remedial alternative.

5.4.2 Remedial Alternatives for Mine Portal MIW Discharges

5.4.2.1 Alternative A1: No Action

Alternative A1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mine portal MIW discharges and partial obstructions to these discharges in their current state, and no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport with the associated contributions to unacceptable risks to the environment.

5.4.2.2 Alternative A2: Diversion/Isolation

Alternative A2 would involve construction of diversion and isolation components to route mine portal MIW discharge around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative A2 would also include maintenance of previously existing and newly constructed diversion and isolation components.

Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect mine portal MIW discharge and divert it around the existing mine waste. The construction of berms immediately upgradient of mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces, while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing MIW diversion or isolation components, repairs would be conducted to improve the conditions of those components.

In addition to mine wastes excavated for open channel diversion, mine wastes or other materials at the entrance to a mine portal that are partially obstructing the free flow of mine portal MIW discharge would be excavated. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated materials through ex situ amendment with a dewatering agent, as necessary, for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization such as analysis of geotechnical parameters would be conducted, as needed, on excavated and dewatered mine waste to evaluate physical stability. All dewatering activities would be conducted in a way to minimize infiltration into the ground surfaces and there is no expectation that incidental infiltration would result in additional adverse impacts to groundwater, if groundwater is present. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include best management practices (BMPs) such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes will be addressed as part of future remedy decisions and response actions.

Monitoring and maintenance of the diversion/isolation components and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

Alternative A2 would also include implementing the common elements required for all alternatives (other than No Action alternatives) as described in Section 5.4.1.

5.4.3 Remedial Alternatives for Mining-Related Source/Stormwater Interactions

5.4.3.1 Alternative B1: No Action

Alternative B1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave stormwater discharges to mining-related sources in their current state, and no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

5.4.3.2 Alternative B2: Stormwater Diversion/Isolation

Alternative B2 would involve construction of diversion and isolation components to route stormwater around mine portals and/or contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative B2 would also include maintenance of previously existing and newly constructed diversion and isolation components.

Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect stormwater and divert it around the existing mine portals or mine waste. The construction of berms immediately upgradient of mine portals or mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing stormwater diversion or isolation components, repairs would be conducted to improve the conditions of those components. Wastes generated from excavation stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation.

Where amenable, this alternative could include subsurface components in conjunction with the surface components previously described. Subsurface components such as interception trenches or French drains could be constructed to intercept stormwater that has infiltrated into the shallow subsurface and divert it around mine portals or mine waste.

Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

Alternative B2 would also include implementing the common elements required for all alternatives (other than No Action alternatives) as described in Section 5.4.1.

5.4.4 Remedial Alternatives for Mine Portal Pond Sediments

5.4.4.1 Alternative C1: No Action

Alternative C1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mine portal pond sediments in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

5.4.4.2 Alternative C2: Excavation and Interim Local Waste Management

Alternative C2 would involve excavating existing sediment and repair of berms within mine portal ponds to allow continued pond function.

Prior to removing sediment, the mine portal ponds would be drained. MIW within ponds would be managed locally solely to facilitate sediment excavation without treatment or external discharge to surface water. At mining-related sources where multiple ponds exist, MIW management from mine portals would include diversion of the MIW from one pond into the other ponds while mine portal pond sediment is being excavated. At mining-related sources where only one pond exists, mine portal pond sediment could be removed in phases using temporary berms in order to manage MIW within the pond. Short-circuiting of ponds (MIW passing through or around the pond without treatment), if those conditions currently exist, would also be addressed through the construction or repair of pond berms.

Excavating sediment would be conducted at mine portal ponds to facilitate continued function of the ponds. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated sediment through ex situ amendment with a dewatering agent, as necessary, for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. All dewatering activities would be conducted in a way to minimize infiltration into the ground surfaces and there is no expectation that incidental infiltration would result in additional adverse impacts to groundwater, if groundwater is present. Excavated wastes would be managed locally at the mining-related source on an interim basis. For this FFS, it is assumed that placement would be at an already impacted area; therefore, placement of mine portal pond sediment would not risk contaminating a previously unimpacted area. Interim local waste management would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes would be addressed as part of future remedy decisions and response actions.

Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to remove future accumulation of sediment in ponds and to maintain the integrity of both newly constructed and previously existing pond berms and interim management location components.

Alternative C2 would also include implementing the common elements required for all alternatives (other than No Action alternatives) as described in Section 5.4.1. The assumptions for Alternative C2 would be refined at the time of remedial design using location-specific information.

5.4.5 Remedial Alternatives for In-Stream Mine Wastes

5.4.5.1 Alternative D1: No Action

Alternative D1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave in-stream mine wastes in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

5.4.5.2 Alternative D2: Excavation and Interim Local Waste Management

Alternative D2 would involve excavating in-stream mine wastes at mining-related sources to remove wastes that impede flow or are susceptible to erosion or leaching of contaminants. During the excavation process, the excavated wastes would be placed outside of the stream channel adjacent to the mining-related source for gravity dewatering. The location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures.

Additional dewatering could be implemented for saturated mine wastes through ex situ amendment with a dewatering agent, as necessary, for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization such as analysis of geotechnical parameters would be conducted, as needed, on excavated and dewatered sediment to evaluate physical stability. All dewatering activities would be conducted in a way to minimize infiltration into the ground surfaces and there is no expectation that incidental infiltration would result in additional adverse impacts to groundwater, if groundwater is present. Excavated wastes would be managed locally at the mining-related source on an interim basis. For this FFS, it is assumed that placement would be at an already impacted area; therefore, placement of in-stream mine wastes would not risk contaminating a previously unimpacted area. Interim local waste management would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, would be addressed as part of future remedy decisions and response actions.

Monitoring and maintenance of the interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of interim management location components.

Alternative D2 would also include implementing the common elements required for all alternatives (other than No Action alternatives) as described in Section 5.4.1. The assumptions for Alternative D2 would be refined at the time of remedial design using location-specific information.

5.4.6 Remedial Alternatives for Mining-Impacted Recreation Staging Areas

5.4.6.1 Alternative E1: No Action

Alternative E1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mining-impacted recreation staging areas in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to human health.

5.4.6.2 Alternative E2: Containment/Isolation

Alternative E2 includes containment/isolation of mine wastes within mining-impacted recreation staging areas using covers to reduce disturbances of mine wastes and migration of contaminants.

A combination of different types of covers would be constructed at mining-impacted recreation staging areas. The covers would provide an exposure barrier and eliminate surface exposure to mine waste or contaminated soil. The covers would be sloped to promote positive drainage in order to minimize erosion and to reduce infiltration that could saturate the subsurface and compromise the integrity of the covers. Covers would minimize infiltration into the ground surfaces and there is no expectation that incidental infiltration would result in additional adverse impacts to groundwater, if groundwater is present. The prepared mine waste or contaminated soil surface would then be covered with an engineered layer of soil (which could be vegetated) or a surface layer of rock. The covers would be sloped to have positive drainage and minimize potential for erosion. The specific types of covers would be determined based on specific recreation staging uses of each mining-related source and availability of sufficient quantities of suitable cover materials for that use. Aggregate covers are assumed to be constructed over mine waste or contaminated soil at staging areas exposed to continuous vehicle traffic, such as parking areas or guided tour start locations, and along stream banks. Soil covers are assumed to be constructed over mine waste at areas not exposed to continuous vehicle traffic, such as campgrounds. These assumptions would be refined at the time of remedial design.

Covers would be revegetated or otherwise reclaimed to match active land use of each mining-impacted recreation staging area. Vegetated layers would be amended with organics, lime, and fertilizer, and then seeded.

Monitoring and maintenance of the covers would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of cover components to assess remedy performance and maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of cover components.

Alternative E2 would also include implementing the common elements required for all alternatives (other than No Action alternatives) as described in Section 5.4.1.

Section 6

Definition of Criteria Used in the Detailed Analysis of Remedial Alternatives

6.1 Definition of Criteria Used in the Detailed Analysis of Alternatives

The remedial alternatives identified in Section 5 are evaluated using the nine NCP evaluation criteria. These criteria were developed to address CERCLA statutory requirements and considerations for remedial action in accordance with the NCP and additional technical and policy considerations that have proven to be important for selecting an appropriate remedial action (EPA 1988). The following subsections describe the nine evaluation criteria used in the detailed analysis of remedial alternatives. Analysis of each alternative against the threshold and balancing criteria is presented in evaluation tables within Appendix E and summarized in Section 7.

The remedial alternatives identified in this FFS are not meant to be a final remedial action for all contaminated media at mining-related sources posing potential unacceptable risks to human health and the environment. While the criteria used for evaluating remedial alternatives do not change from those required by the NCP, the analysis of remedial alternatives is focused on pertinent criteria for the limited scope of these alternatives to meet the identified PRAOs for the IRAs. As appropriate, additional clarification has been provided in the following subsections to identify those criteria that are either not pertinent or have limited pertinence for evaluation of IRAs represented by the remedial alternatives.

6.1.1 Overall Protection of Human Health and the Environment

Each remedial alternative is assessed to determine whether it can provide adequate protection of human health and the environment (short and long term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site. Evaluation of this criterion focuses on how Site risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineered controls, or ICs, and whether a remedial alternative poses any unacceptable cross-media impacts.

Since the scope of the remedial alternatives is limited to addressing specific contaminant migration issues identified in this FFS and excludes other potential pathways (e.g., groundwater), analysis of this criterion is focused on providing adequate protection of human health and the environment on an interim basis to meet the IRA PRAOs until a final remedy is selected.

6.1.2 Compliance with ARARs

For this criterion, each remedial alternative is evaluated to determine how the chemical-, location, and action-specific ARARs identified in Appendix C of this document will be met.

If the assessment indicates an ARAR will not be met, then the basis for justifying one of the six ARAR waivers allowed under CERCLA is discussed. These ARAR waivers are detailed in Exhibit 6-1.

Exhibit 6-1 CERCLA ARAR Waivers

Waiver	Description
Interim measures	The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed. (CERCLA § 121(d)(4)(A))
Greater risk to human health and the environment	Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options. (CERCLA § 121(d)(4)(B))
Technical impracticability	Compliance with such requirement is technically impracticable from an engineering perspective. (CERCLA § 121(d)(4)(C))
Equivalent standard of performance	The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation through use of another method or approach. (CERCLA § 121(d)(4)(D))
Inconsistent application of state standards	With respect to a state standard, requirement, criteria, or limitation, the state has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other remedial actions. (CERCLA § 121(d)(4)(E))
Fund-balancing	In the case of a remedial action to be undertaken solely under Section 104 using the fund, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration and the availability of amounts from the fund to respond to other sites that present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats. (CERCLA § 121(d)(4)(F))

Compliance with an ARAR may not be possible for components of the remedial alternatives since they are interim in scope and do not address all contaminated media posing unacceptable human health and ecological risks. Thus, the CERCLA interim measures waiver is the most pertinent to the IRAs and the only CERCLA ARAR waiver evaluated in this FFS.

6.1.3 Long-Term Effectiveness and Permanence

Long-term effectiveness addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. Factors to be considered, as appropriate, include:

- The magnitude of residual risk remaining from untreated waste or treatment residuals at the conclusion of the remedial activities – The characteristics of the residuals are considered to the degree that they remain hazardous, considering their toxicity, mobility, or volume and propensity to bioaccumulate.

- The adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site – This factor includes an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and ecological receptors is within protective levels. This factor also addresses the long-term reliability of management controls for providing continued protection from residuals, the assessment of the potential need to replace technical components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.

Since the scope of the remedial alternatives is limited to addressing specific contaminant migration issues identified in this FFS and excludes evaluation of other potential migration pathways (e.g., groundwater), analysis of this criterion is focused on relevant short-term impacts by the IRA. Appendix D contains supporting information for evaluating remedial alternative effectiveness (short- and long-term) to assess their ability to mitigate the contamination migration issues identified for the IRA.

6.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion assesses the degree to which each remedial alternative employs a treatment technology to permanently and significantly reduce toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by contaminated media at the Site. Factors to be considered, as appropriate, include:

- The treatment processes that the alternatives used and the materials that they will treat.
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed.
- The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment.
- The degree to which the treatment is irreversible.
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents.
- Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action.

Since none of the remedial alternatives identified in Section 5 include treatment as defined by the NCP, this criterion will not be evaluated in detail.

6.1.5 Short-Term Effectiveness

This criterion reviews the effects of each remedial alternative during the construction and implementation phase of the remedial action until remedial response objectives are met. The short-term impacts of each alternative are assessed, considering the following factors, as appropriate:

- Protection of the community during remedial action – This factor addresses risks that might be posed to the community during implementation of an alternative.
- Protection of workers during remedial action – This factor addresses potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.

- Environmental impacts during remedial action – This factor addresses potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts.
- Time until remedial response objectives (i.e., RAOs) are achieved – This factor includes an estimate of time required to achieve protection for the entire site or individual elements associated with specific site areas or threats.

Since the scope of the remedial alternatives is limited to addressing specific contaminant migration issues identified in this FFS and excludes evaluation of other potential migration pathways (e.g., groundwater), analysis of this criterion is focused on relevant short-term impacts by the IRA. Appendix D contains supporting information for evaluating remedial alternative effectiveness (short- and long-term) to assess their ability to mitigate the contamination migration issues identified for the IRA.

6.1.6 Implementability

The technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation are evaluated under this criterion. The ease or difficulty of implementing each alternative will be assessed by considering the factors detailed in Exhibit 6-2.

Exhibit 6-2 Implementability Factors to be Considered during Alternative Evaluation

Factor	Description
Technical feasibility	▪ Technical difficulties and unknowns associated with the construction and operation of a technology ▪ Reliability of the technology, focusing on technical problems that will lead to schedule delays ▪ Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions ▪ Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure
Administrative feasibility	▪ Activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)
Availability of services and materials	▪ Availability of adequate offsite treatment, storage capacity, and disposal capacity and services ▪ Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources ▪ Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies ▪ Availability of prospective technologies

Since none of the remedial alternatives identified in Section 5 include offsite actions, as defined by the NCP, factors that involve offsite criterion will not be evaluated in detail.

6.1.7 Cost

The evaluation criterion of cost is assessed through cost estimates developed according to *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000). Flexibility is incorporated into each alternative for the location of remedial facilities, the selection of cleanup levels, and the period in which remedial action will be completed. Assumptions of the project scope and duration are defined for each alternative to provide cost estimates for the various remedial alternatives. Important assumptions specific to the scope of each alternative are summarized in the description of the alternatives in Section 5. Additional assumptions pertinent to analysis of cost are included in Section 7 and the detailed cost estimates in Appendix F.

The levels of detail employed in making these estimates are conceptual but are considered appropriate for making choices between alternatives; however, they are not meant to be design-level estimates used for budgeting purposes or Superfund settlements. The information provided in these cost estimates is based on the best available information regarding the anticipated scope of the remedial alternatives. The costs are typically evaluated with respect to the following three cost categories:

- Capital costs are expenditures that are required to construct a remedial action. They are exclusive of costs required to operate or maintain the action throughout its lifetime. Capital costs consist primarily of expenditures initially incurred to build or install the remedial action. Capital costs include all labor, equipment, and material costs (including contractor markups such as overhead and profit) associated with activities such as mobilization/ demobilization, site work, and excavation and transportation of mine wastes. Capital costs also include expenditures for professional/technical services that are necessary to support construction of the remedial action.

  Alternative-specific capital costs include all anticipated activities for implementation at the mining-related sources identified for evaluation to address the specific contaminant migration issue identified in the alternative, exclusive of monitoring and maintenance.

- Annual operation and maintenance (O&M) costs are labor, equipment, and material costs (including contractor markups such as overhead and profit) that occur annually and typically include activities related to monitoring, operating, and maintaining remedy components. Annual O&M costs also include expenditures for professional/technical services necessary to support post-construction activities.

  Annual O&M costs include all anticipated annual activities for alternative-specific, post-construction monitoring such as surface water monitoring to evaluate the effectiveness of the IRAs and inspection of diversion/isolation components, local interim management areas, and covers. Annual activities that are performed irrespective of the alternative (such as watershed monitoring) are excluded from cost analysis. The FFS does not make a distinction as to what entity is responsible for the costs for selected activities included as part of annual O&M costs.

- Periodic O&M costs are costs that occur only once every few years (e.g., for periodic maintenance) or expenditures that occur only once during the entire post-construction period or remedial time frame (e.g., site closeout, remedy failure/replacement). These costs may be either capital or O&M costs, but because of their periodic nature, it is more practical to consider them separately from other capital or annual O&M costs in the estimating process.

Periodic O&M costs include all anticipated periodic activities for alternative-specific, post-construction maintenance such as periodic removal of mine portal pond sediment and maintenance of diversion/isolation components, local interim management areas, and covers. Periodic activities that are performed irrespective of the alternative (such as five-year reviews) are excluded from cost analysis. The FFS does not make a distinction as to what entity is responsible for the costs for selected activities included as part of periodic O&M costs.

The present value cost of each alternative provides the basis for the cost comparison. The present value cost represents the amount of money that, if invested in the initial year of the remedial action at a given rate, would provide the funds required to make future payments to cover all costs associated with the remedial action over its planned life. Future costs are included and discounted (reduced) by the appropriate present value discount rate over the period of analysis selected for each alternative. Per guidance, inflation and depreciation are not considered in preparing the present value costs.

As discussed in *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000), the real discount (interest) rate used for present value analysis in the FFS depends on whether the Site is classified as a federal facility site. Federal facility sites are former or current installations operated or controlled by a federal government agency and identified by EPA's Federal Facilities Restoration and Reuse Office (FFRRO). The Site is not a federal facility identified within FFRRO's site inventory. In addition, the guidance specifically mentions that although a federal-led site cleaned up by EPA using the Superfund trust fund (i.e., fund-led sites) may be an analogous situation to a federal facility site being cleaned up using Superfund authority, there is always a chance that a potentially responsible party could remediate the Site. Thus, per guidance, a real discount rate of 7 percent should be used in calculating present value costs for all non-federal facility sites. A 7 percent real discount rate was used to develop present value costs for each alternative as presented in Appendix F.

The period of analysis is the period of time over which present value is calculated. In general, the period of analysis should be equivalent to the project duration, resulting in a complete life cycle cost estimate for implementing the remedial alternative. The project duration generally begins with the planning, design, and construction of the remedial alternative, continues through short- and long-term post-construction, and ends with project completion and closeout. For this FFS, the period of analysis is meant to cover the construction costs of alternative implementation and the post-construction costs necessary to maintain protectiveness of the IRA until a comprehensive remedial decision is made for the Site. The assumed period of analysis covering these activities for this FFS and used to develop estimates of present value costs for each alternative is 15 years. The guidance indicates site-specific justification should be provided when the project duration exceeds the selected period of present value analysis. Those justifications are provided in Section 7.

A "no-discounting" scenario is also included for the present value analysis of each alternative in Appendix F as recommended by the guidance for long-term projects. A non-discounted constant dollar cash flow over time demonstrates the impact of a discount rate on the total present value cost and the relative amounts of future annual expenditures. Non-discounted constant dollar costs are presented for comparison purposes only and should not be used in place of present value costs in the Superfund remedy section process.

The alternative-specific costs exclude consideration of other remedial alternatives that address other contaminant migration issues at the same mining related sources and locations due to uncertainties such as phasing and funding of the IRAs over the period of implementation. Thus, some common cost elements such as those discussed in Section 5.4.1 that include road improvements for accessing mining-related sources may be duplicative between alternatives and may result in conservative estimates when considering concurrent implementation of alternatives during remedial action.

6.1.8 State (Support Agency) Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. State (support agency) acceptance is a modifying criterion under the NCP. Assessment of the state acceptance will not be completed until comments on the proposed plan are submitted to EPA during the formal comment period. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in the FFS.

6.1.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. Assessment of concerns from the public will be completed after comments on the FFS and proposed plan are received by EPA and addressed in the IROD. Thus, community acceptance is not evaluated in the detailed analysis of alternatives presented in this FFS.

6.1.10 Criteria Priority

The nine NCP alternative evaluation criteria are categorized into three groups during detailed evaluation of the remedial alternatives as detailed in Exhibit 6-3.

Exhibit 6-3 Criteria Priorities

Group	Criteria	Definition
Threshold criteria	▪ Overall protection of human health and the environment ▪ Compliance with ARARs	Must be satisfied for remedial alternative to be selected
Balancing criteria	▪ Long-term effectiveness and permanence ▪ Reduction of toxicity, mobility, or volume through treatment ▪ Short-term effectiveness ▪ Implementability ▪ Cost	Technical criteria evaluated among those alternatives satisfying the threshold criteria
Modifying criteria	▪ State acceptance ▪ Community acceptance	Not evaluated in this FFS; will be evaluated after comments are received on the FFS and proposed plan

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Section 7

Detailed Analysis of Remedial Alternatives

This section presents the detailed analysis of the remedial alternatives described in Section 5. During detailed analysis, each alternative is assessed using the two threshold criteria, five balancing criteria as presented in Section 6, referred to herein as "NCP evaluation criteria." Analysis of each alternative against the threshold and balancing criteria is presented in evaluation tables within Appendix E. The results of the detailed analysis for each remedial alternative are then arrayed to perform a comparative analysis of the alternatives and identify the key tradeoffs between them, as presented in Section 8. The two modifying criteria, which are also NCP evaluation criteria, are not analyzed for remedial alternatives in this FFS due to the rationale provided in Sections 7.7 and 7.8.

7.1 Analysis Assumptions and Considerations

The following subsections describe assumptions made to simplify the detailed analysis of remedial alternatives and the ratings system used in the analysis.

7.1.1 Analysis Assumptions

There are numerous assumptions that affect, but are not drivers for, the overall outcome of detailed analysis for remedial alternatives. These alternative analysis assumptions generally fall into two main categories: mining-related source grouping assumptions and timeframe assumptions. Mining-related source grouping assumptions identify how different groupings of mining-related sources (i.e., land ownership and mining-related source location categories) impact the detailed analysis of remedial alternatives. Timeframe assumptions identify key timing-related assumptions, such as assumed period of analysis and sequencing. These alternative analysis assumptions are presented in Exhibit 7-1. Additional assumptions, including those that impact costs, are presented in Appendix F.

Exhibit 7-1 Alternative Analysis Assumptions

Alternative Analysis Assumption Category	Alternative Analysis Assumption Description	Rationale
Mining-Related Source Grouping Assumptions		
Variability of Mining-Related Source Characteristics	Identification of mining-related source location categories for remedial alternative evaluation	As defined in Section 2.3, mining-related sources in this FFS were divided into four location categories: conventional access-alpine, conventional access-subalpine, nonconventional access-alpine, and nonconventional access-subalpine. These location categories include differentiating factors that affect the evaluation of implementability, effectiveness, and cost criteria. Factors include accessibility of mining-related sources, size of equipment that can access the mining-related source, and sensitive vegetation. The evaluation tables in Appendix E present major differences between these mining-related source categories as they relate to the nine NCP evaluation criteria.

Exhibit 7-1 (continued)

Alternative Analysis Assumption Category	Alternative Analysis Assumption Description	Rationale
Mining-Related Source Grouping Assumptions		
Variability of Mining-Related Source Characteristics (continued)	Evaluation of remedial alternatives by mining-related source location categories rather than individual mining-related sources	This FFS identifies 26 mining-related sources (including two dispersed campground areas) within the Site with one or more contaminant migration issue. As described in the previous assumption, mining-related sources in this FFS were divided into four location categories based on two defining characteristics: road accessibility and ecoregion. Even within these four location categories, there is variability in other site characteristics such as topography and degree of vegetation coverage. Due to this variability of characteristics, evaluation of remedial alternatives against the NCP evaluation criteria without grouping by mining-related source locations would result in cumbersome and extensive evaluations with only minor nuances. For this FFS evaluation, it is assumed that remedial alternatives would be analyzed against the NCP evaluation criteria by mining-related source location categories rather than on an individual mining-related source basis.
Variability in Land Ownership/ Management of Mining-Related Sources	Differentiation of land ownership for mining-related sources only identified as pertinent to evaluations	Private ownership is the predominant ownership form for the mining-related sources identified in this FFS. Although mining-related sources also occur on publicly managed land (e.g., portions of Brooklyn Mine on lands managed by USFS), they do not result in significant differences in remedial alternative analysis against the NCP evaluation criteria except in a few instances. For this FFS evaluation, additional considerations are included for mining-related sources on publicly managed land including coordination with other governmental agencies and consideration of additional ARARs.
Timeframe Assumptions		
Temporal and Locational Sequencing	Temporal and locational sequencing of remedial alternative implementation not evaluated in the FFS	The evaluation of remedial alternatives in the FFS do not consider temporal sequencing or funding. The technical sequencing and funding of various remedial approaches cannot be objectively evaluated in the FFS due to uncertainties in how individual mining-related sources would be prioritized and organized for remedy implementation even if full funding were available. Thus, the analysis of some remedial alternatives components such as temporary access road construction may be duplicative between remedial alternatives that consider the same individual mining-related sources. The methodology and approach for remedial sequencing on an individual mining-related, source-specific basis would be addressed after the FFS during remedy selection or remedial design/remedial action.
Period of Analysis	15-year period of analysis for all remedial alternatives	This FFS evaluates remedial alternatives to address contaminant migration issues at the mining-related sources identified in Section 2. For this FFS, the period of analysis for all alternatives is assumed to be 15 years post-construction. The rationale for this period of analysis is that construction of the IRAs may take up to 5 years and that associated annual and periodic O&M activities would occur for up to an additional 10 years. The FFS assumption is that after this period, results of five-year reviews for the IRA components would inform final remedy decisions that integrate these components.

7.1.2 Analysis Approach and Ratings

Alternative analysis is inherently qualitative in nature (except for cost). The threshold and balancing evaluation criteria described in Section 6 are specified by the NCP and CERCLA guidance; however, the degree to which the criteria are weighted against each other is not specified. A determination of how the individual evaluation criteria influence the overall rankings is based on site-specific considerations and requires engineering judgment.

For this FFS, the following qualitative ratings for alternatives analysis were identified:

- Adequate; not adequate (only applies to overall protection of human health and the environment)
- None; will comply; will comply, but may require CERCLA ARAR waiver(s) (only applies to compliance with ARARs)
- None; low; low to moderate; moderate; moderate to high; high (for balancing criteria, excluding cost)

Appendix E presents the detailed analysis of each remedial alternative for the contaminant migration issues using the threshold and balancing criteria and their pertinent subcriteria. The following minimum information was considered in the analysis:

- Descriptions of mining-related sources
- Mining-related source location categories
- PRAOs and ARARs
- Anticipated remedial alternative scope, including quantities

7.2 Detailed Analysis of Mine Portal MIW Discharges Alternatives

7.2.1 Alternative A1: No Action

The description for Alternative A1 is provided in Section 5.4.2.1. Evaluation of threshold and primary balancing criteria for Alternative A1 is provided in Exhibit 7-2. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-2 Detailed Analysis Summary – Alternative A1

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	No action; does not meet PRAO 1; PRAOs 2 and 3 are not pertinent	Not Adequate	E-1a
	Compliance with ARARs	No action; ARARs not triggered	None	E-1b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Mine portal MIW discharges unaddressed	None	E-1c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-1d
	Short-Term Effectiveness	No action, no short-term risk posed	None	E-1e
	Implementability	No action, criterion is not applicable	None	E-1f
	Cost[1]	No action, criterion is not applicable	$0	E-1g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.2.2 Alternative A2: Diversion/Isolation

The description for Alternative A2 is provided in Section 5.4.2.2. Exhibit 7-3 provides a summary of the major remedial components for Alternative A2 requiring construction and the estimated quantities for these components.

Exhibit 7-3 Summary of Quantities for Major Remedial Components – Alternative A2

Remedial Component	Unit	Estimated Quantity
Estimated number of mining-related sources with mine portal MIW discharges	EA	20
Estimated total length of diversion/isolation components to be constructed	LF	3,560
Estimated in-place volume of mine wastes/materials partially obstructing mine portal MIW discharges	CY	440
Estimated weight of dewatering agent (assumed to be diatomaceous earth)	TON	4
Estimated in-place volume of borrow material for remedial component construction	CY	3,220

Notes:

Quantities summarized in this exhibit and additional quantities for secondary components of alternatives are provided in Appendix F. Although detailed quantities have been provided, they should be considered approximate for FFS evaluation purposes only.

EA – each, LF – linear feet, CY – cubic yards, TON – tons

Evaluation of threshold and primary balancing criteria for Alternative A2 is provided in Exhibit 7-4. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-4 Detailed Analysis Summary – Alternative A2

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	Provides stabilization of the source and prevents further environmental degradation; meets PRAO 1; PRAOs 2 and 3 are not pertinent	Adequate	E-2a
	Compliance with ARARs	See ARARs analysis (Appendix E)	Will comply, but may require CERCLA ARAR waiver(s)	E-2b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	▪ Post-construction inspection and maintenance of diversion/isolation components ▪ Post-construction inspection and maintenance of local waste management locations	Moderate	E-2c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-2d
	Short-Term Effectiveness	▪ Safety issues from transporting equipment and borrow material ▪ Adverse environmental impacts to streams during excavation	Moderate	E-2e
	Implementability	▪ Difficult access and constrained mine locations ▪ Frequent changes in weather and discharge conditions ▪ Uncertain borrow location(s) with suitable quality and quantity	Moderate	E-2f
	Cost[1]	▪ Temporary access road improvements ▪ Developing and transporting borrow material ▪ Post-construction monitoring and maintenance	$2,411,000	E-2g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.3 Detailed Analysis of Mining-Related Source/Stormwater Interactions Alternatives

7.3.1 Alternative B1: No Action

The description for Alternative B1 is provided in Section 5.4.3.1. Evaluation of threshold and primary balancing criteria for Alternative B1 is provided in Exhibit 7-5. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-5 Detailed Analysis Summary – Alternative B1

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	No action; does not meet PRAO 1; PRAOs 2 and 3 are not pertinent	Not Adequate	E-3a
	Compliance with ARARs	No action; ARARs not triggered	None	E-3b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Mining-related source/stormwater interactions unaddressed	None	E-3c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-3d
	Short-Term Effectiveness	No action, no short-term risk posed	None	E-3e
	Implementability	No action, criterion is not applicable	None	E-3f
	Cost[1]	No action, criterion is not applicable	$0	E-3g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.3.2 Alternative B2: Stormwater Diversion/Isolation

The description for Alternative B2 is provided in Section 5.4.3.2. Exhibit 7-6 provides a summary of the major remedial components for Alternative B2 requiring construction and the estimated quantities for these components.

Exhibit 7-6 Summary of Quantities for Major Remedial Components – Alternative B2

Remedial Component	Unit	Estimated Quantity
Estimated number of mining-related sources with mining-related source/stormwater interactions	EA	11
Estimated total length of diversion/isolation components to be constructed	LF	4,270
Estimated in-place volume of borrow material for remedial component construction	CY	50

Notes:

Quantities summarized in this exhibit and additional quantities for secondary components of alternatives are provided in Appendix F. Although detailed quantities have been provided, they should be considered approximate for FFS evaluation purposes only.

EA – each, LF – linear feet, CY – cubic yards

Evaluation of threshold and primary balancing criteria for Alternative B2 is provided in Exhibit 7-7. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-7 Detailed Analysis Summary – Alternative B2

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	Provides stabilization of the source and prevents further environmental degradation; meets PRAO 1; PRAOs 2 and 3 are not pertinent	Adequate	E-4a
	Compliance with ARARs	See ARAR analysis (Appendix E)	Will comply, but may require CERCLA ARAR waiver(s)	E-4b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Post-construction inspection and maintenance of diversion/isolation components	Moderate to High	E-4c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-4d
	Short-Term Effectiveness	Safety issues from transporting equipment and borrow material	Moderate to High	E-4e
	Implementability	▪ Difficult access ▪ Frequent changes in weather and discharge conditions ▪ Uncertain borrow location(s) with suitable quality and quantity	Moderate to High	E-4f
	Cost[1]	▪ Temporary access road improvements ▪ Developing and transporting borrow material ▪ Post-construction monitoring and maintenance	$1,889,000	E-4g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.4 Detailed Analysis of Mine Portal Pond Sediments Alternatives

7.4.1 Alternative C1: No Action

The description for Alternative C1 is provided in Section 5.4.4.1. Evaluation of threshold and primary balancing criteria for Alternative C1 is provided in Exhibit 7-8. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-8 Detailed Analysis Summary – Alternative C1

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	No action; does not meet PRAO 1; PRAOs 2 and 3 are not pertinent	Not Adequate	E-5a
	Compliance with ARARs	No action; ARARs not triggered	None	E-5b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Mine portal pond sediments unaddressed	None	E-5c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-5d
	Short-Term Effectiveness	No action, no short-term risk posed	None	E-5e
	Implementability	No action, criterion is not applicable	None	E-5f
	Cost[1]	No action, criterion is not applicable	$0	E-5g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.4.2 Alternative C2: Excavation and Interim Local Management

The description for Alternative C2 is provided in Section 5.4.4.2. Exhibit 7-9 provides a summary of the major remedial components for Alternative C2 requiring construction and the estimated quantities for these components.

Exhibit 7-9 Summary of Quantities for Major Remedial Components – Alternative C2

Remedial Component	Unit	Estimated Quantity
Estimated number of mining-related sources with mine portal pond sediments	EA	8
Estimated number of ponds	EA	14
Estimated horizontal extent of ponds	SF	68,800
Estimated in-place volume of mine portal pond sediments	CY	10,200
Estimated weight of dewatering agent (assumed to be diatomaceous earth)	TON	190
Estimated in-place volume of borrow material for remedial component construction	CY	2,710

Notes:

Quantities summarized in this exhibit and additional quantities for secondary components of alternatives are provided in Appendix F. Although detailed quantities have been provided, they should be considered approximate for FFS evaluation purposes only.

EA – each, SF – square feet, CY – cubic yards, TON – tons

Evaluation of threshold and primary balancing criteria for Alternative C2 is provided in Exhibit 7-10. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-10 Detailed Analysis Summary – Alternative C2

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	Provides stabilization of the source and prevents further environmental degradation; meets PRAO 1; PRAOs 2 and 3 are not pertinent	Adequate	E-6a
	Compliance with ARARs	See ARAR analysis (Appendix E)	Will comply, but may require CERCLA ARAR waiver(s)	E-6b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	▪ Post-construction inspection and maintenance of mine portal ponds/berms ▪ Post-construction inspection and maintenance of local waste management locations	Moderate	E-6c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-6d
	Short-Term Effectiveness	▪ Safety issues from transporting of equipment and borrow material ▪ Adverse environmental impacts to streams during excavation	Moderate to High	E-6e
	Implementability	▪ Difficult access and constrained mine locations ▪ Frequent changes in weather and discharge conditions ▪ Uncertain borrow location(s) with suitable quality and quantity	Moderate	E-6f
	Cost[1]	▪ Temporary access road improvements ▪ Developing and transporting of borrow material ▪ Management and dewatering of excavated sediment at interim local waste management areas ▪ Post-construction monitoring and maintenance	$3,384,000	E-6g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.5 Detailed Analysis of In-Stream Mine Wastes Alternatives

7.5.1 Alternative D1: No Action

The description for Alternative D1 is provided in Section 5.4.5.1. Evaluation of threshold and primary balancing criteria for Alternative D1 is provided in Exhibit 7-11. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-11 Detailed Analysis Summary – Alternative D1

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	No action; does not meet PRAO 1; PRAOs 2 and 3 are not pertinent	Not Adequate	E-7a
	Compliance with ARARs	No action; ARARs not triggered	None	E-7b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	In-stream mine wastes unaddressed	None	E-7c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-7d
	Short-Term Effectiveness	No action, no short-term risk posed	None	E-7e
	Implementability	No action, criterion is not applicable	None	E-7f
	Cost[1]	No action, criterion is not applicable	$0	E-7g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.5.2 Alternative D2: Excavation and Interim Local Management

The description for Alternative D2 is provided in Section 5.4.5.2. Exhibit 7-12 provides a summary of the major remedial components for Alternative D2 requiring construction and the estimated quantities for these components.

Exhibit 7-12 Summary of Quantities for Major Remedial Components – Alternative D2

Remedial Component	Unit	Estimated Quantity
Estimated number of mining-related sources with in-stream mine wastes	EA	2
Estimated horizontal extent of in-stream mine wastes	SF	8,900
Estimated in-place volume of in-stream mine wastes	CY	990
Estimated weight of dewatering agent (assumed to be diatomaceous earth)	TON	20
Estimated in-place volume of borrow material for remedial component construction	CY	180

Notes:

Quantities summarized in this exhibit as well as additional quantities for secondary components of alternatives are provided in Appendix F. Although detailed quantities have been provided, they should be considered approximate for FFS evaluation purposes only.

EA – each, SF – square feet, CY – cubic yards, TON – tons

Evaluation of threshold and primary balancing criteria for Alternative D2 is provided in Exhibit 7-13. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-13 Detailed Analysis Summary – Alternative D2

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating or Cost	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	Provides stabilization of the source and prevents further environmental degradation; meets PRAO 1; PRAOs 2 and 3 are not pertinent	Adequate	E-8a
	Compliance with ARARs	See ARAR analysis (Appendix E)	Will comply, but may require CERCLA ARAR waiver(s)	E-8b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Post-construction inspection and maintenance of local waste management locations	Moderate to High	E-8c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-8d
	Short-Term Effectiveness	▪ Safety issues from transporting of equipment and borrow material ▪ Adverse environmental impacts to streams from excavation	Moderate to High	E-8e
	Implementability	▪ Excavation performed in streams ▪ Uncertain borrow location(s) with suitable quality and quantity	Moderate	E-8f
	Cost[1]	▪ Temporary access road improvements ▪ Management and dewatering of excavated sediment at interim local waste management areas ▪ Post-construction monitoring and maintenance	$624,000	E-8g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.6 Detailed Analysis of Mining-Impacted Recreation Staging Areas Alternatives

7.6.1 Alternative E1: No Action

The description for Alternative E1 is provided in Section 5.4.6.1. Evaluation of threshold and primary balancing criteria for Alternative E1 is provided in Exhibit 7-14. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-14 Detailed Analysis Summary – Alternative E1

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	No action; does not meet PRAOs 2 and 3; PRAO 1 is not pertinent	Not Adequate	E-9a
	Compliance with ARARs	No action; ARARs not triggered	None	E-9b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Mining-impacted recreation staging areas unaddressed	None	E-9c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-9d
	Short-Term Effectiveness	No action, no short-term risk posed	None	E-9e
	Implementability	No action, criterion is not applicable	None	E-9f
	Cost[1]	No action, criterion is not applicable	$0	E-9g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.6.2 Alternative E2: Containment/Isolation

The description for Alternative E2 is provided in Section 5.4.6.2. Exhibit 7-15 provides a summary of the major remedial components for Alternative E2 requiring construction and the estimated quantities for these components.

Exhibit 7-15 Summary of Quantities for Major Remedial Components – Alternative E2

Remedial Component	Unit	Estimated Quantity
Estimated number of mining-related sources with mining-impacted recreation staging areas	EA	5
Estimated horizontal extent of aggregate (rock) covers to be constructed	AC	2.0
Estimated horizontal extent of soil covers to be constructed	AC	6.9
Estimated in-place volume of borrow material for remedial component construction	CY	18,600

Notes:

Quantities summarized in this exhibit, as well as additional quantities for secondary components of alternatives, are provided in Appendix F. Although detailed quantities have been provided, they should be considered approximate for FFS evaluation purposes only.

EA – each, AC – acres, CY – cubic yards

Evaluation of threshold and primary balancing criteria for Alternative E2 is provided in Exhibit 7-16. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix E that provide justification for the rating.

Exhibit 7-16 Detailed Analysis Summary – Alternative E2

Evaluation Criterion	Evaluation Subcriterion	Key Considerations in Analysis	Qualitative Rating	Evaluation Table Reference (Appendix E)
Threshold Criteria	Overall Protection of Human Health and the Environment	Provides stabilization of the source, prevents further environmental degradation, achieves significant risk reduction; meets PRAOs 2 and 3; PRAO 1 is not pertinent	Adequate	E-10a
	Compliance with ARARs	See ARAR analysis (Appendix E)	Will comply, but may require CERCLA ARAR waiver(s)	E-10b
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Post-construction inspection and maintenance of covers	Moderate to High	E-10c
	Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment	None	E-10d
	Short-Term Effectiveness	▪ Safety issues from grading mine wastes for covers ▪ Safety issues from transporting of equipment and borrow material ▪ Adverse environmental impacts during development and transport of borrow material	Moderate	E-10e
	Implementability	▪ Uncertain borrow location(s) with suitable quality and quantity	Moderate	E-10f
	Cost[1]	▪ Developing and transporting of borrow material ▪ Placement of soil cover ▪ Dust control ▪ Post-construction monitoring and maintenance	$1,668,000	E-10g

Notes:

1. Costs presented in this exhibit are present value costs. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

7.7 State (Support Agency) Acceptance

State (support agency) acceptance is a modifying criterion under the NCP. Assessment of the state acceptance will not be completed until comments on the proposed plan are submitted to EPA during the formal comment period. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in the FFS.

7.8 Community Acceptance

Community acceptance is also a modifying criterion under the NCP. Assessment of community acceptance will include responses to questions any interested person in the community may have regarding any component of the remedial alternatives presented in the proposed plan. This assessment will be completed after EPA receives public comments on the proposed plan during the public commenting period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the FFS.

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Section 8

Comparative Analysis of Alternatives

This FFS evaluated two remedial alternatives (including No Action alternatives required by the NCP) for each of the five contaminant migration issues, for a total of ten alternatives. These remedial alternatives were individually evaluated in Section 7 against the two threshold criteria and five balancing criteria. A comparative analysis of the remedial alternatives for each contaminant migration issue using the threshold and balancing criteria has been put into narrative form in the following subsections. The results of the individual detailed analysis for each remedial alternative are presented on Table 8-1; presentation of this information aids in understanding a comparative analysis of the alternatives and identifying the key tradeoffs between them. Only significant comparative differences between alternatives are presented; the full rationale for the qualitative ratings determined as part of detailed analysis for the individual alternatives is provided in Appendix E.

8.1 Comparative Analysis of Mine Portal MIW Discharges Alternatives (Alternatives A1 and A2)

8.1.1 Overall Protection of Human Health and the Environment

Of the two alternatives, the No Action alternative (i.e., Alternative A1) would fail to provide adequate protection of human health and the environment in the short term until a final remedy is selected and would not achieve PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Unaddressed mine portal MIW discharge would continue to release particulates containing COPCs to surface water and generate additional MIW from interaction with mining-related sources, which contribute to unacceptable ecological risks. Thus, this alternative was given a rating of "not adequate."

Alternative A2 was given a rating of "adequate" because, it would provide protection of human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. Alternative A2 addresses PRAO 1 by constructing and/or maintaining diversion and isolation components to route mine portal MIW discharge around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. This would reduce the potential for mine portal MIW discharges to generate additional MIW and reduce transport of particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. Mine wastes or other materials at the entrance to a mine portal that are partially obstructing free flow of MIW discharge would be excavated to reduce the potential for uncontrolled releases of particulates and MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. Residual risks would remain from untreated mine wastes managed locally at the mining-related sources. Long-term effectiveness of interim waste management locations would depend on BMPs, inspection, and repair, as necessary, to maintain their integrity. EPA would measure the extent by which ecological risks associated with contributions from MIW discharges have been reduced by this alternative. This data would provide information about the effectiveness of the IRA and is intended to help inform future remedial decisions at the Site. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and diversion/isolation components and prevent uses inconsistent with current and reasonably anticipated future land uses.

8.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Under Alternative A1, unaddressed mine portal MIW discharges would continue to release particulates containing COPCs to surface water. Because no action is taken, no chemical-, location, or action-specific ARARs are triggered. Thus, this alternative was given a rating of "none."

Chemical-specific ARARs would be pertinent to Alternative A2. State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative.

Location- and action-specific ARARs for Alternative A2 would be addressed during implementation of the IRA as indicated in the following paragraphs.

Excavation: The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met.

Dust Suppression: Dust suppression and emission-controlled equipment would be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements.

Dewatering: All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado Effluent Limitations and Colorado Discharge Permit System (CDPS) regulations for groundwater.

During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado effluent limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. Similarly, the substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked.

Interim Local Waste Management: Mine wastes at the Site were derived directly or indirectly from the extraction of ore and thus would be exempt from management as a RCRA hazardous waste (i.e., the Bevill exemption), thus mine wastes would be classified as a non-hazardous solid waste.

Pursuant to the Solid Wastes Disposal Sites and Facilities Act, Colorado Revised Statutes (C.R.S.) § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under a Colorado Mined Land Reclamation Board (MLRB) permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. The Colorado Department of Public Health and the Environment (CDPHE) interprets this provision to exempt CERCLA response actions performed consistently with MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal.

All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards), which would allow the alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations.

Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Surface Reclamation: All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Institutional Controls: Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Construction Activities: Cultural resource surveys have not been completed for all mining-related sources addressed by this alternative. If any cultural resources are found, surveys will be necessary to determine if adverse effects would occur, and if so, how the effects may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act.

If bald or golden eagles are observed during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act.

If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service (USFWS) and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations.

If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act.

If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act.

The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations.

Activities conducted during remedial action on USFS-managed land, such as obtaining borrow material and implementing the IRA at the Brooklyn Mine, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.

If the IRA involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and Federal Emergency Management Agency (FEMA) Floodplain Management Regulations. Activities under this alternative would be carried out in a manner that will comply with Colorado Noise Abatement Statue 25-12-103.

Since Alternative A2 could comply with substantive requirements of ARARs or invoke CERCLA ARAR waivers, it was given rating of "will comply, but may require CERCLA ARAR waiver(s)."

8.1.3 Long-Term Effectiveness and Permanence

Alternative A1 fails to provide long-term effectiveness and permanence since no action is taken. Unaddressed obstructed MIW discharges have potential to create unstable impoundments of MIW, sediments, and metal precipitates that could be released to surface water in an uncontrolled manner. This alternative would not reduce generation and migration of MIW and would not reduce releases of COPCs to surface water from interaction of MIW with mining-related sources. Left uncontrolled, mine portal MIW discharges could migrate to surface water and continue to contribute to unacceptable ecological risks. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Thus, this alternative was given a rating of "none."

The loading of COPCs is expected to decrease under Alternative A2 because diversion/isolation components addressing the interaction between mine portal MIW discharges and mine wastes reduces leaching and formation of MIW. However, the water quality in the streams, irrespective of the diversion/isolation components, would still be impacted and contribute to unacceptable ecological risks. Residual risks would remain from untreated mine wastes excavated for diversion/isolation components and managed locally at the mining-related sources on an interim basis. Inspection and repair of the diversion/isolation components would be performed as necessary to maintain their integrity. Long-term effectiveness of diversion/isolation components and interim local management locations would be dependent on BMPs, inspection, and repair, as necessary, to maintain their integrity. Inspection and repair of the diversion/isolation components and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Periodic monitoring and maintenance of interim management locations would be performed until final disposition of managed waste that would be addressed as part of a future response action. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and diversion/isolation components and prevent uses inconsistent with current and reasonably anticipated future land uses

This alternative was given a rating of "moderate," primarily due to considerations affecting long-term effectiveness and permanence of monitoring and maintaining isolation/diversion components at waste rock piles below mine portal MIW discharges and interim local waste management locations, with monitoring and maintenance as needed.

8.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives A1 and A2 fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Although gravity dewatering may result in positive benefits to geotechnical stability, it is not considered treatment per this NCP criterion because it does not result in permanent and irreversible reductions in toxicity, mobility, or volume of contamination. Thus, these alternatives were given a rating of "none."

8.1.5 Short-Term Effectiveness

No action, would be undertaken under Alternative A1 to address mine portal MIW discharges interacting with mining-related sources. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Thus, this alternative was given a rating of "none."

Alternative A2 would pose short-term risks to the community and workers related to increased traffic from transporting equipment and borrow material. Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures such as signage and flaggers would be implemented to protect workers and the community from increased traffic. Short-term risks to workers could also occur due to work in alpine areas and at the entrance to mine portals, but would be mitigated through safety measures such as personal protective equipment (PPE) (e.g., steel toe boots) and work zones, as well as other safety practices.

There would also be short-term impact to the environment. Short-term increases in contaminant loading could result due to disturbing the mine wastes during excavation, resulting in temporary increases in production of MIW. The excavation of mine wastes or other materials at the entrance to mine portals could cause a release of retained sludge and precipitates just inside the mine portals behind the blockages and temporary surges of higher flows of MIW until re-equilibration. Transporting and placing borrow material has potential environmental impacts from equipment emissions and disturbing borrow locations. Developing borrow areas could adversely impact the environment. Mitigation measures could include selecting easily accessible borrow locations and reclaiming borrow areas after use.

Alternative A2 was given a rating of "moderate," primarily due to the moderate quantities of borrow material required and the limited short-term impacts of constructing diversion/isolation components in uncontaminated areas of the mining-related sources. Alternative A2 was given a rating of "moderate," primarily due to short-term impacts associated with working at mine portals and MIW discharges and the moderate quantities of borrow material required for berm and access road construction that would be transported to mining-related sources for this alternative.

8.1.6 Implementability

Alternative A1 has no further action taken. Since no remedial action is taken, this alternative was given a rating of "none."

Alternative A2 includes constructing diversion/isolation components, excavation, dewatering, and interim local management of mine wastes. These are conventional construction practices and can be implemented using available equipment and labor resources. Maintenance and monitoring of diversion/isolation components and interim local waste management areas could prove difficult due to difficult access and constrained locations, especially at alpine and subalpine-category locations with non-conventional access. Uncontaminated borrow material for constructing remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified Monitoring and maintenance of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. Maintenance of ICs may be more difficult due to various types of ownership and land use and would require agency coordination.

Alternative A2 was given a rating of "moderate," primarily due to challenges associated with working at mine portals and MIW discharges and the moderate quantities of borrow material required for berm and access road construction.

8.1.7 Cost

Present value costs for both alternatives were evaluated over a 15-year period after the base year (Years 0 through 15).

The present value cost for Alternative A1 is $0. The present value cost for Alternative A2 is $2,411,000.

8.2 Comparative Analysis of Mining-Related Source/Stormwater Interactions Alternatives (Alternatives B1 and B2)

8.2.1 Overall Protection of Human Health and the Environment

Of the two alternatives, the No Action alternative (i.e., Alternative B1) would fail to provide adequate protection of human health and the environment in the short term until a final remedy is selected and would not achieve PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Unaddressed stormwater interacting with mining-related sources would continue to generate MIW and release particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. Thus, this alternative was given a rating of "not adequate."

Alternative B2 was given a rating of "adequate" because, it would provide protection of human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. Alternative B2 addresses PRAO 1 by constructing and/or maintaining diversion and isolation components to route stormwater around mine portals and/or mine wastes with the potential for interaction and co-mingling at mining-related sources. This would reduce the potential for stormwater to generate additional MIW and reduce transport of particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. Wastes generated from excavating stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation. Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). EPA would measure the extent by which ecological risks associated with contributions from mining related source/storm water interactions have been reduced by this alternative. This data would provide information about the effectiveness of the IRA and is intended to help inform future remedial decisions at the Site. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of diversion/isolation components and prevent uses inconsistent with current and reasonably anticipated future land uses.

8.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

Under Alternative B1, unaddressed stormwater interacting with mining-related sources would continue to release particulates containing COPCs to surface water. Because no action is taken, no chemical-, location-, or action-specific ARARs are triggered. Thus, this alternative was given a rating of "none."

Chemical-specific ARARs would be pertinent to Alternative B2. State water quality standards would likely not be met for streams receiving stormwater discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface

Water. The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative.

Location- and action-specific ARARs for Alternative B2 would be addressed during implementation of the IRA as indicated in the following paragraphs.

Excavation: The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met.

Dust Suppression: Dust suppression and emission-controlled equipment would be used during construction activities for the alternative to achieve compliance with Colorado Emission Control requirements.

Surface Reclamation: All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Institutional Controls: Environmental Covenants would be implemented to protect diversion/isolation components and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Construction Activities: Cultural resource surveys have not been completed for all mining-related sources addressed by this alternative. If any cultural resources are found, surveys will be necessary to determine if adverse effects would occur, and if so, how the effects may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act.

If bald or golden eagles are observed during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act.

If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by USFWS and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations.

If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act.

If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act.

The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations.

Activities conducted during remedial action on USFS-managed land, such as obtaining borrow material and implementing the IRA at the Brooklyn Mine, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.

If the IRA involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management Regulations. Activities under this alternative would be carried out in a manner that will comply with Colorado Noise Abatement Statue 25-12-103.

Since Alternative B2 could comply with substantive requirements of ARARs or invoke CERCLA ARAR waivers, it was given rating of “will comply, but may require CERCLA ARAR waiver(s).”

8.2.3 Long-Term Effectiveness and Permanence

Alternative B1 fails to provide long-term effectiveness and permanence since no action is taken. This alternative would not reduce generation and migration of MIW from interaction of stormwater with mining-related sources and would not reduce releases of COPCs to surface water that would continue to contribute to unacceptable ecological risks. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Thus, this alternative was given a rating of “none.”

The loading of COPCs is expected to decrease under Alternative B2 because diversion/isolation components addressing the interaction between stormwater and mining-related sources reduces leaching and formation of MIW. Routing stormwater around mine portals and/or contaminated mine wastes with the potential for interaction and co-mingling at mining-related sources would reduce the potential for stormwater to generate additional MIW and release particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. However, the water quality in the streams irrespective of diversion/isolation components for stormwater would still be impacted and contribute to unacceptable ecological risks. Long-term effectiveness of diversion/isolation components would depend on their integrity. Inspection and repair of the diversion/isolation components would be conducted, as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of diversion/isolation components and prevent uses inconsistent with current and reasonably anticipated future land uses. This alternative was given a rating of "moderate to high," primarily due to the long-term effectiveness and permanence of isolation/diversion components in uncontaminated areas of mining-related sources, with monitoring and maintenance as needed.

8.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives B1 and B2 fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Thus, these alternatives were both given a rating of "none."

8.2.5 Short-Term Effectiveness

No action would be undertaken under Alternative B1 to address stormwater discharges interacting with mining-related sources. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Thus, this alternative was given a rating of "none."

Alternative B2 would pose short-term risks to the community and workers related to increased traffic. Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures such as signage and flaggers would be implemented to protect workers and the community from increased traffic. Short-term risks to workers would be mitigated through safety measures such as PPE (e.g., steel toe boots) and work zones, as well as other safety practices. There would also be short-term impacts to the environment. Transporting and placing borrow material has potential environmental impacts from equipment emissions and disturbing borrow locations. Developing borrow areas could adversely impact the environment. Mitigation measures could include selecting easily accessible borrow locations and reclaiming borrow areas after use.

Alternative B2 was given a rating of "moderate to high," primarily due to the limited quantities of borrow material required and the limited short-term impacts of constructing diversion/isolation components in uncontaminated areas of the mining-related sources.

8.2.6 Implementability

Alternative B1 has no further action taken. Since no remedial action is taken, this alternative was given a rating of "none."

Alternative B2 includes constructing diversion/isolation components. These are conventional construction practices and can be implemented using available equipment and labor resources. Maintenance and monitoring of diversion/isolation components could provide difficulties due to difficult access and constrained locations, especially at non-conventional access-alpine and subalpine categories. Uncontaminated borrow material for constructing remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified. Monitoring and maintenance of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. Maintenance of ICs may be more difficult due to various types of ownership and land use and would require agency coordination.

Alternative B2 was given a rating of "moderate to high," primarily due to the limited quantities of borrow material required and the relatively simple scope of constructing diversion/isolation components for stormwater in uncontaminated areas.

8.2.7 Cost

Present value costs for both alternatives were evaluated over a 15-year period after the base year (Years 0 through 15).

The present value cost for Alternative B1 is $0. The present value cost for Alternative B2 is $1,889,000.

8.3 Comparative Analysis of Mine Portal Pond Sediments Alternatives (Alternatives C1 and C2)

8.3.1 Overall Protection of Human Health and the Environment

Of the two alternatives, the No Action alternative (i.e., Alternative C1) would fail to provide adequate protection of human health and the environment in the short term until a final remedy is selected and would not achieve PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Unaddressed mine portal pond sediments would continue to reduce storage space and residence time for MIW in ponds increasing the likelihood for short circuiting and uncontrolled release of MIW and particulates containing COPCs, which contribute to unacceptable ecological risks. Thus, this alternative was given a rating of "not adequate."

Alternative C2 was given a rating of "adequate" because, it would provide protection of human health and environment in a short term and is intended to provide adequate protection until a final remedy is selected. This alternative would provide stabilization of the source and prevent further environmental degradation. Alternative C2 addresses PRAO 1 through excavation and interim local waste management of pond sediments that would reduce the potential for uncontrolled releases of particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. Excavation of pond sediments and repair of pond berms would increase storage space for MIW in ponds and minimize short-circuiting of MIW to increase residence time. Excavated mine portal pond sediments would be managed locally at the mining-related source on an interim basis, but residual risks would remain from untreated mine portal pond sediments managed locally. Interim local waste management would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. Long-term effectiveness of interim waste management locations would depend on BMPs, inspection, and repair as necessary to maintain their integrity. Monitoring and maintenance of the interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). EPA would measure the extent by which ecological risks associated with contributions from mine portal pond sediments have been reduced by this alternative. This data would provide information about the effectiveness of the IRA and is intended to help inform future remedial decisions at the Site. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and prevent uses inconsistent with current and reasonably anticipated future land uses.

8.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

Under Alternative C1 unaddressed mine portal pond sediments would continue to release particulates containing COPCs to surface water. Because no action is taken, no chemical-, location-, or action-specific ARARs are triggered. Thus, this alternative was given a rating of "none." Chemical-specific ARARs would be pertinent to Alternative C2. State water quality standards would not be met for the streams after removal of mine pond portal sediments is complete due to other contributing mining-related sources; thus, the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative.

Location- and action-specific ARARs for Alternative C2 would be addressed during implementation of the IRA, as indicated in the following paragraphs.

Excavation: The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met.

Dust Suppression: Dust suppression and emission-controlled equipment would be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements.

Dewatering: All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration into the ground surface that could cause additional degradation of groundwater, if present. Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of CDPS regulations for groundwater.

During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado effluent limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. Similarly, the substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked.

Interim Local Waste Management: Mine wastes at the Site were derived directly or indirectly from the extraction of ore and thus would be exempt from management as a RCRA hazardous waste (i.e., the Bevill exemption), thus mine wastes would be classified as a non-hazardous solid waste.

Pursuant to the Solid Wastes Disposal Sites and Facilities Act, C.R.S. § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under an MLRB permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. CDPHE interprets this provision to exempt CERCLA response actions performed consistently with MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal.

All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards), which would allow alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations.

Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Surface Reclamation: All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Institutional Controls: Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Construction Activities: Cultural resource surveys have not been completed for all mining-related sources addressed by this alternative. If any cultural resources are found, surveys will be necessary to determine if adverse effects would occur, and if so, how the effects may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act.

If bald or golden eagles are observed during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act.

If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by USFWS and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations.

If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act.

If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act.

The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations.

Activities conducted during remedial action on USFS-managed land, such as obtaining borrow material and implementing the IRA at the Brooklyn Mine, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.

If the IRA involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management Regulations. Activities under this alternative would be carried out in a manner that will comply with Colorado Noise Abatement Statue 25-12-103.

Since Alternative C2 could comply with substantive requirements of ARARs or invoke CERCLA ARAR waivers, it was given rating of "will comply, but may require CERCLA ARAR waiver(s)."

8.3.3 Long-Term Effectiveness and Permanence

Alternative C1 fails to provide long-term effectiveness and permanence since no action is taken. Unaddressed sediments would continue to reduce storage space of MIW in mine portal ponds and result in the potential for uncontrolled releases of particulates and/or MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Thus, this alternative was given a rating of "none."

Excavating mine portal pond sediments and repairing pond berms under Alternative C2 improves the effectiveness of the ponds and reduces the potential for an uncontrolled release of MIW. However, the water quality in the streams, irrespective of the excavated mine portal pond sediments, would still be impacted. Residual risks remain from untreated mine portal pond sediments managed locally at the mining-related source on an interim basis. Long-term effectiveness of interim local waste management locations would depend on BMPs, inspection, and repair, as necessary, to maintain their integrity. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and prevent uses inconsistent with current and reasonably anticipated future land uses.

This alternative was given a rating of "moderate," primarily due to considerations affecting long-term effectiveness and permanence of monitoring and maintaining mine portal ponds below mine portal MIW discharges and interim local waste management locations, with monitoring and maintenance as needed.

8.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives C1 and C2 fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Although gravity dewatering under Alternative C2 may result in positive benefits to geotechnical stability, it is not considered treatment per this NCP criterion because it does not result in permanent and irreversible reductions in toxicity, mobility, or volume of contamination. Thus, these alternatives were given a rating of "none."

8.3.5 Short-Term Effectiveness

No action would be undertaken under Alternative C1 to mine portal pond sediments. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Thus, this alternative was given a rating of "none."

Short-term risk posed to the community and workers under Alternative C2 relate to increased traffic. Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures such as signage and flaggers would be implemented to protect workers and community from increased traffic. Short-term risks to workers would be mitigated through safety measures such as PPE (e.g., steel toe boots) and work zones, as well as other safety practices. Short-term risks to workers and the community, and the environment could be mitigated through measures such as water-based dust suppression.

There would also be short-term impacts to the environment. Short-term increases in contaminant loading could result due to disturbing the mine portal pond sediments during excavation, resulting in temporary increases in production of MIW. Transporting and placing borrow material has potential environmental impacts from equipment emissions and disturbing borrow locations. Developing borrow areas could adversely impact the environment. Mitigation measures could include selecting easily accessible borrow locations and reclaiming borrow areas after use.

Alternative C2 was given a rating of "moderate to high," primarily due to the limited quantities of borrow material required and the limited short-term impacts from excavating mine portal pond sediments.

8.3.6 Implementability

Alternative C1 has no further action taken, this alternative was given a rating of "none."

Alternative C2 includes excavation, dewatering, and interim local waste management of mine portal pond sediments. These are conventional construction practices and can be implemented using available equipment and labor resources. Maintenance and monitoring of interim local waste management areas could prove difficult due to access and constrained mining-related categories, especially at alpine and subalpine-category locations with non-conventional access. Uncontaminated borrow material for constructing pond and interim local waste management location berms and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified. Monitoring and maintenance of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. Maintenance of ICs may be more difficult due to various types of ownership and land use and would require agency coordination.

Alternative C2 was given a rating of "moderate," primarily due to challenges associated with working with MIW discharges to ponds and moderate quantities of borrow material required for berms and access road construction.

8.3.7 Cost

Present value costs for both alternatives were evaluated over a 15-year period after the base year (Years 0 through 15).

The present value cost for Alternative C1 is $0. The present value cost for Alternative C2 is $3,384,000.

8.4 Comparative Analysis of In-Stream Mine Wastes Alternatives (Alternatives D1 and D2)

8.4.1 Overall Protection of Human Health and the Environment

Of the two alternatives, the No Action alternative (i.e., Alternative D1) would fail to provide adequate protection of human health and the environment in the short term until a final remedy is selected and would not achieve PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Unaddressed in-stream mine wastes would continue to impede stream flow, increasing the potential for erosion or mass movement of contamination in particulate form and/or leaching of contaminants from mine wastes. Unaddressed in-stream mine wastes could result in migration of particulates and/or MIW containing COPCs to surface water especially during periods of precipitation and snowmelt, which contribute to unacceptable ecological risks. Thus, this alternative was given a rating of "not adequate."

Alternative D2 was given a rating of "adequate" because, it would provide protection of human health and environment in a short term and is intended to provide adequate protection until a final remedy is selected. This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. Alternative D2 achieves PRAO 1 by excavating in-stream mine wastes that impede flow or are susceptible to erosion or leaching of contaminants and formation of MIW and reduces transport of particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. Excavated in-stream mine wastes would be managed locally at the mining-related sources on an interim basis. Interim local waste management would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues but residual risks would remain from untreated in-stream mine wastes managed locally. Monitoring and maintenance of the interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Maintenance would be performed as necessary to maintain the integrity of interim management location components. EPA would measure the extent by which ecological risks associated with contributions from in-stream mine waste have been reduced by this alternative. This data would provide information about the effectiveness of the IRA and is intended to help inform future remedial decisions at the Site. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and prevent uses inconsistent with current and reasonably anticipated future land uses.

8.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

Unaddressed in-stream mine wastes under Alternative D1 would continue to release particulates containing COPCs to surface water. Because no action is taken, no chemical-, location-, or action-specific ARARs are triggered. Thus, this alternative was given a rating of "none." Chemical-specific ARARs would be pertinent to Alternative D2. State water quality standards would likely not be met for streams after removal of in-stream mine wastes due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative.

Location- and action-specific ARARs for Alternative D2 would be addressed during implementation of the IRA as indicated in the following paragraphs.

Excavation: The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met.

Dust Suppression: Dust suppression and emission-controlled equipment would be used during construction activities for the alternative to achieve compliance with Colorado Emission Control requirements.

Dewatering: All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration into the ground surface that could cause additional degradation of groundwater, if present. Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado Effluent Limitations and CDPS regulations for groundwater.

During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado Effluent Limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. Similarly, the substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked.

Interim Local Waste Management: Mine wastes at the Site were derived directly or indirectly from the extraction of ore and thus would be exempt from management as a RCRA hazardous waste (i.e., the Bevill exemption), thus mine wastes would be classified as a non-hazardous solid waste.

Pursuant to the Solid Wastes Disposal Sites and Facilities Act, C.R.S. § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under an MLRB permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. CDPHE interprets this provision to exempt CERCLA response actions performed consistently with MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal.

All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards), which would allow the alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations.

Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Surface Reclamation: All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3.

Institutional Controls: Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Construction Activities: Cultural resource surveys have not been completed for all mining-related sources addressed by this alternative. If any cultural resources are found, surveys will be necessary to determine if adverse effects would occur, and if so, how the effects may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act.

If bald or golden eagles are observed during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act.

If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by USFWS and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations.

If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act.

If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act.

The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations.

Activities conducted during remedial action on USFS-managed land, such as obtaining borrow material, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.

If the IRA involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management Regulations. Activities under this alternative would be carried out in a manner that will comply with Colorado Noise Abatement Statue 25-12-103.

Since Alternative D2 could comply with substantive requirements of ARARs or invoke CERCLA ARAR waivers, it was given rating of "will comply, but may require CERCLA ARAR waiver(s)."

8.4.3 Long-Term Effectiveness and Permanence

Alternative D1 fails to provide long-term effectiveness and permanence since no action is taken. Unaddressed in-stream mine wastes would continue to have the potential for erosion and result in the potential for releases of particulates and/or MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Thus, this alternative was given a rating of "none."

The loading of COPCs is expected to decrease through removing in-stream mine wastes under Alternative D2 because excavation and interim local waste management reduces the contact of the water with the mine waste and thereby reduces leaching and formation of MIW and erosion and transport of particulates containing COPCs to surface water, which contribute to unacceptable ecological risks. However, the water quality in the streams, irrespective of the excavated mine wastes, would still be impacted. Residual risks remain from untreated waste managed locally at the mining-related source on an interim basis. Long-term effectiveness of interim local management locations would depend on BMPs, inspection, and repair, as necessary, to maintain their integrity. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and prevent uses inconsistent with current and reasonably anticipated future land uses.

This alternative was given a rating of "moderate to high," primarily because excavated wastes would no longer be present in streams and would be managed in interim local waste management locations that could be monitored and maintained as needed.

8.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives D1 and D2 fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Although gravity dewatering under Alternative D2 may result in positive benefits to geotechnical stability, it is not considered treatment per this NCP criterion because it does not result in permanent and irreversible reductions in toxicity, mobility, or volume of contamination. Thus, these alternatives were given a rating of "none."

8.4.5 Short-Term Effectiveness

No action would be undertaken under Alternative D1 for in-stream mine wastes. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Thus, this alternative was given a rating of "none."

Short-term risk posed to the community and workers under Alternative D2 relate to increased traffic. Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures such as signage and flaggers would be implemented to protect workers and community from increased traffic. Short-term risks to workers would be mitigated through safety measures such as PPE (e.g., steel toe boots) and work zones, as well as other safety practices.

There would also be short-term impacts to the environment. Short-term increases in contaminant loading could result due to disturbing the in-stream mine wastes during excavation, resulting in temporary increases in production of MIW. Transporting and placing borrow material would have potential environmental impacts from equipment emissions and disturbing borrow locations. Developing borrow areas could adversely impact the environment. Mitigation measures could include selecting easily accessible borrow locations and reclaiming borrow areas after use. Alternative D2 was given a rating of "moderate to high," primarily due to the limited quantities of borrow material required and the limited short-term impacts of excavating in-stream mine wastes.

8.4.6 Implementability

Alternative D1 has no further action taken. Since no remedial action is taken, this alternative was given a rating of "none."

Alternative D2 includes excavation, dewatering, and interim local waste management of in-stream mine waste. These are conventional construction practices and can be implemented using available equipment and labor resources. Maintenance and monitoring of interim local waste management areas could prove difficult due to access and constrained mining-related categories, especially at alpine and subalpine-category locations with non-conventional access. Uncontaminated borrow material for constructing remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified. Monitoring and maintenance of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. Maintenance of ICs may be more difficult due to various types of ownership and land use and would require agency coordination.

Alternative D2 was given a rating of "moderate," primarily due to the challenges of excavating and dewatering in-stream mine wastes.

8.4.7 Cost

Present value costs for both alternatives were evaluated over a 15-year period after the base year (Years 0 through 15).

The present value cost for Alternative D1 is $0. The present value cost for Alternative D2 is $624,000.

8.5 Comparative Analysis of Mining-Impacted Recreation Staging Areas Alternatives (Alternatives E1 and E2)

8.5.1 Overall Protection of Human Health and the Environment

Of the two alternatives, the No Action alternative (i.e., Alternative E1) would fail to provide protection of human health and the environment in the short term until a final remedy is selected. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Unaddressed mining-impacted recreation staging areas would not achieve PRAOs 2 and 3 (PRAO 1 is not pertinent to this contaminant migration issue) since no action would be taken to prevent human exposure through ingestion and inhalation to mine wastes and contaminated soils containing lead and through ingestion to mine wastes and contaminated soils containing arsenic that exceed risk-based levels during camping at recreation staging activities. Thus, this alternative was given a rating of "not adequate."

Alternative E2 was given a rating of "adequate." Alternative E2 would provide protection of human health and environment in the short term until a final remedy is selected. This alternative would provide stabilization of the mining-related sources at recreation staging areas, prevent further environmental degradation, and achieve significant risk reduction quickly. Alternative E2 addresses PRAOs 2 and 3 by containing/isolating mine wastes and contaminated soils within mining-impacted recreation staging areas. Combinations of aggregate and soil covers would be implemented to reduce disturbances of mine wastes and contaminated soils, and migration of contaminants. The covers would provide an exposure barrier and eliminate surface exposure to mine waste and contaminated soils. The covers would be sloped to promote positive drainage in order to minimize erosion and to reduce infiltration that could saturate the subsurface and compromise the integrity of the covers. The covers used for containment/isolation of mine wastes and contaminated soils could be breached if disturbed, resulting in potential COPC exposures to campers. Long-term effectiveness of covers would depend on inspection and repair, as necessary, to maintain their integrity. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of the covers and prevent uses inconsistent with current and reasonably anticipated future land uses. Monitoring and maintenance of the covers would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Maintenance would be performed as necessary to maintain the integrity of covers

8.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

Under Alternative E1, unaddressed mine wastes and contaminated soils at mining-impacted recreation staging areas would continue to pose unacceptable risks to human health. Because no action is taken, no chemical-, location-, or action-specific ARARs are triggered. Thus, this alternative was given a rating of "none."

Chemical-specific ARARs would be pertinent to Alternative E2. State water quality standards would likely not be met for streams after the capping of recreation use areas due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative.

Location- and action-specific ARARs for Alternative E2 would be addressed during implementation of the IRA as indicated in the following paragraphs.

Cover Placement: The placement and grading of covers is assumed to be performed without the discharge of dredged or fill materials into the waters of the U.S. Thus, the substantive requirements of Section 404 would not be triggered. If grading activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. All cover placement activities would be conducted in a way minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado Effluent Limitations and Colorado Discharge Permit System (CDPS) regulations for groundwater. For channelized stormwater discharges from covers, the substantive provisions of the CDPS program would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked. During construction of the covers, the discharge limit requirements of Colorado effluent limitations would be met without treatment; otherwise an interim measures CERCLA ARAR waiver would be invoked.

Surface Reclamation: All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. During construction and seeding of covers, compliance would be achieved through completion of noxious weed surveys and coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Noxious Weed Act and the San Juan County Noxious Weed regulations.

Dust Suppression: Dust suppression and emission-controlled equipment will be used during construction activities for this alternative to achieve compliance with Colorado Emission Control regulations.

Institutional Controls: Environmental Covenants would be implemented for the covered portions of mining-impacted recreation staging areas to meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Construction Activities: Cultural resource surveys have not been completed for all mining-related sources addressed by this alternative. If any cultural resources are found, surveys will be necessary to determine if adverse effects would occur, and if so, how the effects may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act.

If bald or golden eagles are observed during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act.

If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by USFWS and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations.

If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act.

If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act.

The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations.

Activities conducted during remedial action on USFS-managed land, such as obtaining borrow material, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.

If the alternative involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management

Regulations. Activities under this alternative would be carried out in a manner that will comply with Colorado Noise Abatement Statue 25-12-103.

Since Alternative E2 could comply with substantive requirements of ARARs or invoke CERCLA ARAR waivers, be waived, it was given rating of "will comply, but may require CERCLA ARAR waiver(s)."

8.5.3 Long-Term Effectiveness and Permanence

Alternative E1 fails to provide long-term effectiveness and permanence since no action is taken. Unaddressed mine waste and contaminated soils at mining-impacted recreation staging areas could result in potential adverse lead and arsenic exposures to humans during camping. This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. Thus, this alternative was given a rating of "none."

Under Alternative E2, exposures to mine wastes and contaminated soils containing lead or arsenic that exceed risk-based levels are reduced through covers installed over recreation staging areas. However, the mine wastes and contaminated soils posing unacceptable human health risks would be left in place under the covers. The covers used for containing/isolating mine wastes and contaminated soils could be breached resulting in potential lead and arsenic exposures to campers if disturbed. The covers would be sloped to promote positive drainage that minimizes erosion and to reduces infiltration that could saturate the subsurface and compromise the integrity of the covers. ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of the covers and prevent uses inconsistent with current and reasonably anticipated future land uses. Long-term effectiveness of covers would depend on BMPs, inspection, and repair, as necessary, to maintain their integrity. Thus, this alternative was given a rating of "moderate to high," primarily due to the long-term effectiveness and permanence of covers, with monitoring and maintenance as needed.

8.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives E1 and E2 fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives. Thus, both alternatives were given a rating of "none."

8.5.5 Short-Term Effectiveness

No action, would be taken under Alternative E1 to mining-impacted recreation staging areas. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Thus, this alternative was given a rating of "none."

Alternative E2 poses short-term risks to the community and workers related to increased traffic. Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures such as signage and flaggers would be implemented to protect workers and community from increased traffic. Short-term risks to workers would be mitigated through safety measures such as PPE (e.g., steel toe boots) and work zones, as well as other safety practices. Alternative E2 would involve disturbing mine wastes and contaminated soils, which could pose potential adverse impacts through dispersion of dust. Short-term risks to workers, the community, and the environment could be mitigated through measures such as water- or chemical- based suppression for controlling dust during construction.

There would also be short-term impacts to the environment. Transporting and placing borrow material has potential environmental impacts from equipment emissions and disturbing borrow locations. Developing borrow areas could adversely impact the environment. Mitigation measures could include selecting easily accessible borrow locations and reclaiming borrow areas after use.

Thus, Alternative E2 was given a rating of “moderate,” primarily due to the significant quantities of borrow material required and the short-term impacts associated with developing and transporting borrow material for constructing covers.

8.5.6 Implementability

Alternative E1 has no further action taken. Since no remedial action is taken, this alternative was given a rating of “none.”

Alternative E2 involves cover placement. This is a conventional construction practice and can be implemented using available equipment and labor resources. Uncontaminated borrow material for constructing covers and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified. Monitoring and maintenance of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. Maintenance of ICs may be more difficult due to various types of ownership and land use and would require agency coordination.

Thus, Alternative E2 was given a rating of “moderate,” primarily due to the significant quantities of borrow material required for cover construction.

8.5.7 Cost

Present value costs for both alternatives were evaluated over a 15-year period after the base year (Years 0 through 15).

The present value cost for Alternative E1 is $0. The present value cost for Alternative E2 is $1,668,000.

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Section 9

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Tables

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Table 5-1A Matrix of Process Options for Mine Portal MIW Discharges Alternative Development
Bonita Peak Mining District Superfund Site
Focused Feasibility Study

General Response Action	Remedial Technology	Process Option	Alternative A1 No Action	Alternative A2 Diversion/Isolation
No Actior	None	None	✓	
Institutional Controls	Non-Engineered Controls	Governmental Controls, Proprietary Controls, Enforcement Tools with IC Components, and Informational Devices		✓
Containment	Surface Source Controls	Grading		✓
		Soil/Rock Exposure Barrier		
	Hydraulic Isolation, Diversion, and Separation Measures	French Drain and/oı Interception Trench		✓
		Open Channel		✓
		Collection/Diversior Piping or Liner		✓
		Berms		✓
Removal, Transport, Disposal	Removal	Mechanical Excavation (Excavation)		
		Pneumatic Excavation (Vacuum Extraction)		
	Transport	Mechanical Transport (Hauling/Conveying)		
		Pneumatic Transport (Vacuum Extraction)		
	Disposal	Interim Local Waste Managemen		

Notes:
- Exhibit 4-1 summarizes all technology process options identified for all media. Check marks in the table above indicated process options that will be implemented as necessary for each alternative for mine portal MIW discharges as defined in Section 3.2.
- For purposes of FS evaluation, representative process options are selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives, as described in Section 5.

Table 5-1B Matrix of Process Options for Mining-Related Source/Stormwater Interactions Alternative Development
Bonita Peak Mining District Superfund Site
Focused Feasibility Study

General Response Action	Remedial Technology	Process Option	Alternative B1 No Action	Alternative B2 Stormwater Diversion/Isolation
No Action	None	None	✓	
Institutional Controls	Non-Engineered Controls	Governmental Controls, Proprietary Controls, Enforcement Tools with IC Components, and Informational Devices		✓
Containment	Surface Source Controls	Grading		✓
		Soil/Rock Exposure Barrier		
	Hydraulic Isolation, Diversion, and Separation Measures	French Drain and/or Interception Trench		✓
		Open Channel		✓
		Collection/Diversion Piping or Liner		✓
		Berms		✓
Removal, Transport, Disposal	Removal	Mechanical Excavation (Excavation)		
		Pneumatic Excavation (Vacuum Extraction)		
	Transport	Mechanical Transport (Hauling/Conveying)		
		Pneumatic Transport (Vacuum Extraction)		
	Disposal	Interim Local Waste Management		

Notes:
- Exhibit 4-1 summarizes all technology process options identified for all media. Check marks in the table above indicated process options that will be implemented as necessary for each alternative for mining-related source/stormwater interactions as defined in Section 3.2.
- For purposes of FS evaluation, representative process options are selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives, as described in Section 5.

Table 5-1C Matrix of Process Options for Mine Portal Pond Sediments Alternative Development
Bonita Peak Mining District Superfund Site
Focused Feasibility Study

General Response Action	Remedial Technology	Process Option	Alternative C1 No Action	Alternative C2 Excavation and Interim Local Waste Management
No Action	None	None	✓	
Institutional Controls	Non-Engineered Controls	Governmental Controls, Proprietary Controls, Enforcement Tools with IC Components, and Informational Devices		✓
Containment	Surface Source Controls	Grading		✓
		Soil/Rock Exposure Barrier		
	Hydraulic Isolation, Diversion, and Separation Measures	French Drain and/or Interception Trench		
		Open Channel		
		Collection/Diversion Piping or Liner		
		Berms		✓
Removal, Transport, Disposal	Removal	Mechanical Excavation (Excavation)		✓
		Pneumatic Excavation (Vacuum Extraction)		✓
	Transport	Mechanical Transport (Hauling/Conveying)		✓
		Pneumatic Transport (Vacuum Extraction)		✓
	Disposal	Interim Local Waste Management		✓

Notes:
- Exhibit 4-1 summarizes all technology process options identified for all media. Check marks in the table above indicated process options that will be implemented as necessary for each alternative for mine portal pond sediments as defined in Section 3.2.
- For purposes of FS evaluation, representative process options are selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives, as described in Section 5.

Table 5-1D Matrix of Process Options for In-Stream Mine Wastes Alternative Development
Bonita Peak Mining District Superfund Site
Focused Feasibility Study

General Response Action	Remedial Technology	Process Option	Alternative D1 No Action	Alternative D2 Excavation and Interim Local Waste Management
No Action	None	None	✓	
Institutional Controls	Non-Engineered Controls	Governmental Controls, Proprietary Controls, Enforcement Tools with IC Components, and Informational Devices		✓
Containment	Surface Source Controls	Grading		✓
		Soil/Rock Exposure Barrier		
	Hydraulic Isolation, Diversion, and Separation Measures	French Drain and/or Interception Trench		
		Open Channel		
		Collection/Diversion Piping or Liner		
		Berms		✓
Removal, Transport, Disposal	Removal	Mechanical Excavation (Excavation)		✓
		Pneumatic Excavation (Vacuum Extraction)		✓
	Transport	Mechanical Transport (Hauling/Conveying)		✓
		Pneumatic Transport (Vacuum Extraction)		✓
	Disposal	Interim Local Waste Management		✓

Notes:
- Exhibit 4-1 summarizes all technology process options identified for all media. Check marks in the table above indicated process options that will be implemented as necessary for each alternative for in-stream mine wastes as defined in Section 3.2.
- For purposes of FS evaluation, representative process options are selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives, as described in Section 5.

Table 5-1E Matrix of Process Options for Mining-Impacted Recreation Staging Areas Alternative Development
Bonita Peak Mining District Superfund Site
Focused Feasibility Study

General Response Action	Remedial Technology	Process Option	Alternative E1	Alternative E2
			No Action	Containment/Isolation
No Action	None	None	✓	
Institutional Controls	Non-Engineered Controls	Governmental Controls, Proprietary Controls, Enforcement Tools with IC Components, and Informational Devices		✓
Containment	Surface Source Controls	Grading		✓
		Soil/Rock Exposure Barrier		✓
	Hydraulic Isolation, Diversion, and Separation Measures	French Drain and/or Interception Trench		
		Open Channel		
		Collection/Diversion Piping or Liner		
		Berms		
Removal, Transport, Disposal	Removal	Mechanical Excavation (Excavation)		
		Pneumatic Excavation (Vacuum Extraction)		
	Transport	Mechanical Transport (Hauling/Conveying)		
		Pneumatic Transport (Vacuum Extraction)		
	Disposal	Interim Local Waste Management		

Notes:
- Exhibit 4-1 summarizes all technology process options identified for all media. Check marks in the table above indicated process options that will be implemented as necessary for each alternative for mining-impacted recreation staging areas as defined in Section 3.2.
- For purposes of FS evaluation, representative process options are selected for evaluation within the remedial technology category to simplify the analysis and comparison of alternatives, as described in Section 5.

Table 8- 1 Summary of Comparative Analysis of Alternatives

Remedial Alternative	Threshold Criteria		Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)[1]
Mine Portal MIW Discharges Alternatives							
Alternative A1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative A2 – Diversion/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate	None	Moderate	Moderate	$2,411,000
Mining-Related Source/Stormwater Interactions Alternatives							
Alternative B1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative B2 – Stormwater Diversion/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate to High	Moderate to High	$1,889,000
Mine Portal Pond Sediments Alternatives							
Alternative C1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative C2 – Excavation and Interim Local Waste Management	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate	None	Moderate to High	Moderate	$3,384,000
In-Stream Mine Wastes Alternatives							
Alternative D1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative D2 – Excavation and Interim Local Waste Management	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate to High	Moderate	$624,000
Mining-Impacted Recreation Staging Areas Alternatives							
Alternative E1 – No Action[2]	Not Adequate	None	None	None	None	None	$0
Alternative E2 – Containment/Isolation	Adequate	Will comply, but may require CERCLA ARAR waiver(s)	Moderate to High	None	Moderate	Moderate	$1,668,000

Notes:

1. Present value costs and quantitative ratings are subject to change. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.
2. Alternatives A1, B1, C1, D1, and E1 represent the No Action alternatives required by the NCP.

Legend for Qualitative Ratings System:

Threshold Criteria (Overall Protection of Human Health and the Environment)	Threshold Criteria (Compliance with ARARs)	Balancing Criteria (Excluding Cost)
Not Adequate	**None**	**None**
Adequate	**Adequate**	**Low**
	Will comply, but may require CERCLA ARAR Waiver(s)	**Low to Moderate**
		Moderate
		Moderate to High
		High

Figures

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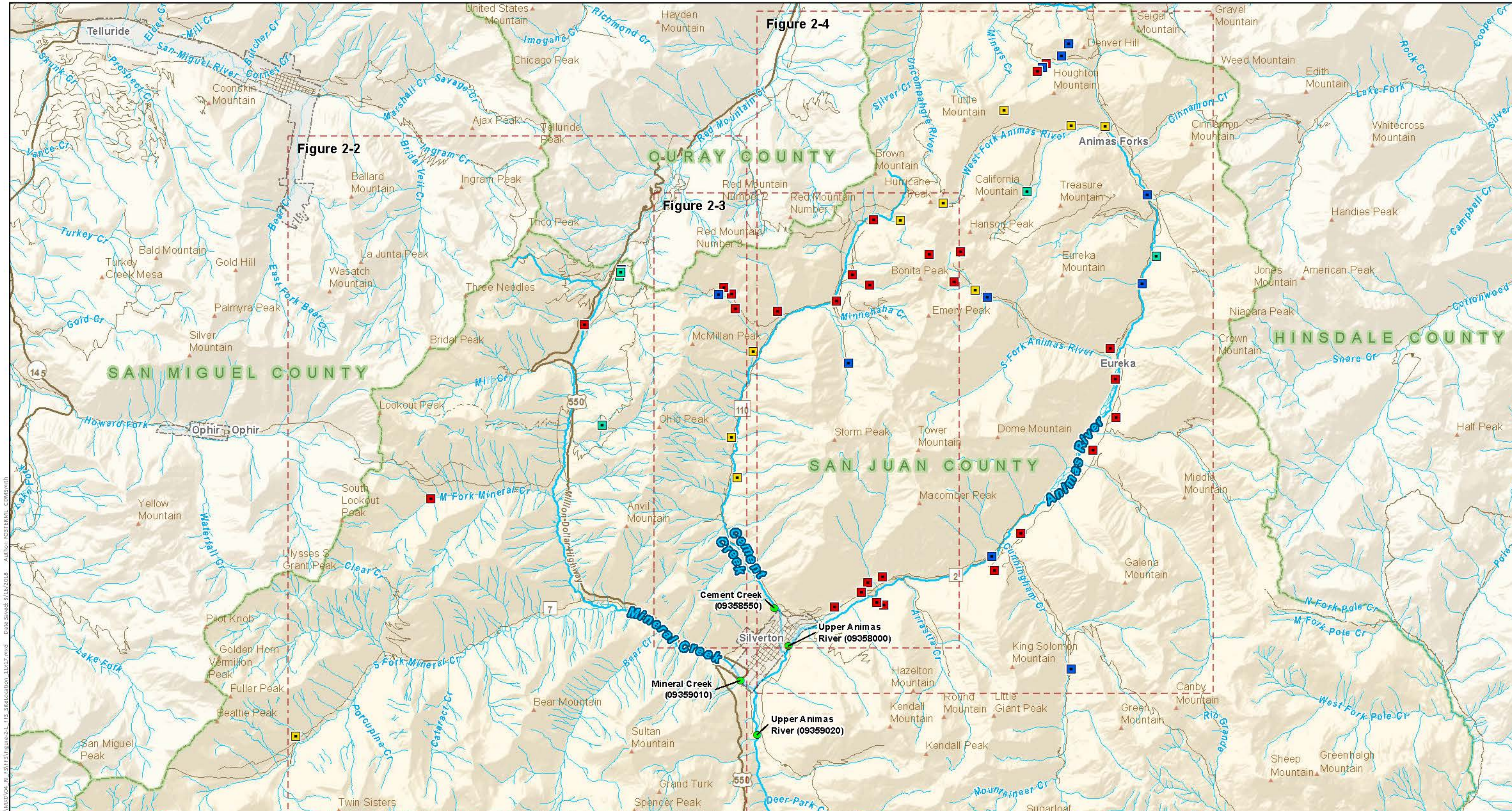


N

0 0.5 1 2 Miles

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

- River
- Forest Service Road
- Road
- US Highway
- County Boundary
- Mining-Related Source - Excluded from FFS
- Mining-Related Source - 1 Contaminant Migration Issue
- Mining-Related Source - 2 Contaminant Migration Issues
- Mining-Related Source - 3 Contaminant Migration Issues
- USGS Gaging Station

Figure 2-1
Site Location Map
Bonita Peak Mining District Superfund Site | San Juan County, CO
Focused Feasibility Study

CDM Smith

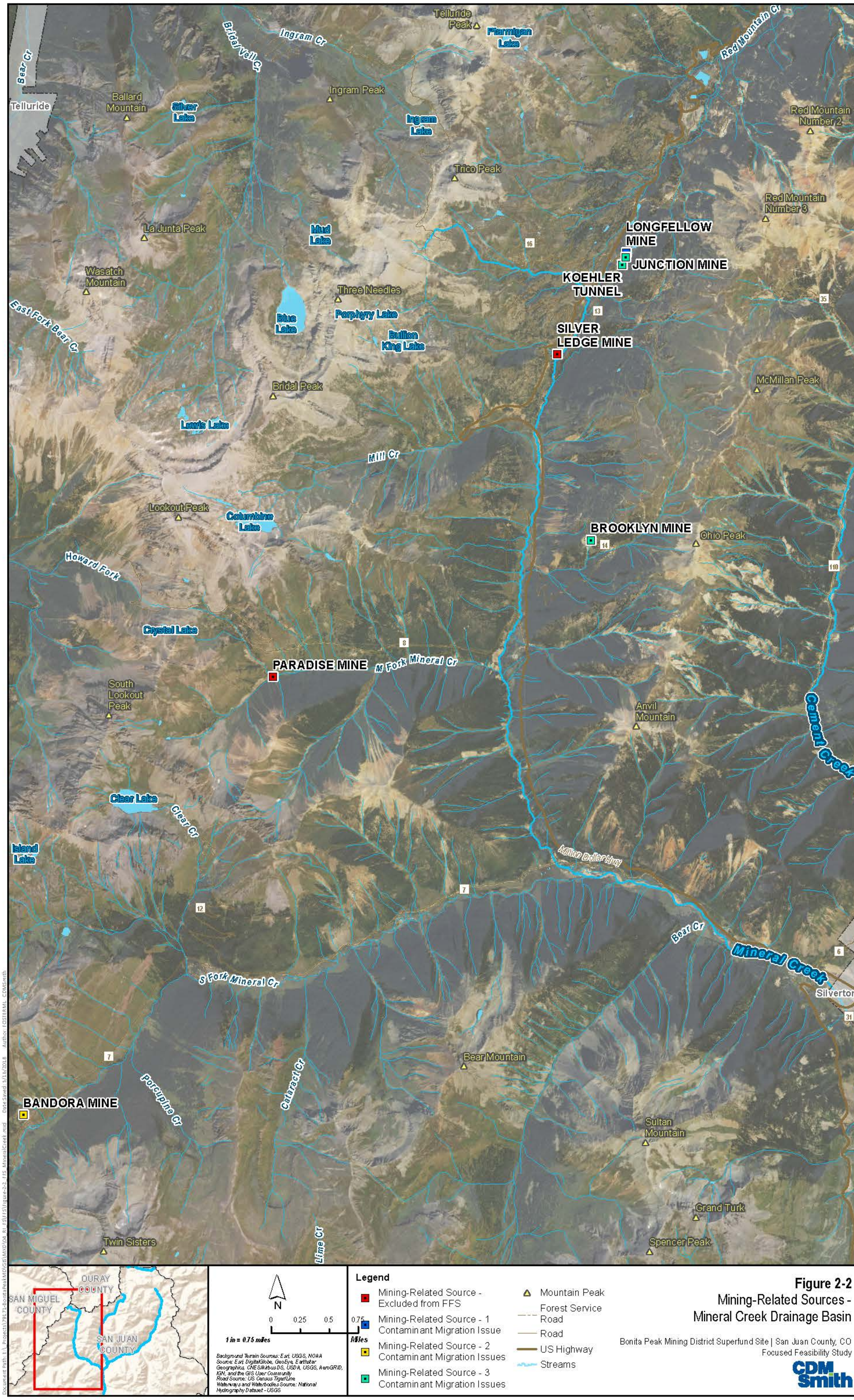
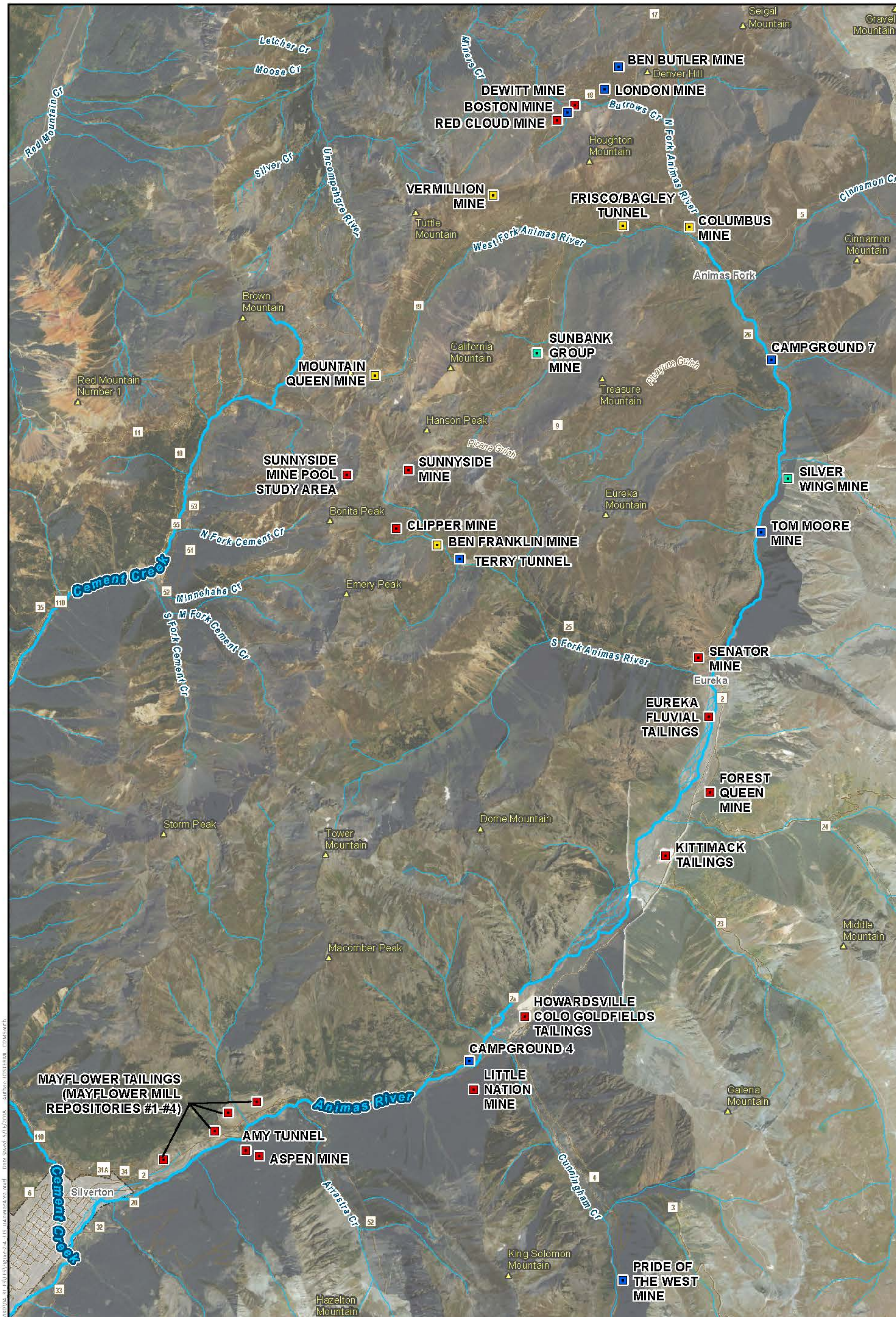
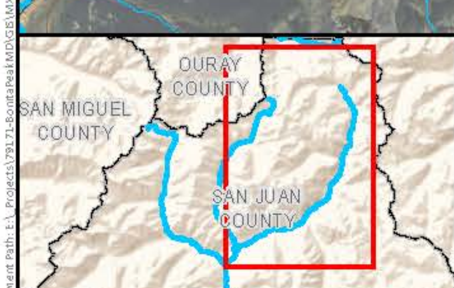


Figure 2-2
Mining-Related Sources - Mineral Creek Drainage Basin

Figure 2-3
Mining-Related Sources - Cement Creek Drainage Basin

Bonita Peak Mining District Superfund Site | San Juan County, CO
Focused Feasibility Study





N

0 0.5 1 Miles

1 in = 0.75 miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

- Mining-Related Source - Excluded from FFS
- Mining-Related Source - 1 Contaminant Migration Issue
- Mining-Related Source - 2 Contaminant Migration Issues
- Mining-Related Source - 3 Contaminant Migration Issues
- Mountain Peak
- Forest Service Road
- Road
- Highway
- Streams

Figure 2-4

Mining-Related Sources - Upper Animas Area Drainage Basin

Bonita Peak Mining District Superfund Site | San Juan County, CO
Focused Feasibility Study

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Appendix A

Preliminary Remedial Investigation Report

CDM Smith

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USACE Contract No: W912DQ-15-D-3013
Task Order No: DK04

Preliminary Remedial Investigation Report

U.S. Army Corps of Engineers Omaha District

Interim Remedial Actions
Bonita Peak Mining District Superfund Site
San Juan County, Colorado

May 2018

CDM Smith

Bonita Peak Mining District Superfund Site
Interim Remedial Actions
San Juan County, Colorado

Preliminary Remedial Investigation Report

Contract No. W912DQ-15-D-3013
Task Order No.: DK04

May 2018

Prepared for:

U.S. Environmental Protection Agency
Region 8
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Acronyms and Abbreviations

Al	aluminum
AMD	acid-mine drainage
ARD	acid-rock drainage
As	arsenic
Au	gold
BPMD	Bonita Peak Mining District
Cd	cadmium
CDM Smith	CDM Federal Programs Corporation
CDMG	Colorado Division of Minerals and Geology
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cfs	cubic feet per second
CGS	Colorado Geological Survey
Cu	copper
cy	cubic yard
DRMS	Colorado Division Reclamation, Mining and Safety
IRA	interim remedial action
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Services Assistance Team
Fe	iron
FFS	focused feasibility study
gpm	gallons per minute
GPS	global positioning system
Hg	mercury
HRS	Hazard Ranking System
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MIW	mining-influenced water
ml	milliliter
Mn	manganese
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRCS	U.S. Department of Agriculture Natural Resource Conservation Service
Pb	lead
RI	remedial investigation
Site	BPMD Superfund Site
SPLP	synthetic precipitation leaching procedure
su	standard units
TechLaw	TechLaw, Inc.
TVS	table value standard
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WQCC	Water Quality Control Commission
Zn	zinc
°F	degrees Fahrenheit
µg/L	micrograms per liter

Section 1

Introduction

This preliminary remedial investigation (RI) report for the Bonita Peak Mining District (BPMD) Superfund Site (Site) in San Juan County, Colorado was prepared by CDM Federal Programs Corporation (CDM Smith) for the U.S. Army Corps of Engineers (USACE) Omaha District on behalf of the U.S. Environmental Protection Agency (EPA) Region 8. This preliminary RI was prepared as part of Task Order No. DK04 under USACE Contract No. W912DQ-15-D-3013 and was generally developed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations 300.430(e)) and EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). This preliminary RI is intended to meet the requirements of a preliminary site characterization summary detailed in EPA 1988 and includes a summary of site data collected under the initial field sampling program.

The Hazard Ranking System documentation record for the Site (EPA 2016a) indicated there are 48 mining-related sources where ongoing characterization and risk evaluation is needed to determine whether and what additional actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may be appropriate. The Site-wide RI and risk assessments are ongoing and will provide information to guide Site-wide objectives. EPA is taking an adaptive management approach to the Site, and data and observations from the initial characterization identified 26 mining-related sources (including two dispersed campground areas) with contaminant migration issues that could be initially addressed through interim remedial actions (IRAs) while the Site-wide RI is ongoing.

The purpose of this preliminary RI report is to summarize the available data and document the current understanding of the nature of mining-related contamination associated with 26 of the mining-related sources under consideration for IRAs, in support of the focused feasibility study (FFS).

1.1 Site Description and Background

This section presents an overview of the general Site location, climate, and history. **Figure 1-1** shows the general location of the Site.

1.1.1 Site Location and Setting

The Site is centered in southwestern Colorado in San Juan County. It spans across five different U.S. Geological Survey (USGS) 7.5-Minute Topographic Quadrangles including Handies Peak, Howardsville, Ironton, Ophir, and Silverton (USGS 2016a through 2016e). Within the Site, there are three main drainages (Mineral Creek, Cement Creek, and Upper Animas River) that flow into the Animas River at Silverton, Colorado as shown in **Figures 1-2, 1-3,** and **1-4**, respectively.

Mineral Creek originates at the top of Red Mountain Pass and flows approximately 9.3 miles before entering the Animas River southwest of Silverton. Cement Creek is approximately 8 miles long, flowing from north to south before the confluence with the Animas River at Silverton (Herron et al. 1998). The Upper Animas River begins approximately 14 miles northeast of

Silverton. After the three main drainages combine as the Animas River, it flows south from Silverton to Durango, Colorado, crosses into New Mexico, and joins the San Juan River in Farmington, New Mexico.

Formed from Pleistocene glaciation and Holocene erosion, the terrain of the western San Juan Mountains is steep and rugged (USGS 2007a). The elevation ranges from approximately 9,500 feet National Geodetic Vertical Datum of 1929 (NGVD29) at the Mayflower Tailings to 12,800 feet NGVD29 at the Mountain Queen Mine, the highest mining-related source at the Site.

1.1.2 Site Mining History

The three main drainages within the Site contain some 400 abandoned or inactive mines where large- to small-scale mining operations occurred. San Juan County is comprised of 10 historic mining districts (Colorado Geological Survey [CGS] 2017a). Historic mining districts within the Mineral Creek, Cement Creek, and Upper Animas River drainages (referred to as “the mining districts”) include Animas, Animas Forks, Cement Creek, Eureka, Ice Lake Basin, and Mineral Point. The discovery of gold and silver brought miners to the Silverton area and the Animas Mining District in the early 1870s. In the late 1870s and early 1880s, the completion of roads, railroads, and construction of a smelter in Durango encouraged mining operations. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement (TechLaw, Inc. [TechLaw] 2017). Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basin whenever prices were favorable (TechLaw 2017).

Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of a historic mining town developed in the 1880s commensurate with the onset of mining in the surrounding area. The town was the central location and railroad terminus for the milling and shipping of mine ores from the surrounding 3-square-mile valley. The town declined in the 1920s and no remnants of the town remain.

Eureka is located approximately 8 miles northeast of Silverton at the confluence of Upper Animas River and Eureka Gulch. Some of the mines located up Eureka Gulch include Sunnyside Mine, Clipper Mine, Ben Franklin Mine, Bavarian Mine, Midway Mine, Moonbeam Mine, and Ransom Mine (Herron et al. 2000). The Sunnyside Flotation Mill in Eureka was built in 1917 with a 600-ton-per-day capacity. Two settling ponds were built in the Animas River valley but after the mill was abandoned in 1949, the tailings dams were partially washed out and tailings were washed down the Animas River (Church et al. 2007). By the 1970s, only one year-round active mine (Sunnyside Mine) remained in the county (CGS 2017b). This mine ceased production in 1991.

Animas Forks, named for the three forks of the Animas River, is located 12 miles northeast of Silverton in San Juan County, CO and was first established in 1874. There were numerous mines located upstream of Animas Forks. The town started to decline in 1910 when the Gold Prince Mill ceased operation and became a ghost town in the 1920s.

1.1.3 NPL Listing

The Site was proposed for addition to the National Priorities List in April 2016 and the listing became effective in September 2016 (EPA 2016c).

1.1.4 Climate

The portions of the Site within San Juan County have a subalpine to alpine climate with snowy, cold winters and cool summers. In the subalpine climate region, the minimum and maximum mean temperatures for January and July are 2 degrees Fahrenheit (°F)/32°F and 40°F/74°F, respectively (Chapman et al. 2006). In the alpine climate region, the minimum and maximum mean temperatures for January and July are minus 8°F/24°F and 36°F/72°F, respectively (Chapman et al. 2006).

Long-term climate data, including precipitation, for Silverton, Colorado has been collected by a participating National Weather Service Cooperative Observing Program weather station. The National Oceanic and Atmospheric Administration (NOAA) has a record of climate data for the Silverton, Colorado station dating back to 1905 (NOAA 2018). The weather station is currently located at a latitude of 37.809 North and a longitude of 107.663 West. In 2016, the Silverton station recorded annual precipitation of approximately 19 inches (NOAA 2018). The greatest amount of snowfall is between November and April, with an average snowfall of 12 feet per year (EPA 2016b).

1.1.5 Geology

The geology of the Site within San Juan County is relevant to the assessment of the hydrogeological framework and understanding of potential source materials present. Therefore, this section focuses on the description of the bedrock geology and ore mineralization. Other aspects of the Site geology were described by Yager and Bove (USGS 2007a), Burbank and Luedke (1969), and Free et al. (1989).

1.1.5.1 Stratigraphy

The Site is centered in the western San Juan Mountains in the area of the Silverton and San Juan calderas. The younger Silverton caldera is situated within the older San Juan caldera, forming between approximately 28 and 27 million years ago (USGS 2007a). During and after the caldera formation period, volcanotectonic events occurred that introduced extensive Tertiary-aged volcanic rock and extensive mineralization within fractured host rock (USGS 2007b). Volcanic formations of the San Juan volcanic field cover land north and east of the Silverton caldera. Comprised of pyroclastic rocks and lava flows, the San Juan volcanic field lies on the Paleozoic and Mesozoic rock formation (Free et al. 1989).

The general stratigraphy in the region consists of Precambrian crystalline basement, Paleozoic to Tertiary sedimentary rocks, Tertiary volcanic rocks, and Quaternary deposits (USGS 2007a).

- Precambrian rocks underlie the Site but are only exposed at the surface south of Silverton along the Animas River and Cunningham Creek (USGS 2007b). These generally consist of amphibolite, schist, and gneiss. Mineral phases in these rocks have high acid-neutralizing capacity and influence water-rock interactions (USGS 2007a).

- Paleozoic, Mesozoic, and Tertiary sedimentary rocks are primarily exposed south of Silverton along the Animas River and west in the basins draining South Fork Mineral Creek (USGS 2007a). These units are of varying thicknesses and compositions including conglomerates, sandstones, siltstones, shales, limestones, and other types of sedimentary rocks as discussed in Yager and Bove (USGS 2007a).
- Tertiary volcanic rocks comprise the bulk of the exposed rocks in the region. Tertiary volcanism began approximately 35 Ma with deposition of the San Juan Formation via lava flows, eruptions forming the San Juan and Silverton calderas and subsequent collapse, and additional lava flows depositing the Silverton Volcanics Group (USGS 2007a). An extensive system of faults and veins characterize the San Juan and Silverton calderas.
  - Most of the Site is located in the collapsed Silverton caldera within the Silverton Volcanic Group (Free et al. 1989, Herron et al. 2000). Three main volcanic units compose the caldera fill (Free et al. 1989):
    - The Eureka Tuff is the lowest formation in the Silverton Volcanic Group and is a lithic rhyolitic ashflow tuff.
    - The Burns Formation is fairly uniform and most commonly composed of rhyodacite, ridged quartz-latic flows, and flow breccias and tuffs (Burbank and Luedke 1969, Free et al. 1989).
    - The Henson Formation is the uppermost formation in the Silverton Volcanic Group, primarily andestitic pyroclastites. An irregular fracture system formed in this member, characterized by layers of volcanic breccias, lapillite, and tuffite.
- Quaternary surficial deposits are the result of glaciation and weathering of bedrock in the headwaters of subbasins. The surficial deposits are either acid generating or acid neutralizing depending on their bedrock source (USGS 2007a).

1.1.5.2 Ore Mineralization

Research conducted by Free et al. is the main source of mineralization information. Their research shows that mineralization occurred in two main phases 23 and 11 Ma (Free et al. 1989). Base metal mineralization occurred first, during recurring volcanic activity near a quartz-monzonite stock in the southern caldera region. Gold (Au) was mineralized epithermally from heat generated by movement of the Red Mountain porphyry stock, which is located in the north-central caldera region. It is hypothesized that meteoric hydrothermal solutions from the Red Mountain Stock funneled through the open fracture system, causing several Au-concentrating alterations. At the Site, Au was concentrated in lodes, which are ore veins in fissures and between layers of rock.

1.1.5.3 Soils

Soil map units were reviewed for mining-related sources using soil survey areas from the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) (NRCS 2016).

These soil map units are based on landscape-scale similarities observed in parent material, general soil characteristics, elevation, precipitation, position within the landscape, and vegetation.

Soil surveys are generated at a 1:24,000 scale and any enlargement of maps beyond the scale of mapping could result in a decrease in accuracy of soil line placement. Due to the size of the mining-related sources and the methodology used to map soil units, some variations could be expected.

Based on the soil survey areas, the soil map units listed in Exhibit 1-1 were identified within the mining-related sources evaluated in this preliminary RI.

Exhibit 1-1 Soil Map Units within Mining-Related Sources

Mining-Related Source	Soil Map Units[1]
Mineral Creek Drainage Basin	
Longfellow Mine	250 – Snowdon-Rock outcrop complex, 30 to 65 percent slopes
Junction Mine	250 – Snowdon-Rock outcrop complex, 30 to 65 percent slopes
Koehler Tunnel	250 – Snowdon-Rock outcrop complex, 30 to 65 percent slopes
Brooklyn Mine	250 – Snowdon-Rock outcrop complex, 30 to 65 percent slopes
Bandora Mine	162 – Quazar-Varden complex, 15 to 65 percent slopes
Cement Creek Drainage Basin	
Grand Mogul Mine	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes
Natalie/Occidental Mine	339 – Henson very gravelly loam, 30 to 60 percent slopes
Henrietta Mine	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes
Mammoth Tunnel	54 – Quazar very cobbly loam, 5 to 25 percent slopes; 250 – Snowdon-Rock outcrop complex, 30 to 65 percent slopes
Anglo Saxon Mine	331 – Needleton stony loam, 30 to 65 percent slopes
Yukon Tunnel	331 – Needleton stony loam, 30 to 65 percent slopes
Upper Animas River Drainage Basin	
Boston Mine	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes
London Mine	56 – Typic Cryaquents-Cryaquolls-Cryofibrists complex, 0 to 5 percent slopes; 342 – Telluride-Rock outcrop complex, 15 to 45 percent slopes; 337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes
Ben Butler Mine	342 – Telluride-Rock outcrop complex, 15 to 45 percent slopes
Mountain Queen Mine	339 – Henson very gravelly loam, 30 to 60 percent slopes
Vermillion Mine	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes
Sunbank Group Mine	339 – Henson very gravelly loam, 30 to 60 percent slopes
Frisco/Bagley Tunnel	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes; 56 – Typic Cryaquents-Cryaquolls-Cryofibrists complex, 0 to 5 percent slopes
Columbus Mine	337 – Whitecross-Rock outcrop complex, 45 to 75 percent slopes; 54 – Quazar very cobbly loam, 5 to 25 percent slopes
Campground 7	162 – Quazar-Varden complex, 15 to 65 percent slopes
Silver Wing Mine	162 – Quazar-Varden complex, 15 to 65 percent slopes
Tom Moore Mine	162 – Quazar-Varden complex, 15 to 65 percent slopes
Ben Franklin Mine	340 – Moran very gravelly loam, 10 to 30 percent slopes
Terry Tunnel	343 – Telluride-Rock outcrop complex, 45 to 75 percent slopes
Pride of the West Mine	251 – Rock outcrop-Snowdon complex, 45 to 75 percent slopes
Campground 4	57 – Howardsville gravelly loam, 1 to 6 percent slopes

[1]Only significant soil map units have been indicated; other soil map units may be present but have minimal extents within the mining-related sources.

1.1.6 Surface Water Hydrology

The Animas River watershed extends from the mountainous terrain in San Juan County, Colorado, south into the San Juan River in Northern New Mexico (URS Operating Services 2012). The three major tributaries of the Animas River in San Juan County include Mineral Creek, Cement Creek, and the Upper Animas River. Cement Creek enters the Upper Animas River on the east side of Silverton, Colorado. About 1 mile downstream from that confluence, Mineral Creek enters the Upper Animas River south of town. The three major tributaries are briefly described in this section.

1.1.6.1 Mineral Creek Drainage Basin

The Mineral Creek gaging station (Station 09359010) is located at Silverton, Colorado at elevation 9,246 feet NGVD29 (USGS 2018a). The drainage area is 52.3 square miles (33,472 acres) (USGS 2018a). The stream gage location is shown on **Figure 1-1**. Daily stream discharge values have been recorded and averaged since 1991. The highest discharge occurs in June, with a monthly average flow of 389 cubic feet per second (cfs). The lowest discharges occur throughout January and February, with monthly average flows of 21 to 22 cfs, respectively (USGS 2018a).

1.1.6.2 Cement Creek Drainage Basin

The Cement Creek watershed area is 20.1 square miles (12,864 acres) (USGS 2018b). Cement Creek occurs within the northern portion of the Animas River watershed. The Cement Creek USGS stream gage at Silverton, Colorado (Station 09358550) is located near the confluence of Cement Creek and the Animas River, at elevation 9,380 feet NGVD29 (USGS 2018b). The stream gage location is shown on **Figure 1-1**. Daily stream discharge values have been recorded and averaged since 1991. The highest discharge occurs in June, with a monthly average flow of 131 cfs. The lowest discharges occur throughout January and February, with monthly average flows of 13 cfs for both months (USGS 2018b).

1.1.6.3 Upper Animas River Drainage Basin

USGS gaging station 09358000 is located approximately 700 feet upstream from the confluence of Cement Creek and the Animas River, at elevation 9,290 feet NGVD29 (USGS 2018c). The watershed area of the Animas River at Silverton measured from this station is 70.6 square miles (45,184 acres) (USGS 2018c). The stream gage location is shown on **Figure 1-1**. Daily stream discharge values have been recorded and averaged since 1991. The highest discharge occurs in June, with a monthly average flow of 503 cfs. The lowest discharges occur throughout January and February, with monthly average flows of 24 to 26 cfs, respectively (USGS 2018c).

USGS gaging station 09359020 is located about 0.7 miles downstream from the confluence of Mineral Creek and the Upper Animas River, at elevation 9,199 feet NAVD88 (USGS 2018d). The watershed area of the Animas River below Silverton measured from this station is 146 square miles (93,440 acres) (USGS 2018d). The stream gage location is shown on **Figure 1-1**. Daily stream discharge values have been recorded and averaged since 1991. The highest discharge occurs in June, with a monthly average flow of 1,050 cfs. The lowest discharges occur throughout January and February, with monthly average flows of 60 and 64 cfs, respectively (USGS 2018d).

1.1.7 Subsurface Hydrogeology

Years of mining and the installation of bulkheads has significantly influenced bedrock groundwater elevations within the Site. Historically, groundwater flowed along fractures and faults, with minimal leakage through bedrock, likely due to low primary permeability. With the advent of underground mining, bedrock groundwater that once followed natural fractures instead followed the new path of least resistance—the networks of tunnels in the underground mine workings. Thus, drainage and haulage tunnels form preferential flow paths for bedrock groundwater.

Permeability in the bedrock generally decreases with depth, as the overburden pressure increases, forming a near-surface aquifer within interconnected fractures and joints (Stover 2007). Additionally, permeability is greater within the welded tuffs such as the layer dividing the upper and lower members of the Burns Formation (Simon Hydro-Search 1993). Major fractures (secondary permeability) serve as one of the main conduits for groundwater flow through the bedrock system and between mine workings. It is understood that water emanating from adits originated from the bedrock groundwater systems at the Site, but the IRAs contemplated would not address sources of contamination within the bedrock groundwater systems or within mine workings. Thus, bedrock groundwater will not be discussed further in this report.

The presence and/or extent of perched groundwater in overburden material or alluvial groundwater is not currently known at the mining-related sources described in the FFS and no groundwater analytical data are available for these mining-related sources. Thus, it is unknown whether perched overburden groundwater or alluvial groundwater is present at the mining-related sources.

1.2 Report Organization

The preliminary RI report is organized in a manner that generally conforms to EPA guidance (EPA 1988) and includes five sections as follows:

- Section 1 – Introduction. Provides the purpose and organization of the report, a brief description of the Site location and layout, and a summary of mining and regulatory activities conducted to date at the Site.
- Section 2 – Previous Investigations and Data Presented. Provides a summary of Site investigations and data presented in this report.
- Section 3 – Contaminant Sources, Fate and Transport. Provides definitions of the contaminated environmental media presented in this report and provides a discussion of the processes that transform solid phase metals and metalloids into mobile forms, and the transport pathways that create potential for harm to humans and aquatic life.
- Section 4 – Preliminary Evaluation of Environmental Data. Provides a discussion of the environmental data presented for each of the 26 mining-related sources discussed in this report.
- Section 5 – References. References and documents referred to in this report.

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Section 2

Previous Investigations and Data Presented

This section provides a summary and brief discussion of select previous sampling efforts and Site investigations completed by EPA/Environmental Services Assistance Team (ESAT), the Colorado Division of Minerals and Geology (CDMG), and U.S. Geological Survey (USGS), which are presented in this report. It should be noted that Site investigations are ongoing; the data presented in this report are not intended to provide a complete characterization of the individual mining-related sources nor the complete nature and extent of contamination.

References to previous reports are included where appropriate to provide Site background information and summarize historical conditions. Readily available data sets judged to be valid and usable were compiled and summarized in this report, with a focus on the data collected by EPA/ESAT in 2015 and 2016 (TechLaw 2016, 2017). The EPA/ESAT data are expected to be most representative of recent conditions at the mining-related sources discussed in this report. Data collected previously on waste rock leachability and estimated waste rock volumes collected by CDMG and USGS are also presented, as these data are expected to still be representative of current Site conditions. **Table 2-1** presents a summary of the data sources used in this report and includes an evaluation of the usability of these secondary data sources.

2.1 Sampling Summaries

The following summarizes field activities completed by EPA/ESAT, CDMG, and USGS.

2.1.1 1996–2000 USGS Sampling and Analysis

Field sampling by USGS of mine waste, mill tailings, and adit drainages at mining-related sources in the Animas River, Cement Creek, and Mineral Creek basins with subsequent reporting (Church et al. 2007) will be partly discussed in Section 4 of this preliminary RI report, specifically the estimated sizes of mine waste materials at each of the mining-related sources. A summary of the work is as follows:

- The purpose of the study was to describe the magnitude of contamination contributed by mine-adit water, mine-waste dumps, and mill tailings on public land.
- Visits were conducted at more than 300 mines.
- Mine-waste dump and mill-tailings samples were collected from 97 mine waste dump sites and 18 mill tailings sites, and 20 samples of unmined, altered rock were also collected. These samples of mine-waste dump material, mill tailings, and altered rocks were studied using a passive leach method.
- The size of mine-waste dumps at mines was estimated using length, width, and thickness.
- Surface water samples were collected at 108 mine portals and mine waste dumps.

- Annually, from 1997 to 2000, observations and sampling of mine adit locations was conducted in late August or early September during low-flow conditions.

2.1.2 1997–1999 CDMG Sampling

Field sampling by CDMG of mines in the Animas River above Eureka, Animas River below Eureka, Cement Creek, and Mineral Creek basins with subsequent reporting occurred between 1997 and 2000 (Herron et al. 1997, 1998, 1999, and 2000). This data will be discussed in Section 3 of this preliminary RI report. A summary of the work is as follows:

- Water samples were collected for metals, ions, and wet chemistry analyses for mines on both public and private land.
- Flow measurements were collected concurrent with water samples.
- Baseline water quality samples were collected in October 1996, and February and June 1997 in Cement Creek.
- Waste rock and mill tailing samples were collected at a total of 138 mines in the Upper Animas, Cement Creek, and Mineral Creek drainages. The samples were collected from the top 2 inches of soil material at a minimum of 10 and maximum of 20 locations at each mine location. The samples were composited in 1-gallon plastic bags and mixed in the field, after which 150 milliliters (ml) of sample was removed and mixed with 300 ml of deionized water in a 1-liter plastic beaker. After 90 minutes of settling, the liquid was filtered using 2-micron soil filters and measured for pH, total acidity, and specific conductance. The remaining liquid was acidified with nitric acid and shipped for laboratory analysis of metals and cations.
- The mining wastes were investigated to provide information for prioritizing future mine location reclamation activities to be performed by the Animas River Stakeholders Group.

2.1.3 2015 EPA/ESAT Sampling

Major 2015 EPA/ESAT field activities conducted at the Site and relevant to this report include the following:

- June 9–10, 2015 – High-flow real-time field water quality measurements, stream flow data collection, surface water sampling, photo documentation, and global positioning system (GPS) coordinate collection.
- August 4–6, 2015 – Real-time field water quality measurements, surface water sampling, soil/waste rock sampling, pore water sampling, sediment sampling, photo documentation, and GPS coordinate collection.
- September 22–26, 2015 – Low-flow real-time field water quality measurements, stream flow data collection, surface water sampling, pore water sampling, sediment sampling, photo documentation, and GPS coordinate collection.

2.1.4 2016 EPA/ESAT Sampling

With field support from stakeholders such as the U.S. Bureau of Land Management; Colorado Division of Reclamation, Mining, and Safety (DRMS); and the U.S. Forest Service, major 2016 EPA/ESAT field activities conducted at the Site and relevant to this report include the following:

- June 6–9, 2016 – High-flow, low elevation, real-time field water quality measurements, stream flow data collection, surface water sampling, photo documentation, and GPS coordinate collection.
- June 28–30, 2016 – High-flow, high elevation, real-time field water quality measurements, stream flow data collection, surface water sampling, photo documentation, and GPS coordinate collection.
- July 25–29, 2016 – Waste rock, campground, and road soil sampling, photo documentation, and GPS coordinate collection.
- September 27–30 and October 4–8, 2016 – Low-flow, real-time field water quality measurements, stream flow data collection, surface water sampling, sediment sampling, overbank soil sampling, pore-water sampling, photo documentation, and GPS coordinate collection.

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Section 3

Contaminant Sources, Fate, and Transport

3.1 Contaminated Environmental Media

The following subsections provide definitions for the contaminated media present at the mining-related sources discussed in detail in Section 4.

3.1.1 Solid Media

Solid media are defined as mining-related solid media that release contaminants to surface water bodies and pose unacceptable risk to ecological receptors. Solid media have been subdivided into three subcategories, which are discussed in the following subsections.

3.1.1.1 Mine Waste

Mine waste is a mining-related solid waste with elevated contaminant concentrations, water soluble contaminant loads, and/or acid-generating potential. It includes waste rock, ore, tailings, and contaminated fills that have been generated and/or processed during mining operations.

3.1.1.2 Sediment

Sediment is a mining-related solid waste material with elevated contaminant concentrations that mainly consists of metal precipitates (i.e., sludge) from untreated mining-influenced water (MIW) that have settled from surface waters after discharge from mining-related sources (e.g., mine adits). Naturally occurring sources of sediment, which include iron fens (a location where metal precipitates form on the surface at groundwater gaining reaches of drainage basins), are present at the Site but would not be addressed as part of anticipated remedial actions. Sediment typically precipitates within Site stream banks, river bottoms, and adit portal detention ponds. Sediment may also include natural material or mine waste that has been deposited within streams or detention ponds due to erosion of adjacent natural (i.e., stream banks) or mining-related source (i.e., waste rock) material. Sediment may also generate MIW when in contact with water.

3.1.1.3 Contaminated Soil

Contaminated soil is native soil that has been impacted by or mixed with other contaminated media (solid or aqueous). Native soil can be affected by either physical dispersion (e.g., erosion, wind, traffic) or hydrogeochemical dispersion of contaminants. Hydrogeochemical dispersion is a broad term that relates to leaching of metals and acidity from mine waste through MIW generation, and sequestration of dissolved metals and acidity in soils as the MIW migrates over or through them.

3.1.2 Aqueous Media

Aqueous media has been subdivided into three subcategories, which are described in the following subsections.

3.1.2.1 Mining-Influenced Water

MIW is water that is contaminated or influenced by mining-related activities and is a contaminant source medium where it discharges from a mine portal or contacts a solid source medium. It is a broad term that does not specify the source of the contamination (other than a mining activity) or the pH of the water. MIW can include both acid-mine drainage (AMD) and acid-rock drainage (ARD), or water that is not acidic. AMD is metal-bearing, acidic water discharged from underground mine workings through adits, tunnels, or shafts (collectively referred to as "portals"). ARD is a similar discharge of metal-bearing acidic water resulting from water seeping or flowing through and from acid-generating materials such as pyritic waste rock, tailings piles, or mineralized rock formations. MIW forms when water and oxygen interact with sulfide-rich mine wastes, host rocks, or vein rocks. Sulfuric acid forms and can dissolve additional metals into the MIW. This MIW can discharge through adit portals and enter surface water. Both AMD and ARD provide more information about the source and nature of the water than does the term MIW; however, in this preliminary RI report, impacted water is referred to as "MIW."

3.1.2.2 Surface Water

Surface water includes water within streams or natural ponds. Impacted surface water may episodically or periodically have elevated contaminant concentrations based on contact with or migration of contaminants from solid media and/or MIW. For purposes of this preliminary RI report, surface water within Mineral Creek, Cement Creek, and the Upper Animas River and tributaries will be considered the receiving water bodies at the Site.

3.1.2.3 Groundwater

As discussed in Section 1.1.7, groundwater at the Site may include perched groundwater, alluvial groundwater, and bedrock groundwater systems.

The presence and/or extent of perched groundwater in overburden material or alluvial groundwater is not currently known at the mining-related sources described in this preliminary RI and no groundwater analytical data are available for these mining-related sources. Thus it is unknown whether perched overburden groundwater or alluvial groundwater is present at the mining-related sources and whether any perched overburden groundwater or alluvial groundwater has been previously or currently impacted by mining-related sources. It is understood that water emanating from adits originated from the bedrock groundwater systems at the Site, but the IRAs contemplated would not address sources of contamination within the bedrock groundwater system or within mine workings. Thus, bedrock groundwater will not be discussed further in this preliminary RI report.

3.2 Fate and Transport of Contaminants

The sources of contaminants at specific mining-related sources at the Site are presented in Section 4.2. It should be noted that Site investigations are ongoing; the fate and transport discussion presented in this report is not intended to be complete and final for the Site. The fate and transport discussion herein is focused on currently identified issues at the Site to be addressed through implementation of the IRAs.

3.2.1 Overview of Fate and Transport

Contaminants at the mining-related sources within the Site, specifically metals and metalloids (which have properties of metals and non-metals, such as arsenic [As]), are present in solid phase materials at the Site (mine waste rock, tailings, soil, and bedrock outcrops) and in MIW. Adverse impacts are associated with transformation of solid phase metals and metalloids into forms that are mobile and potentially harmful to humans and ecological receptors. Crushing and grinding during mining and mineral processing may cause metals to mobilize in the form of very fine-grained particulates that can be physically transported by wind or water. Interaction with water and oxygen with sulfide minerals, especially pyrite, can result in generation of MIW and partial or complete dissolution of metals and/or metalloids from the solid phase, which provides a mechanism for contaminant migration into surface water and potentially groundwater, where it exists. These processes increase the mobility of contaminants in the environment and, therefore, increase the potential for impacts to receptors.

The releases from mining-related sources result in contamination of media, such as surface soil, surface water, sediment, and groundwater, which go on to release contaminants in many ways, including:

- Release of contaminants in surface water to sediments (through precipitation, deposition, and adsorption), biota (through uptake), and groundwater (through infiltration)
- Release of contaminated soils to surface water via erosion or to groundwater via infiltration and leaching
- Release of contaminants in soil to biota (through uptake) or air (wind-generated dust)
- Release of contaminants in groundwater to surface water
- Release of contaminants in sediment to surface water (through adsorption/desorption) and biota (through uptake)

Cycling of contaminants among Site media will also occur. For example, metals may partition between surface water and sediments and migrate between surface water and groundwater in gaining and losing stream reaches.

Numerous mining-related sources within the Site contain acidic MIW in the form of AMD and ARD. **Exhibit 3-1** presents a summary of the process of AMD and ARD formation and a description of the migration of these types of MIW in the environment.

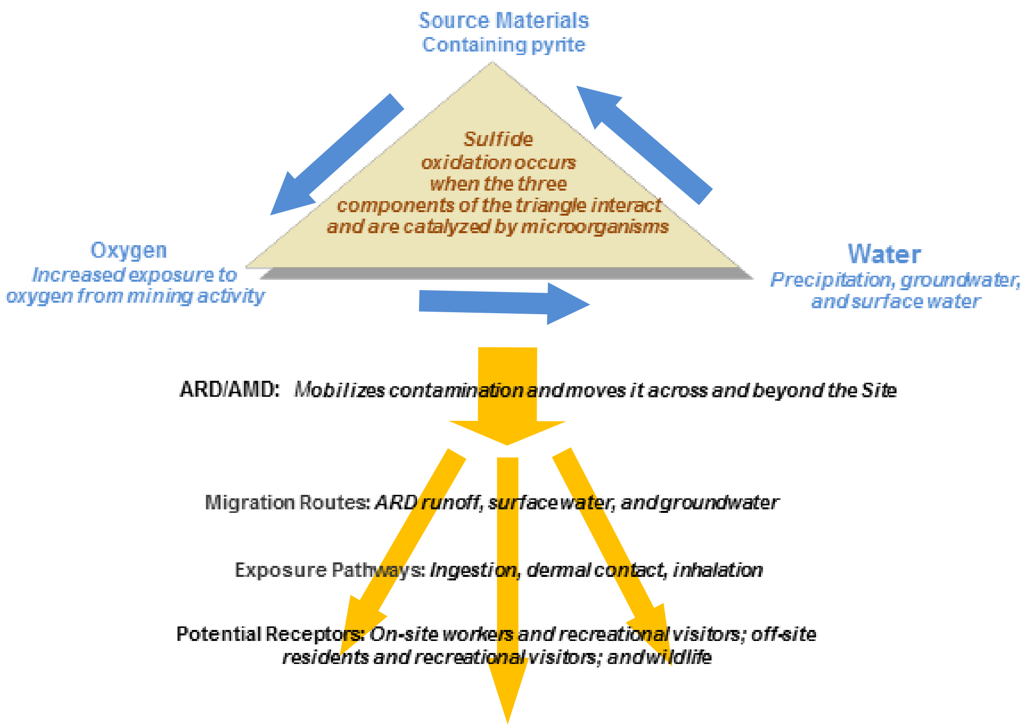

Exhibit 3-1 ARD and AMD Generation and Migration

At the Site, the surface waters in the main stems of Cement Creek, Mineral Creek, and the Upper Animas River carry high loads of total and dissolved metals and high acidity into the Animas River near Silverton even though substantial dilution with cleaner water occurs. Aquatic life in the affected waterways is exposed to the elevated levels of metals.

3.2.2 Fate and Transport Pathways Related to IRA Implementation

The following fate and transport mechanisms are applicable to the specific issues planned to be addressed through implementation of IRAs at the Site:

- The Junction Mine, Koehler Tunnel, Mammoth Tunnel, Anglo Saxon Mine, Sunbank Group, Frisco/Bagley, and Silver Wing Mine utilize settling ponds to reduce metals concentrations from their adit MIW discharge. This allows metals to settle out of the adit discharge water through either formation of iron (Fe) oxy-hydroxides and subsequent co-precipitation (such as the case with As), or through the physical settling of undissolved metals. This process produces residual sludge in the settling ponds. If sufficient sludge and sediment accumulates in the ponds and reduces the residence time of adit discharge in the ponds, or if accumulated sludge diverts the adit discharge such that water does not flow through the settling ponds as intended, then the ability for metals to settle out of the adit discharge water is diminished.

- Several mining-related sources contain draining adits that discharge MIW onto or adjacent to mine waste piles. These MIW discharges contacting mine waste are likely to lead to increased leaching of metals from the mine waste into surface water, as well as increase erosion and transport of mine waste or contaminated soil into receiving waters. Several other mining-related sources have constructed diversions that route the MIW discharge away from mine waste but require maintenance to prevent contact between the MIW and mine waste materials.

- Stormwater run-on at mining-related sources can contact mine waste, which results in increased leaching of metals from the mine waste to surface water.

- Many mining-related sources have mine waste that has been transported in front of a flowing adit or into a stream channel. This mine waste can result in increased potential for obstructed surface water flow and subsequent uncontrolled releases and erosion of mine waste materials into surface water, as well as additional metals leaching from the obstructive mine waste into nearby surface water bodies.

- Several mine-related sources at the Site are used for recreational staging purposes or camping, and these activities have the potential to physically disturb mine waste or contaminated soil, potentially increasing the potential for human exposure to contaminants.

- Mine waste is capable of generating MIW when in contact with water (e.g., stormwater, mine portal MIW discharge). In addition, some mine waste can impede the unrestricted flow of surface water in streams and/or MIW from mine portals (e.g., adits). Mine waste obstructing free flow increases the potential for mass wasting of contamination in particulate form and/or leaching of contaminants from the mine waste as MIW.

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Section 4

Preliminary Evaluation of Environmental Data

Currently, EPA is collecting data to support evaluation of contributors of sources for contaminant loading of waterways and identify areas where additional data is required to evaluate the Site. The following section presents a summary of results from sampling and other field activities relevant to actions at the 26 mining-related sources discussed in this preliminary RI report. The summarized data include available recent water quality data for surface water and adit discharges, stream sediment, waste rock and soils, and mine waste leachability results. The contaminants discussed in this report include aluminum (Al), As, cadmium (Cd), copper (Cu), Fe, lead (Pb), manganese (Mn), mercury (Hg), and zinc (Zn).

4.1 Screening Criteria for Affected Media

MIW, surface water, and synthetic precipitation leachate procedure (SPLP) soil and waste rock results from CDMG and EPA/ESAT are discussed in the following sections and are compared to Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) Regulation 34, *Classifications and Numeric Standards for San Juan River and Dolores River Basins* (CDPHE 2016). From this regulation, the following acute and chronic table value standards (TVSs) for metals were used for comparison to surface water analytical results from the Site. It is important to note that the TVSs described below are being used as screening levels for evaluation of existing environmental data, and that preliminary remedial goals have not yet been developed for the Site; therefore, these TVSs are currently not being used as cleanup criteria.

Al (total recoverable):

$$Acute = e^{(1.3695 * Ln[hardness] + 1.8308)}$$

$$Chronic = e^{(1.3695 * Ln[hardness] - 0.1158)} \text{ or } 87, whichever\ is\ less\ (pH < 7.0)$$

$$Chronic = e^{(1.3695 * Ln[hardness] - 0.1158)}\ (pH > 7.0)$$

As: $Acute = 340$

$$Chronic = 100\ (total\ recoverable)$$

Cd:

$$Acute = (1.136672 - Ln[hardness] * 0.041838)e^{(0.9151 * Ln[hardness] - 3.1485)}$$

$$Chronic = (1.101672 - Ln[hardness] * 0.041838)e^{(0.7998 * Ln[hardness] - 4.4451)}$$

Cu:

$$Acute = e^{(0.9422 * Ln[hardness] - 1.7408)}$$

$$Chronic = e^{(0.8545 * Ln[hardness] - 1.7428)}$$

Fe (total recoverable):

$$Acute = Not\ Applicable$$
$$Chronic = 1000$$

Pb:

$$Acute = (1.46203 - Ln[hardness] * 0.145712)e^{(1.273 * Ln[hardness] - 1.46)}$$
$$Chronic = (1.46203 - Ln[hardness] * 0.145712)e^{(1.273 * Ln[hardness] - 4.705)}$$

Mn:

$$Acute = e^{(0.3331 * Ln[hardness] + 6.4676)}$$
$$Chronic = e^{(0.3331 * Ln[hardness] + 5.8743)}$$

Zn:

$$Acute = 0.978 * e^{(0.9094 * Ln[hardness] + 0.9095)}$$
$$Chronic = 0.986 * e^{(0.9094 * Ln[hardness] + 0.6235)}$$

Hardness (maximum of 400 milligrams per liter (mg/L), except for Al, for which hardness shall not exceed 220 mg/L):

$$[CaCO_3] = 2.5 * [Ca^{2+}] + 4.1 * [Mg^{2+}]$$

Concentrations of metals calculated using TVSs are in micrograms per liter (µg/L), and hardness is in milligrams per liter (mg/L) as calcium carbonate. These criteria were chosen to evaluate the surface water and SPLP data using hardness-based aquatic life criteria developed by CDPHE (CDPHE 2016) and to provide a consistent basis for evaluation of concentrations of relevant metals in surface water. At some sampling locations, the calculated TVS standard is higher than the typical federal water quality criteria, but because CDPHE WQCC Regulation 34 states that "The imposition of effluent limits required under the Federal Act for point sources and cost-effective and reasonable best-management practices for nonpoint sources are not likely to lead to the establishment of aquatic life in these segments", these more stringent standards were not used to analyze the surface water and SPLP samples discussed in this preliminary RI report.

A summary of relevant MIW and surface water data collected in 2015 and 2016 by ESAT and comparison to applicable WQCC standards is provided in **Table 4-1**, while a summary of all 2015 and 2016 analytical data for MIW and surface water is presented in **Attachment A**. Additionally, the leaching test and SPLP results from CDMG and ESAT in **Table 4-2** and **Table 4-3** are also discussed relative to these water quality standards. Acute WQCC standards are always higher than the chronic standards, and if the discussion in Section 4.2 states an exceedance of a WQCC acute standard, the chronic standard was also exceeded but will not be stated.

Total metals results from soil and waste rock samples are also discussed in Section 4.2 and are presented in **Table 4-4**, while a summary of all 2015 and 2016 analytical soil and waste rock data is presented in Attachment B. Metals results from soil and waste rock at mining-impacted recreation staging areas (e.g., established campgrounds or dispersed campsites) were compared to applicable human health risk-based levels presented in Appendix B of the FFS. These screening levels (in units of milligrams per kilograms [mg/kg]) are presented in **Exhibit 4-1**.

Exhibit 4-1 Soils and Waste Rock Metals Human Health Risk-Based Levels

Soil and Waste Rock Risk-Based Levels (mg/kg)		
Analyte	As	Pb
Campground Soil	122	2,081
Waste Rock	1,419	NA

Additionally, total metals results from sediment samples are discussed in Section 4.2 and are presented in **Table 4-5**. The analytical results from these sediment samples were compared to ecological risk-based screening levels based on Macdonald et al. (2000) and Ingersoll et al. (1996). These screening levels are provided in **Exhibit 4-2**.

Exhibit 4-2 Sediments Metals Screening Levels

Sediment Concentration Screening Levels (mg/kg)								
Al	As	Cd	Cu	Fe	Pb	Mn	Hg	Zn
26,000	9.79	0.99	31.6	188,400	35.8	631	0.18	121

The following discusses historical sampling results conducted at each of the 26 mining-related sources. To present information about the mining-related sources in a manner that accounts for the locations of the mining-related sources within the watersheds, Section 4.2 groups mining-related sources into subareas for discussion. These subareas are generally shown on **Figures 1-1 through 1-4**.

4.2 Sampling Results at Mining-Related Sources – Mineral Creek Headwaters

4.2.1 Longfellow Mine

The Longfellow Mine is located at the headwaters of Mineral Creek at an elevation of approximately 11,160 feet National Geodetic Vertical Datum of 1929 (NGVD29) near the top of Red Mountain Pass just east of U.S. Highway 550 and is readily accessible to the public. This mining-related source is adjacent to the Junction Mine and Koehler Tunnel. Water flows from upgradient areas into a diversion channel around an onsite waste rock pile, and into the Mineral Creek Headwaters. A wooden shaft house and shaft are present at the waste rock pile. **Figure 4-1** shows sample locations and other features of this mining-related source.

According to CDMG (Herron et al. 1997), approximately 32,000 cubic yards (cy) of mine waste from the Longfellow Mine, Junction Mine, and Koehler Tunnel was removed by Sunnyside Gold

Corporation in 1996 and 1997 to the Mayflower tailings repository near Silverton. Most of the remaining waste rock at the Longfellow Mine has been capped.

The following sections describe results of analyses conducted for Longfellow Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.2.1.1 Longfellow Mine Surface Water

In 2016, one water quality sampling location was sampled for the Longfellow Mine (**Table 4-1**) at a surface water location north of the shaft house (M02D) (**Figure 4-1**). The measured flow rate was higher during high-flow conditions in June, at 15 gallons per minute (gpm), than in October during low-flow (4.9 gpm). The pH was only marginally lower in the June sample compared to October sample (6.61 standard units [su] versus 6.83 su).

The June 2016 sample exceeded the acute aquatic life standards (acute standards) for Cu, and chronic aquatic life standards (chronic standards) for Al. The October 2016 sample exceeded the chronic standards for Al and Cu.

4.2.1.2 Longfellow Mine CDMG and EPA/ESAT Waste Rock SPLP

No waste rock samples were collected at the Longfellow Mine during the CDMG investigation, and USGS estimates that there was 5,500 cy of waste rock material onsite (**Table 4-2**). However, an SPLP test was conducted on waste rock collected in July 2016 at the Longfellow Mine (WR-M02B) (**Table 4-3**) and the results exceeded the chronic standard for Pb.

4.2.1.3 Longfellow Mine Soils, Waste Rock, and Sediment

As shown in **Table 4-4**, a waste rock sample collected from WR-M02B in July 2016 exceeded the waste rock human health risk-based level for As.

No sediment samples (**Table 4-5**) were collected from the Longfellow mine in 2015 or 2016.

4.2.2 Junction Mine

The Junction Mine is located at the headwaters of Mineral Creek at an elevation of approximately 11,160 feet NGVD29 near the top of Red Mountain Pass just east of U.S. Highway 550, and thus is readily accessible to the public. This mining-related source is adjacent to the Koehler Tunnel and Longfellow Mine. A draining adit is present, and water from the adit flows into an onsite pond that combines with flow from the discharging adit at the Koehler Mine. There is visible precipitate formation in the pond, and soil around the adit flow exhibits staining, indicating seasonally higher flows of MIW. **Figure 4-1** shows sample locations and other features of this mining-related source.

According to CDMG (Herron et al. 1997), approximately 32,000 cy of mine waste from the Longfellow Mine, Junction Mine, and Koehler Tunnel was removed by Sunnyside Gold Corporation in 1996 and 1997 to the tailings repository near Silverton.

The following sections describe results of analyses conducted for Junction Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.2.2.1 Junction Mine Adit Discharge

In 2016, one water quality sampling location was sampled for the Junction Mine (**Table 4-1**) at the adit (M02B) (**Figure 4-1**). The measured flow rate was higher during high-flow conditions in June at 12 gpm, than in October during low-flow (2.9 gpm). The adit water quality data indicate dilution with higher flows, because concentrations were higher in the October sample than the June sample, and the pH was significantly lower (3.86 su in October versus 6.15 su in June).

The June and October 2016 adit samples exceeded acute aquatic life standards (acute standards) for Cd, Cu, and Zn, and chronic aquatic life standards (chronic standards) for Al, As, and Fe. The chronic and acute standards for Pb were also exceeded for the June and October adit samples, respectively.

4.2.2.2 Junction Mine CDMG and EPA/ESAT Waste Rock SPLP

No waste rock samples were collected at the Junction Mine during the CDMG investigation. However, one SPLP test was conducted on waste rock collected in July 2016 at the Junction Mine (WR-M02D) (**Table 4-3**). The SPLP results exceeded the acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al. This indicates that despite the removal of the majority of waste rock at this mining-related source, impacted solid media remains that generates leachate exceeding surface water quality standards.

4.2.2.3 Junction Mine Soils, Waste Rock, and Sediment

As shown in **Table 4-4**, a waste rock sample collected from WR-M02D in July 2016 exceeded the human health risk-based level for As.

Per **Table 4-5**, a sediment sample (M02E) collected from the settling pond collected in October 2016 exceeded sediment ecological screening levels (sediment screening levels) for As, Cd, Cu, Pb, Hg, and Zn. Concentrations of As, Cd, Cu, and Zn in this pond sediment sample were the highest among Mineral Creek mining-related sources.

4.2.3 Koehler Tunnel

The Koehler Tunnel is located in upper Mineral Creak at an elevation of 11,160 feet NGVD29 near the top of Red Mountain Pass, adjacent to the Junction and Longfellow Mines. This mining-related source is accessible to the public.

The Koehler Tunnel was bulkheaded in 2003 with additional grouting around the bulkhead in 2011 (Colorado Division of Reclamation, Mining and Safety [DRMS] 2011); however, some water still discharges from the adit and orange precipitates are present in drainage. The adit discharges down a talus slope and flows into the same pond as the Junction Mine adit discharge. According to CDMG (Herron et al. 1997), mine waste from the Junction Mine, Koehler Tunnel, and Longfellow Mine was removed by Sunnyside Gold Corporation to the tailings repository near Silverton, and most structures were removed. **Figure 4-1** shows sample locations and features of this mining-related source.

Per CDMG (Herron et al. 1997), the adit and waste rock at the Koehler mining-related source produced 52 to 56 percent of the Fe loading and over 90 percent of the Zn loading to Mineral

Creek prior to installation of the bulkhead. The bulkhead has been effective at improving water quality in the upper Mineral Creek watershed (DRMS 2011).

The following sections describe results of analyses conducted for Koehler Tunnel surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.2.3.1 Koehler Tunnel Adit Discharge and Surface Water

In 2016, four water quality sampling locations were collected at the Koehler Mine (**Table 4-1**). Samples were collected from a flowing pipe below the adit (M0K21), from the adit discharge (M02C), from the outlet of the pond (M02E), and from downstream of Koehler Tunnel in Mineral Creek (M02) (**Figure 4-1**). It is unknown if the pipe water sample can be compared to the adit discharge sample.

Flow from the adit (M02C) was 4.5 gpm in October 2016, and the June sample collected from the M02K1 pipe had a flow rate of only 0.1 gpm. The Koehler Tunnel adit sample had a pH of 6.12 su in October, and exceeded the acute standards for Al, As, Cd, Cu, Mn, and Zn and the chronic standard for Fe. The pipe water sample had a pH of 4.54 su in June, and exceeded the acute standards for Cd, Cu, Mn, and Zn, and the chronic standard for Al. The settling pond outlet (M02E), which contains water from both the Koehler Tunnel and the Junction Mine adit, was sampled in June and October 2016 and metals concentrations in both samples exceeded acute standards for Cd, Cu, Mn, and Zn, and chronic standards for Al, As, Fe, and Pb. The flow rate was measured in October at 9 gpm, with a pH of 3.6 su. Concentrations in the pond were generally lower than the concentrations from the adit and the pond pH was several units lower than the adit in October. Downstream in Mineral Creek (M02), in June and October, flows were 150 and 23 gpm, respectively, pH was 5.76 and 8.03 su, respectively, and acute standards for Cd, Cu, Mn, and Zn, and chronic standards for Al, Fe, and Pb, were exceeded during both sampling events.

4.2.3.2 Koehler Tunnel CDMG and EPA/ESAT Waste Rock SPLP

No waste rock samples were collected at the Koehler Mine during the CDMG investigation. However, two SPLP tests were conducted on one soil/waste rock sample collected in July 2016 at the Koehler Mine (WR-M02C) (**Table 4-3**). These SPLP tests were performed on waste rock passing a 10-sieve, which has a 0.0787-inch opening, and 60-sieve, which has a 0.0098-inch opening. For the 10- and 60-sieve samples, the SPLP results exceeded the acute standard for As, and the chronic standards for Al, Fe, and Pb. The 60-sieve sample fraction exceeded the chronic standard for Cu as well. These results indicate that despite the removal of most of the waste rock at this mining-related source, impacted solid media remains that generates leachate exceeding surface water quality standards.

4.2.3.3 Koehler Tunnel Soils, Waste Rock, and Sediment

Table 4-4 shows results for waste rock and soil samples collected at the Koehler Tunnel. Samples were collected from waste rock/soil (WR-M02C), the onsite pond (M02E), and from downstream in Mineral Creek (M02). From the waste rock/soil at WR-M02C, concentrations of As were 13,700 mg/kg in the 10-sieve fraction and 22,200 mg/kg in the 60-sieve fraction, which were the highest among waste rock samples collected at the Site. The results from the 10-sieve and 60-sieve fractions at WR-M02C exceeded the human health risk-based level for As.

Per **Table 4-5**, as discussed for the Junction Mine above, a sediment sample from the settling pond collected in October 2016 (M02E) had the highest As, Cd, Cu, and Zn concentrations found in sediments at Mineral Creek mining-related sources. This sample exceeded sediment screening levels for As, Cd, Cu, Pb, Hg, and Zn.

4.3 Sampling Results at Mining-Related Sources – Browns Gulch

4.3.1 Brooklyn Mine

The Brooklyn Mine adit is located on the east side of Mineral Creek along a steep walled portion of Brown's Gulch at an elevation of approximately 11,400 feet NGVD29. Forest Service Road 825 passes through the site, making it accessible to the public. The Mine has a flowing adit with a metal grate, and flow is piped away from the adit to a constructed channel lined with Burns Formation rock, which has become armored and stained with orange precipitate. There are visual impacts to surface soils from surface water flow after discharge from the constructed channel. There is a possible collapsed adit located above the draining adit. There are three structures on the site, and there are two constructed ponds along Forest Service Road 825 located east of the Brooklyn Mine. A large volume of waste rock is present and a large vegetation kill zone with orange staining is seen at the base of the slope where water discharges from the channel. **Figure 4-2** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Brooklyn Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.3.1.1 Brooklyn Mine Adit Discharge and Surface Water

In 2016, five total water quality sampling locations were collected for the Brooklyn Mine (**Table 4-1**). Samples were collected from the adit (M12C), an adit diversion channel (M12D), upstream of the Brooklyn Mine in Browns Gulch (M12B), downstream of the diversion channel in Emporium Creek (which flows through Browns Gulch) (M12A), downstream of the Brooklyn Mine in Browns Gulch (before the confluence with Mineral Creek) (M12), and the two ponds along Forest Service Road 825 (M12F and M12G) (**Figure 4-2**).

In 2016, adit flow (M12C) was higher in June (7.3 gpm) than in September (1.1 gpm), while pH ranged from 3.63 to 3.84 su. It should be noted that maintenance was completed on the adit diversion piping in October 2016 to improve flow through the diversion. In September, the adit-diversion channel (M12D) pH was 3.72 su, which is similar to the adit. Upstream in Browns Gulch (M12B), June and September flows were 223 and 151 gpm, respectively, and pH ranged from 4.55 to 4.76 su. Downstream of the Brooklyn Mine, in Browns Gulch, before the confluence with Mineral Creek (M12), June and September flows were 438 and 165 gpm, respectively, and pH ranged from 4.17 to 5.08 su. In 2016, Emporium Creek, downstream of the adit diversion channel (M12A), had a flow of 151 gpm in September; pH was 4.51 su in June and 4.45 su in September. In October 2016, the northern pond sample (M12F) had a pH of 7.79 su, while the southern pond sample (M12G) had a pH of 4.07 su.

The June and September 2016 adit samples exceeded acute standards for Cd, Cu, Mn, and Zn, and chronic standards for Al, Pb, and Fe. The adit water quality data appear to indicate metals dilution with higher flows because concentrations were higher in the two September adit samples than the June sample. In the adit diversion channel in September, metals concentrations were similar to the adit. Between upstream and downstream of the Brooklyn Mine in Browns Gulch, Cd and Zn concentrations increased such that they exceeded chronic and acute standards, respectively. The sample collected from one pond (location M12F) in October 2016 did not exceed any acute or chronic water quality standards, while the sample from pond location M12G in October 2016 exceeded acute standards for Cu, Pb, and Zn, and chronic standards for Al and Cd.

4.3.1.2 Brooklyn Mine CDMG and EPA/ESAT Waste Rock SPLP

Three leachate samples were collected by CDMG from waste rock at the Brooklyn Mine. These waste rock samples all exceeded the acute standards for Al, Cd, Cu, Mn, Pb, and Zn, and the chronic standards for Fe. USGS estimated 15,000 cy of waste rock material onsite.

Per **Table 4-3**, three SPLP samples were analyzed from waste rock samples collected in July 2016 at the Brooklyn Mine (WR-M12, WR1-M12, and WR2-M12). For the WR-M12 sample near the adit, SPLP results exceeded the acute standards for Cu, Pb, and Zn, and the chronic standards for Al, Fe, and Pb. For the WR1-M12 sample collected from waste rock below the adit, the acute standards were exceeded for Cd, Cu, Mn, Pb, and Zn, and chronic standards for Al and Fe, while the WR2-M12 sample also exceeded the acute standard for Al. The WR1-M12 waste rock sample had the highest Al, Fe, and Mn concentrations of any SPLP sample collected for the Mineral Creek mining-related sources.

4.3.1.3 Brooklyn Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Brooklyn Mine at three waste rock pile locations (WR-M12, WR1-M12, and WR2-M12), onsite adit soil (M12C), two adit channel locations (M12D,and M12E), upstream of the mine in Browns Gulch (M12B), in Emporium Creek after the diversion channel (M12A), and downstream of the mine in Browns Gulch (M12).

Per **Table 4-5**, sediment samples were collected at eight locations in 2016 at the Brooklyn Mine. The two adit discharge sample exceeded sediment screening levels for As, Cu, Pb, Hg, and Zn. The Brown's Gulch upstream sample exceeded sediment screening levels for As, Cu, Pb, Mn, and Zn, while the Brown's Gulch downstream sample only exceeded sediment screening levels for As and Pb. Within the adit drainage channel, the first sampling location M12E exceeded sediment screening levels for As, Cu, Fe, Pb, and Zn, the second sampling location M12D exceeded sediment screening levels for Al, As, Cd, Cu, Fe, Pb, Mn, and Zn, while the third sampling location M12A only exceeded sediment screening levels for As and Pb. Two samples collected at the two ponds present east of the Brooklyn Mine (M12F and M12G) exceeded sediment screening levels for As, Cd, Cu, Pb, and Zn.

4.4 Sampling Results at Mining-Related Sources – South Fork Mineral Creek

4.4.1 Bandora Mine

The Bandora Mine is located west of Mineral Creek along the South Fork at an elevation range between 10,690 feet to 11,000 feet NGVD29. The mine is situated on a uniform, southeast-facing, steep mountain slope in a forested subalpine terrain just below timberline. The mine is visible from County Road 585 and is accessible to the public. The mine has two flowing adits. The main adit is collapsed and discharge from both adits flow in a diversion channel to the northeast and then downslope and across the road into the South Fork of Mineral Creek. Large amounts of orange precipitates are visible in flow channels and on rocks. There are two dilapidated structures onsite. **Figure 4-3** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Bandora Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.4.1.1 Bandora Mine Adit Discharge and Surface Water

In 2016, six total water quality sampling locations were collected for the Bandora Mine (**Table 4-1**). Samples were collected from two adit locations (M24B and M24C), two samples from the adit drainage channel (M24A and M24D), upstream of Bandora Mine in the South Fork of Mineral Creek (M23), and downstream of Bandora Mine in the South Fork of Mineral Creek (M25) (**Figure 4-3**).

In September 2016, Bandora Mine adit flow at M24B was measured to be 24 gpm and had a pH of 6.71 su. In September 2016 from the lower adit location M24C, pH was 6.96 and 7.41 su, respectively. In the adit flow channel samples M24A and M24D, pH was measured at 6.96 and 6.87 su, respectively, in September. Upstream of Bandora Mine (M23), flow was 7,351 gpm in September 2016, with a pH of 5.98. In June and September 2016, downstream flow (M25) was 21,553 and 9,317 gpm, respectively, and pH was 6.28 and 6.12 su, respectively. These results indicate that there was not a noticeable change in pH within South Fork Mineral Creek across the Bandora Mine site.

The September 2016 M24B adit sample exceeded acute standards for Cd, Mn, and Zn, and chronic standards for Al, Cu, and Fe. The M24C adit sample only exceeded the acute standard for Zn. The adit flow channel samples M24A and M24D exceeded acute standards for Cd, Mn, and Zn, and chronic standards for Al and Fe. In September, both upstream and downstream samples M23 and M25 exceeded chronic standards for Al and Cd, while downstream sample M25 also exceeded the chronic standard for Zn.

4.4.1.2 Bandora Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Bandora Mine (**Table 4-2**). The waste rock sample exceeded the acute standards for Cd, Cu, Pb, and Zn. CDMG and USGS estimated 5,500 cy of waste rock material onsite.

Per **Table 4-3**, four SPLP samples were analyzed from waste rock samples collected in July 2016 at the Bandora Mine (WR1-M24, WR2-M24, WR3-M24, and WR4-M24). All samples exceeded the acute standards for Mn, Pb, and Zn. The WR1-M24, WR2-M24, and WR3-M24 samples also exceeded acute standards for Cd and Cu, and chronic standard for Fe. The WR1-M24 and WR3-M24 samples also exceeded chronic Al standards. The WR1-M24, WR2-M24, and WR3-M24 SPLP samples had the highest Cd, Cu, Pb, and Zn levels among waste rock samples collected at the Mineral Creek mining-related sources.

4.4.1.3 Bandora Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Bandora Mine at four waste rock pile locations (WR1-M24, WR2-M24, WR3-M24, and WR4-M24), the adit drainage channel above the South

Fork of Mineral Creek (M24D), an upstream location (M23), and a downstream location (M25). Waste rock samples collected at Bandora had the highest Cu concentrations in all of Mineral Creek and some of the highest Pb and Zn concentrations in all of the Site. Concentrations typically increased between the upstream and downstream points.

Per **Table 4-5**, sediment samples were collected in 2016 at locations upstream and downstream from the Bandora Mine. Metals concentrations typically increased between the upstream and downstream samples, and the downstream sample exceeded sediment screening levels for Cd, Cu, Pb, and Zn.

4.5 Sampling Results at Mining-Related Sources – Upper Cement Creek

4.5.1 Grand Mogul Mine

The Grand Mogul Mine is located in Ross Basin, about 0.5 miles east of the Mogul Mine main adit near the base of the north basin wall at an elevation of 11,800 feet NGVD29. The Grand Mogul Mine is difficult to access via a jeep trail. The main and most eastern adit is collapsed. Flow from beneath the Grand Mogul Mine waste rock travels westward over soil for approximately 650 feet before entering upper Cement Creek. The overland flow path is heavily stained with orange precipitates. Three piles of mine waste from the workings of the Grand Mogul Mine are located on the north side of Cement Creek. Flow from the collapsed eastern adit is likely seeping out of the toe of the easternmost waste rock pile. Gullies are present on the waste rock piles and the piles have a moderate degree of erosion. A large shaft or stope covered with metal grate is located at the second waste rock pile. There are no other structures onsite. **Figure 4-4** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Grand Mogul Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.5.1.1 Grand Mogul Mine Adit Discharge and Surface Water

In 2016, seven total water quality sampling locations were collected for the Grand Mogul Mine (**Table 4-1**). Samples were collected from two eastern waste rock seep locations (CC01C and CC01C1), an adit and waste rock discharge channel before confluence with Cement Creek (CC01C2), upstream of Grand Mogul Mine in Cement Creek (CC01F), Cement Creek after confluence with the adit and waste rock drainage channel (CC01H) (before confluence with Queen Anne Mine tributary), in the western waste rock drainage channel (CC02I), and downstream in Cement Creek after confluence with the western rock pile drainage and all Grand Mogul mining-related sources (CC01U) (**Figure 4-4**).

In September 2016, Grand Mogul Mine seep flows were measured at CC01C and CC01C1 at 3.6 and 2.8 gpm, respectively, with pH values of 4.1 and 3.96 su, respectively. Flows were not measured at CC01C and CC01C1 during June 2016. In the seep flow channel in June and September, CC01C2 had flows of 73 and 9 gpm, respectively, and pH values of 3.42 and 4.12 su, respectively. Flow at Cement Creek upstream location CC01F was not measured; pH in June and September was 7.27 and 7.16 su, respectively. In Cement Creek at CC02H in June and September 2016, flow was 2,904 and 368 gpm, respectively, while pH values were 6.12 and 6.31 su, respectively. In the western waste rock pile drainage channel at CC02I, flow was 7.3 in June 2016, and pH was 4.69 su. Downstream of Grand Mogul Mine in Cement Creek at CC01U in June and September 2016, flow was 5,327 and 378 gpm, respectively, while pH was 6.16 and 5.72 su, respectively. These results indicate that the Grand Mogul Mine adversely affected pH values in Cement Creek.

In 2016, June and September adit and waste rock channel water samples CC01C, CC01C1, and CC01C2 all exceeded acute standards for Al, Cd, Cu, and Zn, and exceeded chronic standards for Fe. These three sampling points also had exceedances of acute and chronic Mn and Pb during June and September 2016, and Mn concentrations were some of the highest in Cement Creek. The Grand Mogul Mine upstream location in June and September exceeded acute standards for Cu and Zn, and chronic standards for Al and Cd. Cement Creek after confluence with the adit and waste rock drainage channel (CC01H) sample exceeded acute standards for Cd, Cu, and Zn, and the chronic standard for Al. The drainage channel for the western waste rock pile (CC02I) and the Grand Mogul Mine downstream (CC01U) samples exceeded acute standards for Cd, Cu, and Zn, and the chronic standard for Al, and the downstream sample also exceeded the chronic standard for Mn. Results presented in **Table 4-1** show that water flowing from the Grand Mogul Mine meaningfully increased concentrations of Al, Cd, Cu, Fe, Mn, and Zn in Cement Creek.

4.5.1.2 Grand Mogul Mine CDMG and EPA/ESAT Waste Rock SPLP

Two leachate samples were collected by CDMG from waste rock at the Grand Mogul Mine (**Table 4-2**). These waste rock samples all exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and the chronic standards for Fe. CDMG estimated 8,000 and 9,000 cy of waste rock at the west and east waste rock piles, respectively, while USGS estimated 9,000 cy total of waste rock material onsite.

Per **Table 4-3**, three SPLP samples were analyzed from waste rock samples collected in July 2016 at the Grand Mogul Mine (WR-CC01C, WR-CC01C2, and WR-CC02A). These samples exceeded the acute standards for Cd, Cu, Pb, and Zn, and chronic standards for Al. The WR-CC01C2 and WR-CC02A samples also exceeded the chronic Fe standard. The Grand Mogul Mine WR-CC01C and WR-CC01C2 SPLP samples had the highest Cd, Cu, Pb, and Zn concentrations among waste rock samples collected at Cement Creek mining-related sources.

4.5.1.3 Grand Mogul Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Grand Mogul Mine at three waste rock pile locations (WR-CC01C, WR-CC01C2, and WR-CC02A), two seep locations below the eastern waste rock piles (CC01C and CC01C1), the adit and waste rock drainage channel before confluence with Cement Creek (CC01C2), upstream of the mine in Cement Creek (CC01F), in Cement Creek after confluence with the eastern adit and waste rock discharge channel (CC01H), in a drainage channel for the western waste rock (CC02I), and downstream of all Grand Mogul mining-related sources in Cement Creek (CC01U). The WR-CC01C and WR-CC01C2 waste rock samples had the highest Pb and Zn concentrations among Cement Creek mining-related sources, and the CC01C2 drainage channel location had the highest Al, Cd, and Mn concentrations of any sample collected among the Cement Creek mining-related sources.

Per **Table 4-5,** sediment samples were collected in 2016 at seven locations at the Grand Mogul Mine. All samples exceeded sediment screening levels for As, Cu, Pb, Mn, and Zn, and all samples except for CC01C also exceeded sediment screening levels for Cd.

4.6 Sampling Results at Mining-Related Sources – Gladstone Area

4.6.1 Natalie/Occidental Mine

The Natalie/Occidental mine is located one mile southeast of Gladstone on the north side of the South Fork of Cement Creek, directly across from the Big Colorado Mine. The discharging adit elevation is at 11,000 feet NGVD29. The Natalie/Occidental Mine is accessible via a county road and is accessible to the public. The primary discharging adit is covered with a grate, and a possible collapsed adit and exploration pit are upslope of the primary adit. The adit discharge flows southwest over soil and adjacent to waste rock for approximately 240 feet before entering the South Fork of Cement Creek. Heavy orange precipitate is observed throughout this adit flow channel. Precipitate buildup behind the adit grate has raised the level with which water flows out of the adit. Staining on the grate indicates that higher flows have been present historically. Discharged adit water flows over waste rock at the site, and the onsite waste rock is being undercut by the South Fork of Cement Creek with a high degree of erosion. **Figure 4-5** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Natalie/Occidental Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.6.1.1 Natalie/Occidental Mine Adit Discharge and Surface Water

In 2015 and 2016, three total water quality sampling locations were collected for the Natalie/Occidental Mine (**Table 4-1**). Samples were collected from an adit location (CC14), upstream of Natalie/Occidental Mine in the South Fork of Cement Creek (CC15), and downstream of Natalie Occidental Mine in the South Fork of Cement Creek (CC15A) (**Figure 4-5**).

In September 2016, the adit flow rate was measured at CC14 at 407 gpm, with a pH value of 5.39 su. The remaining 2015 and 2016 adit pH values ranged from 6.09 to 6.32 su. Upstream of Natalie/Occidental in the South Fork of Cement Creek at CC15, flows were measured at 7,277 and 301 gpm in June and September 2016, respectively, with no pH measurement in June and a pH value of 7 su in September. Downstream of the Natalie/Occidental Mine in the South Fork of Cement Creek at CC15A, flows were measured as 7,206 and 1,170 gpm in June and September 2016, respectively, with a pH value of 6.8 su in September and no pH measurement in June. These results indicate that the Natalie/Occidental Mine significantly contributes to flow to the South Fork of Cement Creek during September low-flow conditions.

In 2015 and 2016, the Natalie/Occidental Mine adit discharge exceeded acute standards for Zn, and chronic standards for Al, Cd, and Fe. Additionally, the June 2015 and 2016 samples exceeded acute standards for Cu. Upstream samples from 2016 only exceeded the chronic standards for Al. Downstream of the Natalie/Occidental Mine, the June 2016 sample exceeded the acute standard for Zn and chronic standards for Al, Cd, Cu, and Fe, while the September 2016 sample exceeded the chronic standards for Al, Cd, Fe, and Zn. These water quality results indicate that the Natalie/Occidental Mine increases concentrations of Fe, Mn, and Zn in the South Fork of Cement Creek.

4.6.1.2 Natalie/Occidental Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Natalie/Occidental Mine (**Table 4-2**). This waste rock sample exceeded the acute standard for Al, Cd, Cu, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 6,800 cy of waste rock material onsite.

Per **Table 4-3**, two SPLP samples were analyzed from waste rock samples collected in July 2016 at the Natalie/Occidental Mine (WR-CC14A and WR-CC14B). These samples exceeded the acute standards for Al and Pb, and chronic standards for Fe. The WR-CC14B sample also exceeded the acute Zn standard.

4.6.1.3 Natalie/Occidental Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Natalie/Occidental Mine at two waste rock pile locations (WR-CC14A and WR-CC14B), upstream of the mine in the South Fork of Cement Creek (CC15), and downstream of the mine in the South Fork of Cement Creek (CC15A).

Per **Table 4-5**, sediment samples were collected in 2016 at two locations (upstream and downstream in South Fork of Cement Creek) at the Natalie/Occidental Mine. Metals concentrations were typically higher downstream of the mine and exceeded sediment screening levels for As, Cu, and Pb in all samples.

4.7 Sampling Results at Mining-Related Sources – Lower Cement Creek

4.7.1 Henrietta Mine

The Henrietta Mine is located on the south side of Prospect Gulch and is accessible by 4-wheel drive vehicle from County Road 35, with at least six levels into the mine. The 700 Level entrance to the mine is at an elevation of 11,360 feet NGVD29. The 800 Level is collapsed and topographically below and north of the 700 Level portal, close to Prospect Gulch. CDMG reported a large compound waste dump located at the adit portals of the 700 and 800 levels, which is divided by Prospect Gulch and is mostly located on the south side of Prospect Gulch below the 700 Level. CDMG estimated from a survey that 30,000 cy of waste are onsite from the 700 and 800 levels, while USGS estimated approximately 36,000 cy. This 700- and 800-level waste rock pile has since been reclaimed. Presently, the 700 Level adit flows only during high-flow conditions and is diverted into a drainage channel that flows on the southeastern side of the waste rock. There is a small cabin located near the 700 Level adit. A grate is in place on the 700 Level portal and the surrounding slope is eroding. Additional orange precipitate is present in Prospect Gulch downstream of a wooden dam near the 800 Level adit. **Figure 4-6** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for the Henrietta Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.7.1.1 Henrietta Mine Adit Discharge and Surface Water

In 2016, three total water quality sampling locations were collected for the Henrietta Mine (**Table 4-1**). Samples were collected from the 700 Level adit location (CC24G), upstream of

Henrietta Mine in Prospect Gulch (CC22D), a midpoint in Prospect Gulch (CC22B), and downstream of Henrietta Mine in Prospect Gulch (CC24B) (**Figure 4-6**).

Flows were measured from the Prospect Gulch upstream (CC22D), midpoint (CC22B), and downstream (CC24B) locations in September 2016 as 73, 131, and 166 gpm, respectively, with pH values of 5.79, 4.33, and 3.93 su, respectively. pH values were similar between June and September at the upstream location but dropped at the midpoint and downstream location between high- and low-flow conditions. These flow and pH results indicate that the northern and southern waste rock seeps and 800 Level adit are impacting Prospect Gulch flow and pH during both high- and low-flow conditions. At the 700-level adit (CC24G), flows were not measured in 2016, and pH was 4.61 in June 2016.

The June 2016 Henrietta Mine 700-level adit water sample exceeded acute standards for Al, Cu, and Zn, and chronic standards for Cd, Fe, and Pb. The 2016 upstream and midpoint samples exceeded the acute standards for Al, Cd, Cu, Pb, and Zn. The downstream June sample exceeded acute standards for Cu and Zn and chronic standards for Al, Cd, Fe, and Pb, while the downstream September sample exceeded acute standards for Al, Cd, Cu, Pb, and Zn and the chronic standard for Fe. Concentrations of Al and Pb increased between the upstream and midpoint samples during both high- and low-flow samples, and concentrations typically increased between the upstream and downstream sampling points.

4.7.1.2 Henrietta Mine CDMG and EPA/ESAT Waste Rock SPLP

Three leachate samples were collected by CDMG from waste rock at the Henrietta Mine (**Table 4-2**). These samples exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 30,000 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP test was conducted on a waste rock sample collected in July 2016 at the toe of the Henrietta Mine waste rock pile (WR-CC22). This sample exceeded the acute standard for Pb and chronic standards for Al and Fe.

4.7.1.3 Henrietta Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Henrietta Mine in July 2016 at one waste rock location (WR-CC22), and in September 2016 at one upstream soil location in Prospect Gulch (CC22D), one midpoint location in Prospect Gulch (CC22B), and one downstream soil location in Prospect Gulch (CC24B).

Per **Table 4-5**, sediment samples were collected in September 2016 at three locations at the Henrietta Mine. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, and Zn. Except for Al, metals concentrations typically decreased in Prospect Gulch between the upstream and downstream samples.

4.7.2 Mammoth Tunnel

The Mammoth Tunnel is located on the west side of Cement Creek near the mouth of Georgia Gulch at an elevation of 10,400 feet NGVD29. This mining-related source is located on a county road and is accessible to the public. The USGS estimated the waste rock pile at 100 cy. The adit is collapsed and a pipe protrudes from the side of the hill to allow discharge. The adit flow is channelized and flows down the side of the waste rock in a lined channel into two constructed settling ponds. Some of the discharged flow bypasses the first pond into the second pond. Adit discharge does not flow out of second pond, but instead seeps into the ground. Algae and Fe staining and metal precipitates are found throughout the discharge channel and ponds. **Figure 4-7** shows relevant features of this mining-related source.

Due to property access limitations, analytical samples were not collected by EPA/ESAT for any media during their 2015/2016 sampling events. Thus, limited historic information from the USGS and CDMG are provided. According to the leachability test performed by CDMG on waste rock from the Mammoth Tunnel, the leachate exceeded the water quality screening criteria for acute Al, Cd, Cu, and Zn (**Table 4-2**).

4.7.3 Anglo Saxon Mine

The Anglo Saxon Mine is adjacent to County Road 110 on the west side of Cement Creek, approximately 3 miles upstream from Silverton. The site is accessible to the public. This mine consists of an adit located close to County Road 110. The adit is at an elevation of 10,080 feet NGVD29 and the adit discharge flows from a collapsed wooden structure. The main adit discharges across a moderately eroded waste pile, and cascades down to a culvert underneath the road to a constructed settling pond before continuing to Cement Creek. Orange precipitate staining is observed on the flow channels draining from this primary adit. A wooden shack and a crib wall are present at the site. **Figure 4-8** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Anglo Saxon Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.7.3.1 Anglo Saxon Mine Adit Discharge and Surface Water

In 2016, six total water quality sampling locations were collected for the Anglo Saxon Mine and Porcupine adit area (**Table 4-1**). Samples were collected from the lower (main) adit location (CC37), upstream of Anglo Saxon Mine in Cement Creek (CC39B), downstream of Anglo Saxon Mine in Cement Creek (CC39), Porcupine Gulch adit (upper adit) (CC38B), upstream of upper adit in Porcupine Gulch (CC38C), and downstream of the upper adit before confluence with Cement Creek (CC38) (**Figure 4-8**).

Flows were measured from the lower main adit (CC37) in June and September 2016 to be 41 gpm during both events, with a pH of 6.53 su during both events. At the upper adit (CC38B) in June and September, flows were 59 and 36 gpm, respectively, with pH values of 6.15 and 6.67 su, respectively. Upstream (CC38C) and downstream (CC38) of the upper adit in September, flows in Porcupine Gulch were 15 and 37 gpm, respectively, and pH was 7.32 and 7.25 su, respectively. Upstream of the Anglo Saxon Mine in Cement Creek (CC39B), flow was 6,993 gpm in September (no flow measured in June), and pH in June and September was 5.1 and 3.82 su, respectively. Downstream of Anglo Saxon Mine in Cement Creek (CC39), flow was 7,970 gpm in September (no flow measured in June), and pH in June and September was 5.26 and 3.62 su, respectively. These results indicate that the Porcupine Gulch adit contributes significantly to flow in Porcupine Gulch during low-flow, and the effect of seasonal flows reduces Cement Creek pH at this point by approximately 1.5 su between June and September, though the pH is relatively unchanged across the site.

The 2016 Anglo Saxon Mine main adit and Porcupine Gulch adit water samples all exceeded acute standards for Mn and Zn, and chronic standards for Al, Cd, and Fe. The June 2016 sample from the Porcupine Gulch adit also exceeded the acute standard for Cu. These metals concentrations do not appear to change meaningfully between June to September. Upstream and downstream locations in Cement Creek both exceeded acute standards for Cu and Zn, and chronic standards for Al, Cd, Fe, and Pb.

4.7.3.2 Anglo Saxon Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Anglo Saxon Mine (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated there was 2,200 cy of waste rock material onsite.

Per **Table 4-3**, four SPLP tests were conducted on two waste rock samples collected in July 2016 at the Anglo Saxon Mine and the Porcupine Gulch adit (WR-CC37 and WR-CC38B). These SPLP tests were performed on waste rock passing a 10- and 60-sieve. The WR-CC37 10-sieve sample exceeded acute standards for Pb and Zn, and chronic standard for Mn, while the 60-sieve portion also exceeded the acute standards for Al, Cu, and Mn, and chronic standard for Fe. The 60-sieve portion of this sample contained the highest Fe and Mn concentrations among the Cement Creek mining-related sources. For the WR-CC38B 10- and 60-sieve samples, acute standards were exceeded for Al, Cd, Cu, Pb, and Zn, and chronic standard for Fe.

4.7.3.3 Anglo Saxon Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Anglo Saxon Mine and Porcupine Gulch adit in 2016 at two waste rock pile locations (WR-CC37 and WR-CC38B), three locations in Porcupine Gulch before confluence with Cement Creek (CC38, CC38C, and CC38D), upstream of the mine in Cement Creek (CC39B), and downstream of the mine in Cement Creek (CC39).

Per **Table 4-5**, sediment samples were collected in 2016 at five locations at the Anglo Saxon Mine. The upstream CC39B location exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn, while the downstream location only exceeded sediment screening levels for As, Cu, Pb, and Zn. The three sampling locations in Porcupine Gulch all exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn, and the CC38 location also exceeded the sediment screening level for Fe. Metals concentrations did not typically increase in Cement Creek between the mine upstream and downstream samples.

4.7.4 Yukon Tunnel

The Yukon Tunnel lies on the east side of Cement Creek along County Road 110 about 2.5 miles upstream from Silverton. Access is via an old bridge across Cement Creek at an elevation of 10,080 feet NGVD29. The site access road is gated but still accessible by walking. The adit has a metal door and the closure is in generally poor condition. Adit discharge is directed within the adit into a pipe, which discharges to the north of a large waste rock pile into Illinois Gulch adjacent to the mine. There is a moderate amount of erosion on the waste rock pile, and four structures are onsite. **Figure 4-9** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Yukon Tunnel surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.7.4.1 Yukon Tunnel Adit Discharge and Surface Water

In 2016, four total water quality sampling locations were collected for the Yukon Tunnel (Table 4-1). Samples were collected from the adit discharge pipe (CC43C), upstream in Cement Creek (CC41), downstream in Cement Creek (CC43E), and from an onsite pond where previous reclamation activities had occurred (CC43D) (**Figure 4-9**).

In September 2016, flows were measured at the upstream (CC41) and downstream (CC43E) points in Cement Creek as 6,939 and 7,069 gpm, respectively, with pH values of 3.55 and 3.88 su, respectively. In June, the upstream and downstream locations in Cement Creek had pH values of 5.16 and 5.37 su, respectively. These results indicate pH effects from seasonal flows in Cement Creek. The pond location (CC43D) pH was 2.98 su in June. The pH at the pipe outlet from the Yukon Tunnel adit (CC43C) in June and September 2016 was 6.82 and 6.68 su, respectively, and flow was not measured.

In 2016, the adit discharge pipe (CC43C) exceeded chronic standards Al and Fe, while the onsite reclaimed pond sample in June 2016 (CC43D) exceeded acute standards for Al, Cd, Cu, Mn, and Zn, and chronic standards for Fe. The metals concentrations in the reclaimed pond were typically orders of magnitude above those from the adit location. In Cement Creek upstream (CC41) and downstream (CC43E) of Yukon Tunnel in June, acute standards were exceeded for Cd, Cu, and Zn, and chronic standards for Al, Fe, and Pb. In September, the upstream and downstream locations exceeded acute standards for Cu and Zn, and chronic standards for Al, Cd, Fe, and Pb. From **Table 4-1**, these results indicate that in June 2016, metals concentrations increased across the Yukon Tunnel site, while in September 2016 metals concentrations decreased across the site.

4.7.4.2 Yukon Tunnel CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Yukon Tunnel (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Pb, and Zn. CDMG and USGS estimated 18,000 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in July 2016 at the Yukon Tunnel (WR-CC43). This sample exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and chronic standard for Fe. This sample had the highest waste rock SPLP Al concentration of any sample among the Cement Creek mining-related sources.

4.7.4.3 Yukon Tunnel Soils, Waste Rock, and Sediment

Per **Table 4-4**, samples were collected from the Yukon Tunnel in 2016 at one waste rock pile location (WR-CC43), an onsite pond location (CC43D), in Illinois Gulch before confluence with Cement Creek (CC42), upstream of the mine in Cement Creek (CC41), and downstream of the mine in Cement Creek (CC43E).

Per **Table 4-5**, sediment samples were collected in 2016 at four locations at the Yukon Tunnel. At the Cement Creek upstream and downstream locations, metals concentrations exceeded sediment screening levels for As, Pb, and Zn, while the downstream location also exceeded sediment screening levels for Cd and Cu. The two samples collected from Illinois Gulch exceeded sediment screening levels for As, Cu, Pb, Mn, and Zn, and the CC42 sample also exceeded sediment screening levels for Cd. Additionally, Mn sediment concentrations were elevated at the mouth of Illinois Gulch compared to Cement Creek.

4.8 Sampling Results at Mining-Related Sources – Burrows Creek

4.8.1 Boston Mine

The Boston Mine is located on the north side of Burrows Creek (a tributary to the upper Animas River), along the northwest side of Houghton Mountain above the trans-basin diversion ditch at an elevation of 12,088 feet NGVD29. This mining-related source is between the Red Cloud and Dewitt Mines, and is accessible to the public off County Road 18. This location consists of a 900-cy waste rock pile and tunnel. There is no visible flow from the tunnel. A polyvinyl chloride pipe coming out of the concrete cover was not discharging during the site visit in fall 2016. Burrows Creek flows adjacent to the waste rock in a channel, and there is evidence of waste rock and soil eroding and sloughing off into the channel. There are no structures onsite. **Figure 4-10** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for Boston Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.8.1.1 Boston Mine Surface Water

In 2016, three total water quality sampling locations were collected from the Boston Mine (Table 4-1). Samples were collected at an upstream location above the mine (A07E), the trans-basin diversion ditch above the confluence with Burrows Creek (A07D1), the trans-basin diversion ditch below Burrows Creek (A07D2), and a downstream location in Burrows Creek just before the Dewitt Mine (A07D). No locations represent an adit discharge but demonstrate the change in water quality from water flowing through the Boston Mine site (**Figure 4-10**).

In October 2016, the flow at the upstream (A07E) and downstream (A07D) points was reported to be 49 and 9 gpm, respectively. In the trans-basin ditch upstream of the site (A07D1), flow was 55 gpm in June. No other flow rate measurements were available. The upstream June and October samples had pH values of 4.18 and 3.86 su, respectively, and the downstream June and October samples had pH values of 4.23 and 4.11 su, respectively. At all sampling locations, the June and October samples exceeded the acute standards for Al, Cd, Cu, Mn, and Zn, and the chronic standard for Pb. In the trans-basin diversion sample upstream of the site, the pH was 4.26 su and the sample had the highest Al, Cd, Mn, and Zn at the Boston Mine. At the upstream and downstream locations in Burrows Gulch, concentrations were typically higher in October than in June and concentrations increased between upstream and downstream points.

4.8.1.2 Boston Mine Leachate

One leachate sample was collected by CDMG from waste rock at the Boston Mine from the lower shaft (**Table 4-2**). This sample exceeded the acute standard for Cd, Cu, Pb, and Zn, and the chronic standard for Al. CDMG and USGS estimated 900 cy of waste rock material onsite. Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in July 2016 at the Boston Mine (WR-BSN). This sample exceeded the acute standards for Cd, Pb, and Zn.

4.8.1.3 Boston Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2016 waste rock sample results for the Boston Mine. Samples were collected at a waste rock location (WR-BSN), upstream of the Mine in Burrow Gulch (A07E), and downstream of the mine (A07D).

Per **Table 4-5**, sediment samples were collected in 2016 at two locations at the Boston Mine in Burrows Creek. With the exception of Al, metals concentrations increased upstream to downstream. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn in both samples.

4.8.2 London Mine

The London Mine is located on the north side of Burrows Creek along the north side of Houghton Mountain at an elevation of 11,976 feet NGVD29. This mining-related source is directly off County Road 18 and is easily accessible to the public. There are two adits: one has a 3-foot by 3-foot grate and the other is collapsed. Flow is observed from each adit and seeps are present around the base of two large waste rock piles. CDMG and USGS estimated 3,300 cy of waste rock at this location. Orange precipitates are present in adit flow, and vegetation is stressed. **Figure 4-11** shows sample locations and other features of this mining-related source.

The following sections describe results of analyses conducted for London Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.8.2.1 London Mine Surface Water

In 2015 and 2016, four total water quality sampling locations were collected from the London Mine (**Table 4-1**). Samples were collected at the west adit (DM6), the east adit (DM7), an upstream location in Burrows Creek (A07B1), and a downstream location in Burrows Creek (A07B) (**Figure 4-11**). Location A07B was the only location sampled in 2015 in September.

Flow rates were measured at the two adit locations in June 2016. The west adit (DM6) had a higher flow rate of 3.2 gpm compared to the east adit (DM7) at 1.1 gpm. Discharge at the west adit dropped to 0.7 gpm during the September 2016 event; the east adit flow rate was not measured. The west adit pH dropped from 6.13 to 3.21 su in 2016, and the east adit pH was 6.69 and 6.41 su in June and September 2016, respectively. In June 2016, the upstream location in Burrows Creek (A07B1) had a flow rate of 1329 gpm and a pH of 4.28 su, and the downstream location (A07B) had a flow rate of 1206 gpm and a pH of 4.32 su. During low-flow conditions in September 2015, the downstream location in Burrows Creek had a flow rate of 21 gpm and a pH of 4.3, and in September 2016 had a flow rate of 186 gpm and a pH of 4.08 su.

In June 2016, the west adit sample exceeded acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al. Metals concentrations in the west adit September 2016 sample had a nearly 10-fold increase over the June 2016 sample. The east adit samples exceeded acute standards for Cd and Zn, and chronic standards for Al and Fe. Upstream and downstream samples in Burrows Creek exceeded acute standards for Al, Cd, Cu, Mn, and Zn, and chronic standards for Pb.

4.8.2.2 London Mine Leachate

One leachate sample was collected by CDMG from waste rock at the London Mine (**Table 4-2**). This sample exceeded the acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al. CDMG and USGS estimated 3,300 cy of waste rock material onsite.

Per **Table 4-3**, three SPLP samples were analyzed from waste rock samples collected in August 2015 and July 2016 at the London Mine (WR1-LND, WR2-LND, and AE18). The samples all exceeded the acute standards for Cd, Cu, Pb, and Zn. The WR1-LND and AE18 samples also exceeded the chronic standards for Al.

4.8.2.3 London Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2015 and 2016 waste rock sample results from the London Mine. Samples were collected from three waste rock locations (WR1-LND, WR2-LND, and AE18), and soil downstream of the mine in Burrows Creek (A07B). The sample collected downstream of London Mine had the highest Al concentration in waste rock and soil samples collected at the Site.

Per **Table 4-5**, a total of three sediment samples were collected in 2015 and 2016 at location A07B, downstream of the London Mine in Burrows Creek. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn in all samples.

4.8.3 Ben Butler Mine

Ben Butler Mine is located on the north side of Burrows Creek on the south slope of Denver Hill at an elevation of 12,200 feet NGVD29, approximately 1,200 feet north of the London Mine. The mine is off County Road 18, but there are no direct roads to the site and it is not readily accessible to the public. There are two shafts and three stopes at the site, which are all filled with water. CDMG estimates 500 cy of waste rock at this location. There are scattered metal and wood debris onsite, but no structures. A 200-yard-long vegetation kill zone extends downslope from the waste dump towards Burrows Creek. **Figure 4-12** shows sample locations and other features of this mining-related source.

The following sections describe results of analyses conducted for Ben Butler Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.8.3.1 Ben Butler Mine Adit Discharge and Surface Water

In June 2016, one water quality sample was collected for the Ben Butler Mine (**Table 4-1**) at the shaft location (BB1) (**Figure 4-12**). Flow was not measured, pH was 3.97 su, and acute standards were exceeded for Al, Cd, Cu, Pb, and Zn.

4.8.3.2 Ben Butler Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Ben Butler Mine (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 500 cy of waste rock material onsite. Of the CDMG samples, the waste rock at Ben Butler had the highest concentrations of Al, Cd, Fe, and Zn samples among the Animas River mining-related sources.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in July 2016 at the Ben Butler Mine (WR-BB). This sample exceeded the acute standards for Cd, Cu, Pb, and Zn, and chronic standard for Fe. The concentrations of Pb and Zn in this waste rock SPLP sample were among the highest for Animas River mining-related sources.

4.8.3.3 Ben Butler Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2016 waste rock sample results from the Ben Butler Mine. Samples were collected from a waste rock location (WR-BB), and soil downstream of the mine in a drainage channel (BB2).

Per **Table 4-5**, a sediment sample was collected in 2016 at location BB2 at the Ben Butler Mine below the waste rock pile. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn in the sample.

4.9 Sampling Results at Mining-Related Sources – Animas River Headwaters

4.9.1 Mountain Queen Mine

The Mountain Queen Mine is located on the east side of Hurricane Peak at the headwaters of California Gulch, with a shaft near the top of California Pass at an elevation of 12,790 feet NGVD29 and a draining adit east of the shaft at an elevation of 12,375 feet NGVD29. There are three shafts: a collapsed shaft, a shaft/vent, and an upper shaft drill pad with a drill rod sticking out of ground. The waste rock pile at the upper shaft is situated adjacent to the 4-wheel drive road over California Pass and CDMG estimates 1,900 cy of material at this location. CDMG estimates the waste rock pile located at the lower adit has approximately 3,200 cy of material, and snow commonly drifts around the rock pile. There are moderate degrees of erosion on both waste rock piles. The mine is directly off the road and is accessible to the public. The lower adit opening is covered with a grate and rock fall occurred recently above the grate. The adit discharge flows around both sides of the waste rock pile and into California Gulch. **Figure 4-13** shows sample locations and other features of this mining-related source.

The following sections describe results of analyses conducted for Mountain Queen Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.9.1.1 Mountain Queen Mine Adit Discharge and Surface Water

In 2015 and 2016, two total water quality sampling locations were collected for the Mountain Queen Mine (**Table 4-1**). Samples were collected from the lower adit location (A19A), and downstream of the mine in California Gulch (A18) (**Figure 4-13**).

In September 2015 and September 2016, flows were measured at the adit (A19A) to be 0.8 and 2.7 gpm, respectively. pH at the adit was 3.70 su in September 2015, and pH was not reported in September 2016. In October 2016, downstream flow at A18 was not measured, and pH was 7.30 su.

At the adit location in September 2015 and September 2016, acute standards were exceeded for Al, Cd, Cu, Mn, Pb, and Zn, and chronic standards were exceeded for Fe. Downstream, the chronic standards were exceeded for Al, Cd, and Cu.

4.9.1.2 Mountain Queen Mine CDMG and EPA/ESAT Waste Rock SPLP

Two leachate samples were collected by CDMG from waste rock at the Mountain Queen Mine at the upper shaft and lower adit locations (**Table 4-2**). These samples exceeded the acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al. The upper shaft also exceeded the chronic standard for Fe. CDMG and USGS estimated 5,100 and 1,900 cy of waste rock material onsite, respectively, for the upper and lower locations.

Per **Table 4-3**, two SPLP samples were analyzed from waste rock samples collected in August 2015 at the Mountain Queen Mine (AE1 and AE2). These samples both exceeded the acute standards for Cu, Pb, and Zn, and chronic standard for Al. The AE1 sample also exceeded the acute standard for Cd. The AE1 upper-shaft waste rock SPLP location had the highest Pb concentration among Animas River mining-related sources.

4.9.1.3 Mountain Queen Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2015 waste rock sample results from the Mountain Queen Mine. Samples were collected from an upper shaft location (AE1) and adit downstream (AE2).

Per **Table 4-5**, sediment samples were collected in 2015 at two locations at the Mountain Queen Mine in upper California Gulch. Metals concentrations exceeded sediment screening levels for As, Cu, Pb, Mn, and Zn in both samples, and Cd in the downstream sample.

4.9.2 Vermillion Mine

The Vermillion Mine is located in a large gentle swale high on the north side of California Gulch near the southwestern flank of Houghton Mountain at an elevation of 12,440 feet NGVD29. The site requires hiking to access and has limited accessibility to the public. There is one draining adit at the Vermillion Mine site. The adit discharge flows south over soil before infiltrating into the waste rock pile. The drainage continues to flow approximately 2,000 feet south and southeast where it enters the West Fork Animas River. CDMG and USGS estimated 5,100 cy of waste rock at this location. **Figure 4-14** shows sample locations and other features of this mining-related source.

The following sections describe results of analyses conducted for Vermillion Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.9.2.1 Vermillion Mine Adit Discharge and Surface Water

In 2015 and 2016, four total water quality sampling locations were collected for the Vermillion Mine (**Table 4-1**). Samples were collected from a drainage channel downstream of the upper adit (CG5), upstream of the mine in California Gulch (CG4), downstream of the mine in California Gulch (CG6), and further downstream in California Gulch (CG6A) (**Figure 4-14**).

In 2016, the adit drainage channel (CG5) flow was not measured; pH was 5.48 su. Upstream of the mine (CG4), the flow rate was 247 gpm in September 2015, 6,127 gpm in June 2016, and 1,006 gpm in October 2016. The pH at this point ranged from 5.01 to 6.58 at these times, with lower pH values observed during low-flow in September and October. Downstream of the mine at CG6, the flow rate was 189 gpm in September 2015, 7,803 gpm in June 2016, and 785 gpm in September 2016. The pH ranged from 4.97 to 6.46 su at these times, and as with the upstream location, lower flows had lower pH values. The farther downstream sampling location (CG6A) had a flow of 5,679 gpm and a pH of 6.57 su in June 2016.

At all sampling locations, acute standards were exceeded for Al, Cd, Cu, and Zn. Acute standards for Mn were also exceeded during most events. Metals concentrations were typically lower between the upstream and downstream locations.

4.9.2.2 Vermillion Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Vermillion Mine (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Pb, and Zn, and the chronic standards for Fe and Mn. CDMG and USGS estimated 5,100 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in July 2016 at the Vermillion Mine near the adit (AE9A). This sample exceeded the acute standards for Cu, Pb, and Zn, and chronic standards for Al and Fe.

4.9.2.3 Vermillion Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2016 waste rock sample results from the Vermillion Mine. Samples were collected from a waste rock location (AE9A) and downstream of the mine in California Gulch (CG6).

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at two locations at the Vermillion Mine. Metals concentrations exceeded sediment screening levels for As, Cu, Pb, Mn, and Zn in all samples, and exceeded sediment screening levels for Cd in all samples except for September 2016.

4.9.3 Sunbank Group Mine

The Sunbank Group Mine is located directly east of the road in Placer Gulch and is accessible to the public. The adit is sealed with a concrete block; however, flow is coming out of the top of the concrete block and from seeps upgradient of the adit block. Adit discharge is directed into a series of settling ponds immediately adjacent to Placer Gulch. The ponds appear to no longer be functional and adit drainage no longer flows sequentially through the ponds prior to discharging into Placer Gulch. Fe precipitate is present in the drainage. Waste rock has been regraded along the slope and partially vegetated, but the volume was not estimated. There are no onsite structures. **Figure 4-15** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for Sunbank Group Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.9.3.1 Sunbank Group Mine Surface Water

In 2015 and 2016, three total water quality sampling locations were collected for the Sunbank Mine Group (**Table 4-1**). Samples were collected from the adit discharge location (A21A), upstream of the mine in Placer Gulch (A22), and downstream of the mine (A21) (**Figure 4-15**).

At the adit location (A21A), flow was measured in September 2015 at 16.4 gpm and the pH was 4.79 su. No flows were recorded with the 2016 adit samples; pH was 5.51 and 3.78 in June and September 2016, respectively. Upstream of the mine (A22), the flow was 3,576 gpm in June 2016, and 61 and 531 gpm in September 2015 and 2016, respectively. pH values at these times ranged from 5.97 to 6.99 su with lower pH values occurring during low-flow conditions. Downstream of the mine in Placer Gulch (A21), the flow was 4,916 gpm in June 2016, and 76 and 515 gpm in September 2015 and 2016, respectively. pH values at these times ranged from 5.54 to 6.94 su, with lower pH values occurring during low-flow conditions. A pH decrease across the Sunbank Group Mine was observed during fall low-flow conditions, but that effect is not apparent during spring high-flow conditions.

At the adit in 2015 and 2016, all water samples exceeded the acute standards for Al, Cd, Mn, Pb, and Zn, and the chronic standard for Fe. The June 2016 upstream sample also exceeded acute standards for Cd, Cu, and Mn, and the upstream September 2015 and 2016 samples also exceeded the chronic standard for Cd. 2015 and 2016 downstream samples exceeded the acute standards for Cd and Zn and the chronic standards for Al and Pb. The June 2016 downstream sample also exceeded the acute standards for Cu and Mn, and the downstream September samples also had exceedances of the chronic standards for Cu, Fe, and Mn. Comparing metals results between upstream and downstream locations suggests that there is an increase in Fe, Pb, and Zn concentrations in Placer Gulch due to the Sunbank Mine Group.

4.9.3.2 Sunbank Group Mine Leachate

No waste rock samples were collected at the Sunbank Group Mine during the CDMG investigation. However, three SPLP samples were analyzed from waste rock samples collected in August 2015 at locations AE44, AE45, and AE46 (**Table 4-3**). Leachate concentrations exceeded the acute standards for Cd, Cu, Pb, and Zn at all three locations. Additionally, at AE45 and AE46, the acute standards were exceeded for Al and Mn. At the AE45 location, waste rock SPLP concentrations of Al and Mn were among the highest of waste rock samples for the Animas River mining-related sources.

4.9.3.3 Sunbank Group Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2015 and 2016 soil and waste rock sample results for the Sunbank Group Mine. Samples were collected from three adit locations (AE44, AE45, and AE46), an upstream location in Placer Gulch (A22), and downstream location in Placer Gulch (A21).

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at two locations at the Sunbank Mine Group in Placer Gulch. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, Hg, and Zn in all samples. Concentrations of Hg were significantly higher than sediments from all other mining-related sources, and concentrations of Pb and Zn noticeably increased between the upstream and downstream locations.

4.9.4 Frisco/Bagley Tunnel

The Frisco/Bagley Tunnel is located approximately 0.5 miles west of Animas Forks on the north side of California Gulch. The site is located at an elevation of 11,440 feet NGVD29. A 4-wheel drive access road (County Road 9) passes through the mine area and splits a large waste rock pile in two, making it accessible to the public. CDMG and USGS estimated these two waste rock piles at 41,000 cy and 20,500 cy, respectively. A rock and mortar closure with a grate is installed at the adit portal located on top of the waste rock pile on the north side of the road. The adit discharge is channelized southwest across a waste rock pile and red staining is highly visible throughout the channels, which flow into California Gulch. Vegetation kill is apparent at the site and within the adit flow channel. Additional adit flow ponds on top of the waste rock pile. Water seeps out base of waste rock pile, and the waste rock pile is being undercut by California Gulch. There is a mill structure onsite. **Figure 4-16** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Frisco/Bagley Tunnel surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.9.4.1 Frisco/Bagley Tunnel Adit Discharge and Surface Water

In 2015 and 2016, three total water quality sampling locations were collected for the Frisco/ Bagley Tunnel (**Table 4-1**). Samples were collected from an adit discharge channel (A12), upstream of the mine in California Gulch (A13), and downstream of the mine (CG9) (**Figure 4-16**).

In the adit discharge channel (A12), flows ranged from 18 to 83 gpm during high-flow conditions in June 2015 and 2016, and from 18 to 58 gpm during low-flow conditions in September 2015 and October 2016. pH at the adit ranged from 6.25 to 7.14 su in 2015 and 2016. Upstream of the Frisco/Bagley Tunnel at A13, flow was 25,192 gpm in June 2015, and flow ranged from 521 to 2,053 gpm in September 2015 and 2016, respectively. Downstream flows at CG9 were similar. Upstream (A13) pH in June 2015 and 2016 ranged from 6.20 to 6.57 su, which decreased and ranged from 5.31 to 5.43 su in September 2015 and 2016, indicating that seasonal changes in pH are occurring in this area. Downstream of the mine at CG9, June 2015 and 2016 samples had a pH range of 6.28 to 6.50 su, and a range of 5.27 to 5.48 su in September.

The Frisco/Bagley Tunnel adit channel samples all exceeded acute standards for Mn and Zn, and chronic standards for Al, Cd, and Fe. The upstream samples all exceeded acute standards for Al, Cd, Cu, and Zn. Also, except the June 2015 sample, all upstream samples exceeded the acute standard for Mn, and except the September 2016 sample, all upstream samples exceeded the chronic standard for Pb. The downstream samples all exceeded acute standards for Cd and Zn. Also, except the September 2015 sample, all downstream samples exceeded the acute standard for Al, except the September 2016 sample, all downstream samples exceeded the acute standard for Cu and the chronic standard for Pb, and except the June 2015 sample, all downstream samples exceeded the acute standard for Mn. The data from **Table 4-1** indicate that metals concentrations in California Gulch at this point were higher during fall low-flow conditions when compared to June high-flow conditions.

4.9.4.2 Frisco/Bagley Tunnel CDMG and EPA/ESAT Waste Rock SPLP

Two leachate samples were collected by CDMG from waste rock and tailings at the Frisco/Bagley Tunnel (**Table 4-2**). These samples exceeded the acute standards for Cd, Cu, Pb, and Zn, and the tailings sample exceeded the chronic standard for Al. CDMG and USGS estimated 41,000 and 20,500 cy of waste rock material onsite, respectively.

Per **Table 4-3**, two SPLP samples were analyzed from waste rock samples collected in August 2015 at the Frisco/Bagley Tunnel (AE10 and AE10A). The AE10 sample exceeded the acute standards for Cd and Zn, and chronic standards for Mn and Pb. The AE10A sample exceeded the chronic standards for Cd, Mn, and Pb, and had the lowest waste rock SPLP concentrations for Zn waste rock samples among the Animas River mining-related sources.

4.9.4.3 Frisco/Bagley Tunnel Soils, Waste Rock, and Sediment

Table 4-4 presents 2015 and 2016 soil and waste rock sample results for the Frisco/Bagley Tunnel. Samples were collected from two waste rock locations (AE10 and AE10A), a location north of the mine (GC-OPP), an upstream location in California Gulch (A13), and a downstream location in California Gulch (CG9). The downstream sample had the highest Mn and Zn concentrations of any sample collected in the Upper Animas River.

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at three locations at the Frisco/Bagley Tunnel. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn at all locations, and Fe exceeded sediment screening levels at the adit drainage in September 2016. Sediment concentrations of Fe and Zn at the adit drainage were the highest measured among Animas River mining-related sources, and metals concentrations typically increased between the upstream and downstream sample.

4.9.5 Columbus Mine

The Columbus Mine adit is located across the stream in California Gulch from Animas Forks at an elevation of 11,240 feet NGVD29. The site is adjacent to County Road 9 and is accessible to the public. CDMG and USGS both estimated 24,000 cy of waste rock onsite. The site has a single discharging adit that infiltrates into the waste rock pile, which flows south for approximately 300 feet before emerging at the base of the waste rock and enters California Gulch. There are a series of seeps below both levels of the waste rock pile that may be from the adit discharge. The waste rock pile is both moderately eroded and being undercut at the creek. At the adit, a 3-foot by 3-foot grate is installed. There are four dilapidated buildings onsite. **Figure 4-17** shows sample locations and features of this mining-related source.

The following sections describe results of analyses conducted for the Columbus Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.9.5.1 Columbus Mine Adit Discharge and Surface Water

In 2015 and 2016, three total water quality sampling locations were collected for the Columbus Mine (**Table 4-1**). Samples were collected from an adit discharge (A11A), upstream of the mine in California Gulch (CG11), and downstream of the mine before confluence with the Upper Animas River (A10) (**Figure 4-17**).

At the adit discharge (A11A) in June 2015 and 2016, flow ranged from 27 to 37 gpm and pH ranged from 3.05 to 4.16 su. In October 2015 and 2016, flow at the adit ranged from 0.1 to 0.3 gpm and pH ranged from 2.85 to 2.89 su, indicating a notable seasonal change in adit discharge. Upstream of Columbus at CG11, flow was 21,799 gpm in June 2015 and pH ranged from 6.26 to 6.46 su in June 2015 and 2016, while flow ranged from 572 to 3,305 gpm and pH was 5.34 su in September 2015 and 2016. Downstream from the Columbus Mine at A10, pH was 6.18 su in June 2015 and flow was 16,137 gpm in June 2016, and flow ranged from 634 to 2387 gpm and pH ranged from 5.13 to 5.43 su in September 2015 and 2016.

The Columbus Mine adit samples all exceeded acute standards for Al, Cd, Cu, Mn, Pb, and Zn, and chronic standards for Fe. Adit samples from the Columbus Mine contained the highest concentrations of Cd and Zn measured in the Upper Animas basin. All upstream and downstream samples exceeded acute standards for Cd, Cu, and Zn, and chronic standards for Pb. Except for the September 2015 and 2016 upstream samples, all samples also exceeded the acute standard for Al, and except for the June 2015 upstream sample, all samples exceeded the acute standard for Mn.

The data from **Table 4-1** indicate that adit metals concentrations were typically orders of magnitude higher than upstream and downstream concentrations in the West Fork Animas River, and that metals concentrations in the West Fork Animas River at the Columbus Mine were higher during September low-flow conditions than during June high-flow conditions.

4.9.5.2 Columbus Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from waste rock at the Columbus Mine (**Table 4-2**). This sample exceeded the acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al. CDMG and USGS estimated there was 24,000 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in August 2015 at the Columbus Mine near the adit (AE13). This sample exceeded the acute standards for Cd, Cu, and Zn, and chronic standards for Mn and Pb.

4.9.5.3 Columbus Mine Soils, Waste Rock, and Sediment

Table 4-4 presents 2015 and 2016 waste rock sample results for the Columbus Mine. Samples were collected from the waste rock (AE13), an upstream location in California Gulch (CG11), and downstream location in California Gulch (A10).

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at two locations at the Columbus Mine. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn at all locations, and Al and Hg exceeded sediment screening levels in the downstream sample in September 2015. The sediment concentration of Al in the downstream sample in September 2015 was the highest measured among Animas River mining-related sources.

4.10 Sampling Results at Mining-Related Sources – Animas Forks to Eureka

4.10.1 Campground 7

Campground 7 is located approximately 1.1 miles south of Animas Forks, on the west side of the Upper Animas River at the road fork below a bridge crossing the Upper Animas River. Campground 7 is considered a dispersed campsite, an area that is suitable for camping or where camping is known to occur but may not be a formal campground. Campground 7 is near the former location of the Eclipse Smelter according to USGS (Church et al. 2007), at an elevation of approximately 10,800 feet. The site is accessible to the public and is used for recreational purposes. **Figure 4-18** shows relevant features of this mining-related source.

The following section describes results of analyses conducted for the Campground 7 location for soil/waste rock concentrations, as provided in **Table 4-4.** No surface water, leachability, or sediment samples are associated specifically with this location.

4.10.1.1 Campground 7 Waste Rock

Per **Table 4-4**, a sample of soil/waste rock was collected in July 2016 from the Campground 7 location (CMP7). The sample exceeded the human health risk-based level for Pb.

4.10.2 Silver Wing Mine

The Silver Wing Mine is located on the east side of the Upper Animas River, south of Animas Forks, at an elevation of 10,500 feet NGVD29. This mining-related source is generally not accessible to the public. CDMG and USGS estimated 10,000 cy of waste material onsite. Adit flow is directed into a settling pond, which was formerly directed though bioreactor tanks prior to discharge to the Upper Animas River. The bioreactor tanks are not functional, and flow currently bypasses the former tanks and is piped to the river. **Figure 4-19** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for Silver Wing Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.10.2.1 Silver Wing Mine Surface Water

In 2015 and 2016, four total water quality sampling locations were collected for the Silver Wing Mine (**Table 4-1**). Samples were collected from the adit discharge location (A29), a discharging pipe into the Animas River (A29A), upstream of the mine in the Upper Animas River (A28), and downstream of the mine in the Upper Animas River (A30) (**Figure 4-19**).

The flow rate was measured only once at the adit (A29) in June 2016 at 7.3 gpm. Flow at the discharge point into the Upper Animas River (A29A) was not measured in 2015 or 2016 so it is unknown if flow is lost between the adit and the pipe discharge point. Flow was measured in September 2015 at the upstream (A28) and downstream (A30) points to be 1,754 and 2,503 gpm, respectively. Flow was not reported at the upstream and downstream locations in the Upper Animas River in 2016. At the adit, pH ranged from 6.42 to 6.49 su in June 2015 and June 2016, respectively, and was 5.74 su in September 2015. pH was not reported at the adit in September 2016. At the discharging pipe, pH ranged from 6.96 to 7.08 su in June 2015 and 2016. In June 2015 and 2016, upstream pH ranged from 7.57 to 7.62 su, and downstream pH ranged from 7.52 to 7.54 su. In September 2015, a change in pH between upstream and downstream was observed (7.03 and 5.82 su, respectively).

At the adit and adit discharging pipe, water quality samples exceeded acute standards for Cd, Cu, and Zn, and exceeded the chronic standard for Al, Fe, and Mn. Except for the June 2015 sample, adit samples exceeded the chronic standard for As. There does not appear to be a significant increase in metals concentrations between high- and low-flow conditions at the adit.

Upstream of the Silver Wing Mine in the Upper Animas River, water samples exceeded acute standards for Cd and Zn, and the chronic standards for Al. At this location, acute standards were also exceeded for Cu and Mn during June and September 2015, respectively.

Downstream of the mine, acute standards were exceeded for Cd and Zn, and chronic standards for Al. The June 2015 and 2016 downstream samples also exceeded the acute standards for Cu and the chronic standard for Pb. The September 2015 sample also exceeded the acute standard for Mn and the chronic standard for Cu. Between high-flow and low-flow conditions at both the upstream and downstream points, there is an increase in metals concentrations in the Upper Animas River.

4.10.2.2 Silver Wing Mine Leachate

One leachate sample was collected by CDMG from waste rock at the Silver Wing Mine (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Mn, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 10,000 cy of waste rock material onsite.

Per **Table 4-3**, two SPLP samples were analyzed from waste rock samples collected in August 2015 at the Silver Wing Mine near the adit (AE32A and AE32b). At AE32A, leachate concentrations exceeded acute standards for Cd, Cu, Pb, and Zn, and chronic standards for Al and Fe. At AE32b, leachate concentrations exceed acute standards for Al, Cd, Cu, Pb, and Zn, and chronic standards for Fe and Mn. At the AE32B location, the waste rock SPLP concentration of Cu was orders of magnitude higher than those typically found in the other Animas River mining-related sources.

4.10.2.3 Silver Wing Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, two waste rock samples were collected in August 2015 from the Silver Wing Mine site (AE32A and AE32b).

Per **Table 4-5**, sediment samples were collected in August and September 2015 at two locations at the Silver Wing Mine. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn at both locations. Concentrations of Al. Cu, and Mn typically increased between the upstream and downstream sample locations.

4.10.3 Tom Moore Mine

The Tom Moore Mine adit is located approximately 1.25 miles north of Eureka on County Road 2 at an elevation of 10,360 feet NGVD29. The mine is located across the Upper Animas River from the road and has very limited accessibility to the public. CDMG and USGS both estimated 4,000 cy of waste rock onsite. The waste rock pile is located immediately adjacent to the Upper Animas River, and erosion and undercutting of the waste rock is observed. A concrete foundation is present onsite. **Figure 4-20** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for Tom Moore Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.10.3.1 Tom Moore Mine Adit Discharge and Surface Water

In 2016, three total water quality sampling locations were collected for the Tom Moore Mine (**Table 4-1**). Samples were collected from the adit discharge location (DM22), upstream of the mine (A30A), and downstream of the mine (A30B) (**Figure 4-20**).

Flow was measured at the adit location (DM22) in September 2016 to be 21 gpm, and pH at this location was 7.31 su in June 2016. Downstream of the mine at A30B, flow was 7,096 gpm in September 2016. Upstream pH ranged from 6.94 to 7.29 su at A30A, and downstream pH ranged from 6.97 to 7.45 su, where the lower pH values corresponded to fall low-flow conditions.

At the Tom Moore Mine adit, acute standards were only exceeded for Zn, and chronic standards for Cd. Upstream and downstream metals concentrations exceeded acute standards for Cd and Zn, and chronic standards for Al. At this point in the Upper Animas River, acute Cu standards were exceeded during June 2015 and 2016 high-flow conditions and acute Mn standards were exceeded during September low-flow conditions. Metals concentrations in the Upper Animas River were also generally higher during low-flow conditions.

4.10.3.2 Tom Moore Mine CDMG and EPA/ESAT Waste Rock SPLP

One leachate sample was collected by CDMG from soil/waste rock at the Tom Moore Mine (**Table 4-2**). This sample exceeded the acute standards for Al, Cd, Cu, Mn, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 4,000 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in July 2016 at the Tom Moore Mine (WR-TM). This sample exceeded the acute standards for Cd, Cu, Mn, Pb, and Zn, and chronic standards for Al and Fe. Waste rock SPLP concentrations of Al, Cd, Mn, and Zn in this waste rock sample were significantly higher than those typically found in the Animas River mining-related sources.

4.10.3.3 Tom Moore Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, one waste rock sample was collected in August 2016 from the Tom Moore Mine at an onsite waste rock location (WR-TM).

Per **Table 4-5**, sediment samples were collected in 2016 at two locations at the Tom Moore Mine. Metals concentrations exceeded screening levels for As, Cd, Cu, Pb, Mn, and Zn at both locations. Metals concentrations in sediments did not typically increase between the upstream and downstream sample.

4.11 Sampling Results at Mining-Related Sources – Eureka Gulch

4.11.1 Ben Franklin Mine

This Ben Franklin Mine is located immediately below the confluence of the headwaters of Eureka Gulch at an elevation of 11,920 feet NGVD29. The site is adjacent to County Road 25 and is accessible to the public. A barbed wire fence is present surrounding a stope at the site. Currently, stream flow has been diverted through a culvert across the road to the main channel of Eureka Gulch to avoid flowing through the stope. The mine adit shows signs of seasonal discharge. The waste rock pile is located adjacent to Eureka Gulch and there is a moderate degree of erosion of this waste rock. USGS estimated 500 cy of waste rock onsite. A portion of the waste rock has been used to create a levee for the stream channel. Waste rock at the adit discharge smells of sulfur. Eureka Gulch flows on the north side of waste rock. There is stressed vegetation below the waste rock. There are no structures onsite. **Figure 4-21** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for Ben Franklin Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.11.1.1 Ben Franklin Mine Adit Discharge and Surface Water

In 2015 and 2016, four total water quality sampling locations were collected for the Ben Franklin Mine (**Table 4-1**). Samples were collected from the drainage of the waste rock pile (ARD1), upstream of the mine before culvert under road (EG3A), near the midpoint of the Ben Franklin Mine waste rock in Eureka Gulch (EG5), and downstream of the mine (A39A) (**Figure 4-21**).

Upstream of the mine at EG3A, flow was 35 gpm September 2015 and 4,657gpm in June 2016, while flow was 222 gpm in September 2016 at the mine midpoint location (EG5). At the upstream location, pH ranged from 6.24 to 7.25 su, with the lower pH occurring during spring high-flow conditions in 2016. At the mine midpoint location, pH ranged from 7.01 to 7.14 su, while pH was 7.59 su in June 2016 at the downstream location. At the waste rock pile drainage location (ARD1), pH ranged from 2.76 to 3.10 su.

At the waste rock pile drainage location, acute standards were exceeded for Al, Cd, Cu, Mn, Pb, and Zn, and chronic standards for Fe. These metals concentrations from the waste rock pile were orders of magnitude above those found upstream and downstream of the mine in Eureka Gulch. Upstream of the Ben Franklin Mine, June 2016 acute standards were exceeded for Cd, Cu, and Zn, while September 2015 exceeded the acute standard for Zn, and chronic standards for Cd, Cu, and Pb. Downstream in June 2016, acute standards were exceeded for Cd, Cu, and Zn, and chronic standards for Al, and Pb. In June 2016, the midpoint waste rock sample exceeded acute standards for Cd, Cu, and Zn, and chronic standards for Al and Pb. Metals concentrations were generally higher during spring high-flow conditions when compared to fall low-flow conditions at the upstream and midpoint sample locations.

4.11.1.2 Ben Franklin Mine CDMG and EPA/ESAT Waste Rock SPLP

Two leachate samples were collected by CDMG from waste rock at the Ben Franklin Mine (**Table 4-2**). The prospect sample exceeded the acute standards for Cd, Cu, Mn, Pb, and Zn, and the mine sample exceeded the acute standards for Al, Cd, Cu, Mn, Pb, and Zn, and the chronic standard for Fe. CDMG and USGS estimated 500 cy of waste rock material onsite.

Per **Table 4-3**, one SPLP sample was analyzed from waste rock samples collected in August 2015 at the Ben Franklin Mine (BE4). This sample exceeded the acute standards for Cd, Cu, Mn, Pb, and Zn, and chronic standards for Al and Fe.

4.11.1.3 Ben Franklin Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, waste rock and soil samples were collected in 2015 and 2016 from the Ben Franklin Mine at a waste rock location (BE4), an upstream location in Eureka Gulch (EG3A), and a location downstream from the onsite stope (EG5).

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at three locations at the Ben Franklin Mine. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn at all locations. Hg was elevated above sediment screening levels in the upstream September 2015 sample, and the September 2016 downstream sample had the highest Pb and Mn concentrations of the Animas River mining-related sources. Metals concentrations in sediments typically increased between the upstream and downstream samples.

4.11.2 Terry Tunnel

The Terry Tunnel is located just south of County Road 25 at an elevation of 11,560 feet NGVD29. There is a road onto the waste rock pile which is accessible to the public. The Terry Tunnel is bulkheaded and buried, and water flows out of the bulkheaded tunnel into a drainage ditch that directs water around the reclaimed waste rock pile. The waste rock pile has been covered by native rock material; Eureka Gulch flows below the toe of the waste rock pile. There are no structures onsite. **Figure 4-22** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for Terry Tunnel surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.11.2.1 Terry Tunnel Adit Discharge and Surface Water

In 2015 and 2016, three total water quality sampling locations were collected for the Terry Tunnel (**Table 4-1**). Samples were collected from the tunnel drainage (A38), upstream of the reclaimed waste rock pile (A39), and downstream of Terry Tunnel in Eureka Gulch (EG6) (**Figure 4-22**).

At the Terry Tunnel drainage (A38), flow was not measured in June or September 2016; pH ranged from 7.07 su to 7.16 su. Upstream at A39 and downstream of Terry Tunnel at EG6, pH ranged from 7.10 to 7.55 su in 2015 and 2016. Flow downstream of the Terry Tunnel was 7,133 gpm in June 2016 and was 98 and 373 gpm in September 2015 and September 2016, respectively.

At the tunnel drainage, metals concentrations in 2016 exceeded acute standards for Mn and Zn. Upstream of the reclaimed waste rock, metals concentrations in June 2016 exceeded acute standards for Cd, Cu, and Zn, and chronic standards for Al and Pb. The September 2015 and 2016 upstream samples exceeded acute standards for Cu and Zn, and chronic standards for Al and Cd.

Downstream of Terry Tunnel in June 2015 and 2016, acute standards were exceeded for Cd, Cu, and Zn, and the chronic standard for Al. Downstream of Terry Tunnel in September 2015 and 2016, metals concentrations were lower than in June of those years and acute standards were exceeded only for Zn. These results indicate that the Terry Tunnel did not meaningfully contribute to metals concentrations in Eureka Gulch at these points in time.

4.11.2.2 Terry Tunnel CDMG and EPA/ESAT Waste Rock SPLP

No waste rock leachability samples were collected at the Terry Tunnel during the CDMG or recent ESAT investigations.

4.11.2.3 Terry Tunnel Soils, Waste Rock, and Sediment

Per **Table 4-4**, soil samples were collected in 2016 from the Terry Tunnel at an upstream location in Eureka Gulch (A39) and a downstream location (EG6).

Per **Table 4-5**, sediment samples were collected in 2015 and 2016 at two locations at the Terry Tunnel. Metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn at all locations.

4.12 Sampling Results at Mining-Related Sources – Cunningham Gulch

4.12.1 Pride of the West Mine

The Pride of the West Mine is located on the east side of Cunningham Creek off of County Road 4 at an elevation of 10,280 feet NGVD29. The site is gated but is still accessible to the public by walking. The primary adit has a metal frame cover and is chained and padlocked. The primary adit discharges water through a channel on top of a large waste rock pile, through a culvert, and down a gully on the waste rock pile into the stream. Two additional, nonflowing, grated adits are located north of the flowing adit. The waste rock pile is of unknown size but is large and spans along the canyon wall. In 1997, approximately 84,000 cy of tailings were removed. The degree of erosion of the waste rock is moderate, and the pile is being undercut by the stream. There are six structures onsite in various stages of repair. There is an onsite bunkhouse, which is advertised as a vacation rental. **Figure 4-23** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for the Pride of the West Mine surface water, SPLP, soils, waste rock, and sediments, as provided in **Tables 4-1 through 4-5**.

4.12.1.1 Pride of the West Mine Adit Discharge and Surface Water

In 2016, three total water quality sampling locations were collected for the Pride of the West Mine (**Table 4-1**). Samples were collected from an upstream location in Cunningham Creek (CU4), a downstream location in Cunningham Creek (CU4A), and an adit location (A50) (**Figure 4-23**).

In September 2016, upstream (CU4) and downstream (CU4A) flows were 6,610 and 6,739 gpm, respectively. Adit flow at A50 was not reported. 2016 upstream pH ranged from 7.39 to 7.45, downstream pH ranged from 7.23 to 7.36 su, and adit pH ranged from 7.67 to 7.75 su.

Upstream and downstream sampling points both exceeded acute standards for Al in June 2016. Fe was also elevated during June 2016 high-flow conditions relative to the fall. At the adit, all samples in 2016 exceeded acute standards for Cd and Zn and chronic standards for Al, while June 2016 samples also had exceedances of chronic standards for Cu and Pb.

4.12.1.2 Pride of the West Mine CDMG and EPA/ESAT Waste Rock SPLP

No waste rock samples were collected at the Pride of the West Mine during the CDMG investigation. However, two SPLP locations were analyzed from waste rock samples collected in July 2016 (WR-PWN and WR-PWS) (**Table 4-3**). The WR-PWN sample exceeded the acute standard for Cd, and the chronic standards for Al, Pb and Zn. The 10- and 60-sieve portions of the WR-PWS sample both exceeded acute standards for Cd, Cu, Pb, and Zn, and the chronic standard for Al.

4.12.1.3 Pride of the West Mine Soils, Waste Rock, and Sediment

Per **Table 4-4**, waste rock and soil samples were collected in 2016 from the Pride of the West Mine at north and south waste rock locations (WR-PWN and WR-PWS), an upstream location in Cunningham Creek (CU4), and a downstream location (CU4A).

Per **Table 4-5**, sediment samples were collected in 2016 at three locations at the Pride of the West Mine. At the adit, metals concentrations exceeded sediment screening levels for As, Cd, Cu, Pb, Mn, and Zn. Upstream of the mine in Cunningham Creek, metals concentrations exceeded sediment screening levels for Pb, Mn, and Zn. Downstream of the mine, sediments exceeded sediment screening levels for Cd, Pb, Mn, and Zn. Metals concentrations in sediments typically increased between the upstream and downstream sample.

4.13 Sampling Results at Mining-Related Sources – Howardsville to Silverton

4.13.1 Campground 4

Campground 4 is located near the Animas River adjacent to a spur road off of County Road 2 below Howardsville, approximately 900 feet below the Howardsville bridge over the Upper Animas River. The Campground 4 location sits at an elevation of approximately 9,600 feet. Campground 4 is considered a dispersed campsite, an area that is suitable for camping or where camping is known to occur but may not be a formal campground. The Campground 4 area was identified as a mine tailings area by CDMG, described as Mill Tailings Site #20 in Herron et al. (2000). The site is adjacent to the spur road and is accessible to the public and used for recreational purposes. **Figure 4-24** shows relevant features of this mining-related source.

The following sections describe results of analyses conducted for the Campground 4 location for leachability and soil/waste rock concentrations, as provided in **Tables 4-2** and **4-4.** No surface water or sediment samples are associated specifically with this location.

4.13.1.1 Campground 4 CDMG Waste Rock SPLP

One leachate sample was collected by CDMG from the tailings and waste rock at the Campground 4 area/mill tailings site #20 (**Table 4-2**). The leachability results exceeded the acute standards for Cd, Cu, Mn, Pb, and Zn, and the chronic standard for Al. CDMG estimated 1,200 cy of tailings/waste rock material onsite.

4.13.1.2 Campground 4 Waste Rock

Per **Table 4-4**, a sample of soil/waste rock was collected in 2016 from the Campground 4 location (CMP4). The sample exceeded the human health risk-based level for Pb. In addition to elevated Cu and Zn, this sample had the highest Pb and Hg in waste rock and soils measured in the Upper Animas River.

Section 5

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Tables

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Table 2-1
Evaluation Summary of Existing Data Reports
Preliminary Remedial Investigation Report, Bonita Peak Mining District

Data Source (originating organization, report title, and date)	Report Description (data types, generation, and collection dates)	Data generated under an approved quality plan or sampling document?	Measurement performance criteria met?	Reporting limits low enough to meet the performance criteria?	Data comparable to other accepted data sets?	Data relevant to existing site conditions?	How will the data be used?	Limitations on Data Use
USGS Professional Paper 1651 (2007)	Mine waste material volumes data collected 1996–2000	Unknown	NA	NA	NA	Yes	Approximation of mine waste material volumes	Volumes reported are estimated
CDMG Reclamation Feasibility Reports (Herron et al. 1997, 1998, 1999, and 2000)	Mine waste leachability test data collected 1997–1999	Unknown	Unknown	Unknown	Unknown	Yes	Screening-level comparison to water quality standards to evaluate metals leachability	Use for background information only
EPA/ESAT, Sampling and Analysis Report (ESAT 2016)	Surface water, sediment, soil/waste rock, and leachability test data collected 2015	Yes	Yes	Yes	Yes	Yes	Comparison to water quality standards and risk-based screening levels	None
EPA/ESAT, Sampling and Analysis Report (ESAT 2017)	2016 surface water, sediment, soil/waste rock, and leachability test data collected 2016	Yes	Yes	Yes	Yes	Yes	Comparison to water quality standards and risk-based screening levels	None

Notes:
USGS – U.S. Geological Survey
CDMG – Colorado Division of Minerals and Geology
NA – not applicable
EPA – U.S. Environmental Protection Agency
ESAT – Environmental Services Assistance Team

Table 4-1
Total and Dissolved Metals for 2015 and 2016 EPA/ESAT Surface Water Samples
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

					Metal Concentrations (µg/L)																															
					Aluminum				Arsenic				Cadmium				Copper				Iron				Manganese				Lead				Zinc			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Location	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Longfellow Mine	M02D	6/29/2016	6.61	15	286		33.4	J	3.85	J	2.64		0.5	U	0.1	U	8.91		7.2		650		179	J	80		51.9		1.45		0.213		10	U	10	U
	M02D	10/7/2016	6.83	4.9	183		22.4	J	2.5	U	1.67	J	0.5	U	0.1	U	5.04		4.14		577		146	J	88.1		64.7		0.931	J	0.185	J	10	U	10	U
Junction Mine	M02B	6/29/2016	6.15	12	1720		227		143		57.2		7.17		7.46		261		182		16600		13500		348		365		131		5.26		1640		1770	
	M02B	10/7/2016	3.86	2.9	7110		6320		303		213		25.1		26.1		777		794		64000		56100		1780		1740		304		300		6590		6510	
Koehler Tunnel	M02K1	6/29/2016	4.54	0.1	3870		3720		2.5	U	2.5	U	40.7		40.5		3170		3310		324		309		16600		16400		3.19		3.29		17700		18100	
	M02C	10/7/2016	6.12	4.5	12900		1950		3000		1020		86.2		89.4		3140		2100		177000		152000		37600		37300		152		1.51		41500		41400	
	M02E	6/29/2016	--	--	3500		2460		177		30.4		19.4		21.1		891		863		17600		13000		7220		7020		100		36.6		7870		7930	
	M02E	10/7/2016	3.60	9.0	8100		7590		234		67.4		47.2		42.8		1610		1410		40400		33800		20800		17200		59.8		73.4		22400		18700	
	M02	6/29/2016	5.76	150	2590		422		119		15.1		12.2		12.5		522		449		10000		6710		4120		4050		75.3		8.87		4590		4690	
	M02	10/7/2016	8.03	23	6770		6190		90.3		30.3		35.7		36.4		1290		1320		17100		15200		16200		15600		35.5		35.1		16800		16400	
Brooklyn Mine	M12	6/7/2016	4.55	--	3460		290		7.59	J	0.5	U	0.726	J	0.719		15.6		6.08		7400		136	J	488		301		14.6		0.198	J	174		156	
	M12	6/29/2016	5.08	438	3370		3030		2.5	U	0.5	U	3.94		4.02		33.9		34.4		911		410		1320		1300		3.3		2.52		861		887	
	M12	9/29/2016	4.17	165	9130		8700		2.5	U	0.5	U	6.07		6.2		53.4		54.4		1210		1040		2280		2280		3.88		4.02		1300		1370	
	M12A	6/29/2016	4.51	--	3850		3120		2.5	U	0.5	U	1.05		1.11		22.9		22.3		1590		362		799		763		7.04		1.44		282		276	
	M12A	9/30/2016	4.45	151	10200		9630		2.5	U	0.5	U	1.28		1.49		31.7		32.2		1200		627		1440		1440		1.66		1.55		347		363	
	M12B	6/29/2016	4.76	223	3940		3510		2.5	U	0.5	U	0.5	U	0.266		11.1		11.2		966		419		545		535		1.11		0.65		61		54.6	
	M12B	9/30/2016	4.55	151	11900		11000		2.5	U	0.5	U	0.5	U	0.307		19.6		20.1		1770		1050		1190		1190		0.81	J	0.631		81		81.5	
	M12C	6/29/2016	3.63	7.3	1890		1010		20.7		0.5	U	14.9		15.6		236		177		26400		4070		5240		5100		25.1		1.69		4670		4600	
	M12C	9/29/2016	3.84	1.1	3620		2920		39.3		1.63	J	19.1		18.7		348		300		58800		16300		6440		6430		116		20.7		5780		6060	
	M12C	9/30/2016	3.84	1.1	3020		2450		20.6		2.7		19		18.8		319		302		33700		16600		6380		6390		25		18.2		5690		5950	
	M12D	9/30/2016	3.72	2.2	2770		2170		20.1		1.4	J	18.9		19		328		317		27600		10400		6300		6300		24.7		19.5		5810		6100	
	M12F	10/7/2016	7.79	--	83.1		48.1	J	2.5	U	0.908	J	0.5	U	0.1	U	2.5	U	0.945	J	105	J	100	U	193		4.09	J	0.5	U	0.1	U	10	U	10	U
	M12G	10/7/2016	4.07	--	642		576		2.5	U	0.5	U	0.5	U	0.433		22.1		23.8		591		502		938		915		126		125		117		121	
Bandora Mine	M23	9/27/2016	5.98	7351	2070		554		2.5	U	0.5	U	0.5	U	0.349		2.5	U	1.33		162	J	100	U	200		200		0.5	U	0.246		32.5		40	
	M24A	9/28/2016	6.96	--	957		36	J	12.8		0.5	U	67.8		35.8		1070		3.15		74900		195	J	6770		4870		977		0.147	J	13500		8750	
	M24B	9/28/2016	6.71	24	210		37.8	J	2.5	U	0.507	J	49.3		48		233		19.3		16100		5300		5290		4940		201		3.69		11200		11200	
	M24C	9/28/2016	7.41	--	31.2	J	30.1	J	2.5	U	2.5	U	0.5	U	0.5	U	2.5	U	2.5	U	112	J	141	J	2100		2030		0.663	J	0.581	J	540		541	
	M24D	9/27/2016	6.87	--	200		20	U	2.5	U	0.5	U	42.4		35.2		189		2.23		11500		100	U	4780		4630		177		0.1	U	10700		9250	
	M25	6/29/2016	6.28	21553	696		49.7	J	2.5	U	0.5	U	0.5	U	0.336		2.5	U	1.28		100	U	100	U	90.7		89.8		0.5	U	0.1	U	58.4		64.1	
	M25	9/27/2016	6.12	9317	1840		266		2.5	U	0.5	U	0.54	J	0.622		2.5	U	1.2		159	J	100	U	207		202		0.5	U	0.1	U	104		111	
Grand Mogul Mine	CC01C	6/29/2016	3.59	--	2010		1850		2.5	U	1.56	J	18.7		17.6		470		462		2410		2210		1720		1660		39.7		38.2		3650		3660	
	CC01C	9/28/2016	4.10	3.6	10300		9720		37.1		39		95.4		97		2620		2620		57900		55100		6120		6050		27.9		26.4		24500		25100	
	CC01C1	6/29/2016	3.17	--	4570		4190		3.85	J	5.54		41.7		35.1	J	1440		1360		10000		12700		3760		3570		33.7		33		8850		8550	
	CC01C1	9/28/2016	3.96	2.8	15000		14100		20.3		21.8		127		130		5080		5070		54600		52200		11400		11300		7.59		7.12		31300		31600	
	CC01C2	6/29/2016	3.42	73	2960		2750		2.5	U	0.617	J	23.1		21.5		733		708		3030		2850		2180		2090		28.1		26.9		4680		4660	
	CC01C2	9/28/2016	4.12	9.0	8090		7730		2.5	U	2.94		69.1		62.9		2220		2130		9380		8900		5730		5610		22.1		21.5		14900		14700	
	CC01F	6/29/2016	7.27	--	238		97.6		2.5	U	0.5	U	1.19		1.2		31.1		20.6		100	U	100	U	82.5		78.2		8.04		3.8		267		261	
	CC01F	9/28/2016	7.16	--	372		114		2.5	U	0.5	U	2.7		2.77		59		29.7		100	U	100	U	126		123		2.93		0.843		475		454	
	CC01H	6/29/2016	6.12	2904	721		197		2.5	U	0.5	U	5.39		5.41		163		133		611		100	U	474		450		10		2.98		1120		1100	
	CC01H	9/27/2016	6.31	368	663		213		2.5	U	0.5	U	7.13		7.34		161		141		582		100	U	417		407		2.14		0.348		1600		1610	
	CC02I	6/28/2016	4.69	7.3	979		924		2.5	U	0.5	U	6.17		6.11		24		24.4		100	U	100	U	121		122		8.84		8.46		1750		1770	
	CC02I	9/27/2016	5.90	350	1880		1000		2.5	U	0.5	U	11.2		12		128		116		224	J	100	U	2330		2280		2.93		1.8		2140		2110	
	CC01U	6/28/2016	6.16	5327	1120		197		2.5	U	0.5	U	4.18		4.3		69.2		51.5		299		100	U	1890		1810		8.95		2.04		815		802	
	CC01U	9/27/2016	5.72	378	1860		926		2.5	U	0.5	U	12.1		12.1		131		117		244	J	100	U	2310		2260		4.53		3.11		2200		2160	

CDM Smith

					Metal Concentrations (µg/L)																															
					Aluminum				Arsenic				Cadmium				Copper				Iron				Manganese				Lead				Zinc			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Location	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Natalie/Occidental Mine	CC14	6/10/2015	6.09	--	1830		1150		4.46	J	1.88	J	5.25		4.68		86.9		67.6		19800		18000		1980		1940		7.3		0.339		843		884	
	CC14	9/29/2015	6.32	--	920		664		2.5	U	2.5	U	1.82		1.78		7.78		3.51	J	19600		18100		2630		2680		3.41		0.557	J	732		751	
	CC14	6/9/2016	6.13	--	2440		1900		2.5	U	5	U	5.59		5.9		90.8		75.9		27200		27200		2670		2680		9.84		1.63	J	1130		1150	
	CC14	9/29/2016	5.39	407	955		791		2.53	J	2.94	J	1.87		1.87		7.17		3.16	J	18600		17600		2520		2480		3.17		0.536	J	704		673	
	CC15	6/9/2016	--	7277	643		91.6		2.5	U	0.5	U	0.5	U	0.271		8.71		4.97		796		100	U	84.3		81.2		0.579	J	0.1	U	61.6		64.6	
	CC15	9/29/2016	7.00	301	446		95.8		2.5	U	0.5	U	0.5	U	0.226		5.38		2.92		145	J	100	U	64.2		63.5		0.5	U	0.1	U	36		36.1	
	CC15A	6/9/2016	--	7206	751		177		2.5	U	0.5	U	0.787	J	0.831		15.8		10.2		2920		2530		325		331		1.28		0.1	U	165		171	
	CC15A	9/29/2016	6.80	1170	868		267		2.5	U	2.5	U	1.16		1.2		8.95		4.21	J	9330		8340		1410		1390		1.93		0.5	U	403		391	
Henrietta Mine	CC24G	6/30/2016	4.61	--	1840		1790		2.72	J	3.5		0.5	U	0.293		36.9		35.8		20900		20400		72.9		75.6		3.3		3.17		116		123	
	CC22D	6/8/2016	5.76	--	488		84.4		2.5	U	0.5	U	1.65		1.61		46.1		37.1		944		127	J	92.1		73.4		31.4		8.1		406		432	
	CC22D	9/29/2016	5.79	73	1130		124		2.5	U	0.5	U	1.7		1.74		42.6		28.9		1440		211	J	307		289		59.9		18.3		435		400	
	CC22B	6/8/2016	4.73	--	811		622		2.5	U	0.5	U	1.11		1.22		34		33.8		663		312		110		109		23.9		18.1		302		333	
	CC22B	9/29/2016	4.33	131	3600		3120		2.5	U	0.5	U	1.43		1.61		33.6		33.3		533		347		584		567		43.8		40.3		376		372	
	CC24B	6/8/2016	4.37	--	904		666		2.5	U	0.848	J	1.08		1.29		58.9		57.9		1210		769		124		119		25.6		18.9		330		342	
	CC24B	9/29/2016	3.93	166	2790		2460		2.5	U	0.5	U	2.03		2.32		106		107		1740		1450		506		498		44.5		44.2		549		571	
Anglo Saxon Mine	CC37	6/7/2016	6.53	41	500		477		7.91	J	6.93	J	2.75		2.52		7.68		7.03		28200		28400		8940		9050		10.3		2.04		2930		3040	
	CC37	9/28/2016	6.53	41	458		433		7.17	J	6.78	J	2.26		2.36		5.21		4.09	J	28700		25700		8700		8580		8.44		0.964	J	2830		2850	
	CC38	6/7/2016	7.43	--	1160		86.5		2.6	J	0.5	U	0.5	U	0.363		11.9		6.54		2260		556		640		592		31.1		2.73		179		162	
	CC38	9/28/2016	7.25	37	438		61.4		2.96	J	2.5	U	2.11		1.97		18.8		2.58	J	11600		6300		7860		7770		8.73		0.5	U	1790		1640	
	CC38B	6/7/2016	6.15	59	885		790		6.39	J	3.32	J	2.06		2.08		58.8		65.9		20500		16300		11600		11600		9.54		0.542	J	2290		2450	
	CC38B	9/28/2016	6.67	36	638		211		5.93	J	3.36	J	1.95		1.81		24.4		7.69		21800		17300		12400		12100		3.89		0.5	U	2530		2480	
	CC38C	6/7/2016	7.07	--	1530		104		2.5	U	0.5	U	0.5	U	0.206		19.9		5.06		2160		100	U	105		18.2		110		2.85		103		49.5	
	CC38C	9/28/2016	7.32	15	266		95.8		2.5	U	0.5	U	2.2		2.46		20.2		10.9		107	J	100	U	91		89.9		24.4		9.58		533		555	
	CC39	6/7/2016	5.26	--	2140		643		4.72	J	0.5	U	2.26		2.19		70.1		53.9		6800		2100		932		869		50.9		5.29		669		658	
	CC39	9/27/2016	3.62	7970	6770		5930		6.93	J	2.6	J	5.72		5.78		108		99.7		14800		10000		4460		4400		44.7		20.5		2400		2330	
	CC39B	6/7/2016	5.10	--	2230		913		5.76	J	0.5	U	2.41		2.33		69.3		58.7		6790		2330		917		834		58.8		8.64		657		679	
	CC39B	9/28/2016	3.82	6993	6180		5760		4.78	J	2.5	U	5.43		5.49		55		59		13700		12500		4690		4700		13.7		13.5		2140		2170	
Yukon Tunnel	CC41	6/7/2016	5.16	--	2410		907		4.12	J	0.5	U	2.98		2.91		99.4		72.6		8110		2460		1060		978		43.1		5.73		858		854	
	CC41	9/27/2016	3.55	6939	6220		5520		6.49	J	2.5	U	6.63		6.36		141		96.3		12500		7480		5110		4920		27.2		17.1		2610		2420	
	CC43C	6/7/2016	6.82	--	533		171		2.5	U	2.5	U	0.5	U	0.5	U	11.6		3.98	J	2460		1190		793		768		2.76		0.5	U	109		100	
	CC43C	9/27/2016	6.68	--	486		168		2.5	U	2.5	U	0.5	U	0.5	U	12.2		2.94	J	2440		1110		1130		1090		2.65		0.5	U	121		108	
	CC43D	6/7/2016	2.98	--	30900		28200		2.5	U	0.81	J	21.4		18.4		3610		2770		42900		39300		6530		6170		3.89		4.11		5810		5720	
	CC43E	6/7/2016	5.37	--	3020		891		5.63	J	0.5	U	3		3.19		104		82.3		10000		2250		1100		977		59.4		4.52		912		919	
	CC43E	9/27/2016	3.88	7069	5630		5240		3.6	J	2.5	U	5.06		5.01		84.9		81.9		10100		7080		4170		4150		15.2		13.9		2070		2050	
Boston Mine	A07D	6/28/2016	4.23	--	5970		5550		2.5	U	0.5	U	7.55		7		38.9		34.6		242	J	149	J	2160		2100		11.6		9.47		1130		1140	
	A07D	10/5/2016	4.11	9.0	16000		15100		2.5	U	0.5	U	19.1		19.5		92.5		92.5		100	U	100	U	4860		4810		7.22		7.47		2840		2830	
	A07D1	6/28/2016	4.26	55	19300		18000		2.5	U	0.5	U	33.2		32.4		55.5		51.3		100	U	100	U	6080		5890		1.52		1.26		6020		5870	
	A07D2	6/28/2016	4.31	--	2340		2150		2.5	U	0.5	U	25.5		23.8		96.2		90		100	U	100	U	824		793		22.5		18.7		3740		3680	
	A07E	6/28/2016	4.18	--	4830		4570		2.5	U	0.5	U	5.02		4.93		35.4		33		234	J	141	J	1820		1780		11.6		9.77		715		718	
	A07E	10/5/2016	3.86	49	13800		13000		2.5	U	0.5	U	12.3		13.3		64.6		68.8		311		304		5090		4950		14		15.4		2150		2120	

Table 4-1
Total and Dissolved Metals for 2015 and 2016 EPA/ESAT Surface Water Samples
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

					Metal Concentrations (µg/L)																															
					Aluminum				Arsenic				Cadmium				Copper				Iron				Manganese				Lead				Zinc			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Location	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
London Mine	DM6	6/28/2016	6.13	3.2	121		88.5		2.5	U	0.5	U	8.17		8.7		30.3		30		443		324		189		197		61.7		48.3		1540		1680	
	DM6	9/30/2016	3.21	0.7	1220		1100		2.5	U	1.36	J	84.4		71.4		260		218		6180		4870		1640		1550		226		202		17200		17200	
	DM7	6/8/2016	6.69	--	360		23.1	J	4.25	J	0.595	J	13.8		12.8		41.3		4.53		2150		100	U	277		234		13.3		0.1	J	2930		2870	
	DM7	6/28/2016	6.05	1.1	644		41.2	J	11.9		2.58		46.2		43.2		107		9.99		4700		255		1030		984		22.1		0.23		8130		8120	
	DM7	9/30/2016	6.41	--	929		37.9	J	14.8		2.86		49.4		42		123		6.57		7400		312		1230		1230		27.9		0.1	U	8170		8280	
	A07B1	6/28/2016	4.28	1329	7230		6790		2.5	U	0.5	U	11.3		10.8		43.5		39.8		148	J	103	J	2540		2480		11.2		9.57		1810		1790	
	A07B	9/30/2015	4.30	21	14000		13400		2.5	U	0.5	U	21.7		23		49.8		51.5		166	J	102	J	5890		6110		8.87		9.44		3990		4340	
	A07B	6/28/2016	4.323	1206	6860		6440		2.5	U	0.5	U	10.4		10.7		42.2		38.9		134	J	108	J	2380		2340		10.8		9.34		1690		1720	
	A07B	9/30/2016	4.08	186	17100		17000		2.5	U	0.5	U	26.4		24.1		61.6		56.6		170	J	161	J	5980		5920		10.5		9.35		4260		4280	
Ben Butler Mine	BB1	6/28/2016	3.97	--	546		502		2.5	U	0.5	U	10.7		10.6		192		189		373		303		92.8		89.6		830		819		2080		2050	
Mountain Queen Mine	A18	10/6/2016	7.30	--	520		87.5		2.5	U	2.5	U	2.53		2.53		46.4		27.9		123	J	100	U	498		476		0.996	J	0.5	U	374		360	
	A19A	9/30/2015	3.70	0.8	3310		3200		2.5	U	1.42	J	44.5		45.7		1270		1270		5110		5050		5750		5700		192		208		5630		6230	
	A19A	9/28/2016	--	2.7	3270		3180		2.5	U	1.32	J	43		37.9		1260		1150		5470		5100		4190		4030		139		137		5060		4920	
Vermillion Mine	CG4	9/30/2015	5.01	247	16300		15500		2.5	U	0.5	U	18.2		18.7		47.2		72.6		140	J	127	J	36400		36600		0.567	J	0.552		6030		6270	
	CG4	6/28/2016	6.58	6127	3820		2790		2.5	U	0.5	U	5.49		5.81		18.5		16		108	J	100	U	9020		9210		1.16		0.452		1550		1660	
	CG4	10/6/2016	5.47	1006	14900		12100		2.5	U	0.5	U	13.8		14.2		36.6		34.8		495		183	J	27300		26600		1.36		0.644		4380		4240	
	CG5	6/28/2016	5.48	--	628		602		2.5	U	0.5	U	7.84		7.67		61.3		60.5		100	U	100	U	472		479		47.7		44.8		1730		1900	
	CG6	9/30/2015	5.17	189	13700		12000		2.5	U	0.5	U	15.9		16.4		41.2		35.9		151	J	106	J	31600		31500		1.41		0.597		5260		5310	
	CG6	6/28/2016	6.46	7803	3620		2540		2.5	U	0.5	U	5.74		5.65		18.3		15.8		111	J	100	U	8750		8630		2.16		1.21		1560		1620	
	CG6	9/30/2016	4.97	785	11900		10400		2.5	U	0.5	U	12.2		11.1		31.8		25.6		100	U	100	U	25600		25700		0.889	J	0.414		3510		3700	
	CG6A	6/29/2016	6.57	5679	4500		2390		2.5	U	0.5	U	5.57		5.58		23.4		14.9		1150		100	U	8350		8360		26.2		1.4		1580		1690	
Sunbank Group Mine	A21	9/29/2015	5.54	76	2290		815		2.5	U	0.5	U	3.85		3.93		14.2		12.6		1020		801		1880		1900		34.1		32.6		1700		1780	
	A21	6/29/2016	6.94	4916	1050		125		2.5	U	0.5	U	3.88		3.55		42.3		27.3		100	U	100	U	3120		2980		9.02		2.35		1410		1340	
	A21	9/30/2016	5.93	515	1490		304		2.5	U	0.5	U	4.03		3.65		18.1		12.4		289		248	J	1550		1480		103		7.61		1610		1560	
	A22	9/29/2015	5.97	61	340		29.7	J	2.5	U	0.5	U	1.84		1.99		8.15		4.71		100	U	100	U	346		348		4.52		2.01		1050		1150	
	A22	6/29/2016	6.99	3576	1090		148		2.5	U	0.5	U	3.65		3.62		43		31.1		100	U	100	U	3370		3250		6.09	J	1.05		1360		1360	
	A22	9/30/2016	6.46	531	1160		76.1		2.5	U	0.5	U	3.11		2.96		14.1		7.3		100	U	100	U	1250		1190		4.32		0.863		1430		1380	
	A21A	9/29/2015	4.79	16.4	13600		13500		2.5	U	1.4	J	12.1		12.1		2.5	U	1.44		16400		16300		9460		9600		194		198		4590		4930	
	A21A	6/29/2016	5.51	--	14100		13200		2.5	U	1.29	J	11.9		10.9		2.5	U	0.774	J	19200		16500		8980		8750		253		216		4300		4270	
	A21A	9/30/2016	3.78	--	15100		15000		2.5	U	1.76	J	13.3		13		2.5	U	1.04		18000		17100		9160		8980		188		190		4710		4670	
Frisco/Bagley Tunnel	A12	6/9/2015	7.14	83	285		107		2.5	U	1.34	J	4.69		4.69		5.29		4.7		2390		2210		7950		8190		4.02		0.591		3500		3830	
	A12	10/1/2015	6.25	18	434		285		2.5	U	2.47		4.47		4.77		2.5	U	2.36		4390		3550		16500		16600		1.39	J	0.482		5470		6080	
	A12	6/7/2016	6.48	18	642		550		2.5	U	2.14		7.76		8.51		7.36		6.95		4450		4170		16300		16300		1.61		0.355		6640		6980	
	A12	9/28/2016	--	58	356		325		2.5	U	1.86	J	5.43		4.94		2.93	J	2.62		2450		2210		13900		13700		0.5	U	0.1	U	5090		5060	
	A13	6/9/2015	6.20	25192	1120		305		2.5	U	0.5	U	2.39		2.26		22.9		11.5		239	J	100	U	1960		1980		28.9		2.82		757		802	
	A13	9/29/2015	5.31	521	7530		5590		2.5	U	0.5	U	9.78		10.2		31.4		28.3		292		203	J	18200		18900		8.85		7.83		3500		3920	
	A13	6/7/2016	6.57	--	2060		966		2.5	U	0.5	U	2.87		2.49		28.2		8.33		633		100	U	3510		3280		106		2.44		950		859	
	A13	9/30/2016	5.43	2053	6270		4680		2.5	U	0.5	U	7.17		6.88		22.7		17.2		152	J	117	J	13400		13400		4.2		2.56		2360		2360	
	CG9	6/9/2015	6.28	23919	1020		267		2.5	U	0.5	U	2		2.07		17.9		10.3		206	J	100	U	1910		1880		15.3		2.12		701		727	
	CG9	9/29/2015	5.48	610	7140		4020		2.5	U	0.5	U	9.53		10.3		31.8		26.8		479		297		18300		18000		8.7		6.16		3980		3880	
	CG9	6/7/2016	6.50	--	1810		551		2.5	U	0.5	U	2.77		2.2		38.9		8.83		556		100	U	2780		2530		152		2.87		881		777	
	CG9	9/30/2016	5.27	2182	5590		3680		2.5	U	0.5	U	6.92		6.41		23.1		16.5		196	J	167	J	12600		12600		4.05		2.59		2300		2430	

					Metal Concentrations (µg/L)																															
					Aluminum				Arsenic				Cadmium				Copper				Iron				Manganese				Lead				Zinc			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Location	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Columbus Mine	A10	6/9/2015	6.18	--	991		247		2.5	U	0.5	U	2.62		3.02		23.1		16.2		199	J	100	U	2100		2080		14.4		2.81		967		969	
	A10	9/29/2015	5.43	634	6280		3800		2.5	U	0.5	U	11.1		11.6		41.2		39.4		401		306		17500		18000		8.13		7.22		4130		4560	
	A10	6/7/2016	--	16137	1480		774		2.5	U	0.5	U	2.54		2.72		20.5		12.9		195	J	100	U	3160		3100		37.3		3.67		934		932	
	A10	9/29/2016	5.13	2387	5480		3790		2.5	U	0.5	U	7.69		7.48		30.9		25.1		204	J	136	J	13000		12700		5.66		4.31		2670		2630	
	A11A	6/9/2015	3.05	37	3370		3160		8.65	J	6.38		194		193		2510		2510		11700		12200		1840		1900		1010		947		47000		51200	
	A11A	9/29/2015	2.89	0.1	31000		29500		12		12		1090		896		6800		6790		61100		61100		17600		17900		254		289		278000		302000	
	A11A	6/7/2016	4.16	27	3360		3450		5.91	J	5.43		180		173		2350		2310		11300		11600		1710		1720		911		913		40300		43100	
	A11A	9/30/2016	2.85	0.3	25600		24900		14		11		1030		938		6960		6300		54700		51600		12400		12100		302		254		229000		223000	
	CG11	6/9/2015	6.26	21799	1000		222		2.5	U	0.5	U	2.11		2.28		15.8		9.39		179	J	100	U	1910		1970		10.8		1.87		696		762	
	CG11	9/29/2015	5.34	572	6610		3830		2.5	U	0.5	U	9.54		10.2		31.5		27.9		440		324		17700		17600		7.29		5.96		3930		3930	
	CG11	6/7/2016	6.46	--	1480		587		2.5	U	0.5	U	2.29		2.17		24.9		8.96		306		100	U	2690		2550		89.9		2.74		765		759	J
	CG11	9/30/2016	5.34	3305	5390		3510		2.5	U	0.5	U	6.89		6.28		22.4		17.1		173	J	163	J	12200		12100		4.15		3.23		2280		2380	
Silver Wing Mine	A28	6/9/2015	7.57	--	137		43.5	J	2.5	U	0.5	U	2.04		1.78		7.23		6.88		100	U	100	U	736		721		1.81		0.763		452		480	
	A28	9/30/2015	7.03	1754	1400		39.5	J	2.5	U	0.5	U	4.69		4.43		12.2		3.56		100	U	100	U	3870		3800		3.85		0.442		1360		1330	
	A28	6/28/2016	7.62	--	848		52		2.5	U	0.5	U	2.25		2.46		11.3		4.73		100	U	100	U	1850		1780		3.48		0.613		587		569	
	A30	6/9/2015	7.52	--	454		44.7	J	2.5	U	0.5	U	2.07		1.85		23.5		13.4		115	J	100	U	745		715		7.76		0.918		507		496	
	A30	9/30/2015	5.82	2503	1390		42.9	J	2.5	U	0.5	U	4.79		4.44		83.2		19.3		180	J	100	U	3810		3750		4.82		0.313		1440		1410	
	A30	6/7/2016	7.54	--	747		54.6		2.5	U	0.5	U	1.9		1.92		18.6		7.99		204	J	100	U	1250		1190		14.6		0.672		505		504	
	A29	6/9/2015	6.42	--	1380		428		99.7		2.5	U	14		14.1		6190		2320		10900		2470		3100		3120		25.8		0.5	U	3950		4010	
	A29	9/30/2015	5.74	--	1860		958		132		4.4		16.6		15.1		10200		4200		16000		6130		3520		3480		25.5		0.1	U	4320		4500	
	A29	6/7/2016	6.49	7.3	1590		762		161		2.87		16.1		16.4		6280		2730		13700		3870		3300		3170		22.7		0.1	U	4220		4260	
	A29	9/28/2016	--	--	1590		603		110		3.1		14.8		14.6		6970		2770		11700		2790		3290		3250		19.1		0.159	J	4020		3870	
	A29A	6/9/2015	6.96	--	825		31.5	J	39.7		2.5	U	13.4		13.5		3820		712		5570		100	U	3030		3040		12.8		0.5	U	3790		3830	
	A29A	6/7/2016	7.08	--	1800		98.5		143		1.17	J	14.7		15.3		6660		509		15600		137	J	3070		3130		61.8		0.1	U	3900		3960	
Tom Moore Mine	A30A	6/8/2016	7.29	--	659		45.8	J	2.5	U	0.5	U	1.86		1.82		15.6		6.44		201	J	100	U	1200		1120		11.5		0.582		469		474	
	A30A	9/29/2016	6.94	--	1740		74.2		2.5	U	0.5	U	4.25		3.98		35.2		7.45		102	J	100	U	3760		3670		3.22		0.321		1130		1030	
	A30B	6/8/2016	7.45	--	602		47.3	J	2.5	U	0.5	U	1.68		1.71		14.5		5.98		204	J	100	U	1100		1010		12.1		0.532		433		433	
	A30B	9/29/2016	6.97	7096	1810		67.5		2.5	U	0.5	U	4.09		3.98		53.4		7.79		128	J	100	U	3670		3580		3.48		0.339		1120		1020	
	DM22	6/28/2016	7.31	--	29.6	J	23.3	J	2.5	U	0.5	U	1.14		1.18		2.5	U	0.515	J	100	U	100	U	409		411		0.826	J	0.284		627		673	
	DM22	9/28/2016	--	21	27.1	J	23.9	J	2.5	U	0.5	U	0.77	J	0.811		2.5	U	0.598	J	100	U	100	U	165		156		0.5	U	0.1	U	572		619	
Ben Franklin Mine	ARD1	9/29/2015	3.10	--	7180		6370		2.5	U	0.558	J	57.5		55.6		1940		1970		3560		2390		22300		22300		840		861		19900		19500	
	ARD1	6/28/2016	2.76	--	3860		3630		2.5	U	0.5	U	43.8		41		1990		1880		5520		5190		12700		12300		745		720		12500		12300	
	ARD1	9/28/2016	3.12	--	9980		9650		2.5	U	2.5	U	79.7		72.9		2690		2420		4080		3940		26000		26100		747		686		23000		24300	
	EG3A	9/29/2015	7.25	35	63		31.7	J	2.5	U	0.5	U	0.551	J	0.588		11.4		9.78		100	U	100	U	116		107		4.18		2.45		217		215	
	EG3A	6/28/2016	6.24	4657	153		87.3		2.5	U	0.5	U	3.33		3.35		12.9		11.6		100	J	100	U	633		650		2.63		0.691		1120		1210	
	EG3A	9/29/2016	6.94	--	31.9	J	24.1	J	2.5	U	0.5	U	0.5	U	0.228		2.79	J	1.79		100	U	100	U	18.3		16.2		0.5	U	0.152	J	79.8		85.7	
	EG5	9/30/2015	7.14	--	31.8	J	25.6	J	2.5	U	0.5	U	0.5	U	0.535		6.27		5.53		100	U	100	U	53.2		53.2		1.68		1.12		221		228	
	EG5	6/28/2016	7.01	--	132		91.2		2.5	U	0.5	U	3.11		3.33		14.8		12.2		100	U	100	U	636		655		2.56		1.74		1120		1200	
	EG5	9/28/2016	7.70	222	96.5		64.4		2.5	U	0.5	U	1.18		1.18		12.2		8.05		100	U	100	U	144		144		3.11		1.48		493		529	
	A39A	6/28/2016	7.59	--	133		99		2.5	U	0.5	U	3.25		3.19		16.2		13.8		100	U	100	U	607		593		3.06		2.14		1040		1030	

					Metal Concentrations (µg/L)																															
					Aluminum				Arsenic				Cadmium				Copper				Iron				Manganese				Lead				Zinc			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Location	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Terry Tunnel	A38	6/28/2016	7.14	--	66.2		63.1		2.5	U	0.5	U	0.5	U	0.148	J	2.5	U	1.26		237	J	100	U	10600		10400		2.36		0.1	U	1180		1150	
	A38	9/28/2016	7.07	--	82.3		76.3		2.5	U	2.5	U	0.726	J	0.5	U	2.5	U	2.5	U	940		100	U	11000		10700		8.53		0.5	U	1340		1220	
	A39	9/30/2015	7.10	--	118		48.8	J-	2.5	U	0.5	U	1.2		1.08		22.8		14.6		100	U	100	U	256		250		5.01		2.23		385		393	
	A39	6/28/2016	7.55	--	133		88.6		2.5	U	0.5	U	3.06		3.06		15.6		13.7		100	U	100	U	589		568		3.13		2.12		1000		1010	
	A39	9/28/2016	7.51	--	180		109		2.5	U	0.5	U	1.73		1.61		29.7		17.9		100	U	100	U	310		305		7.6		2.09		618		630	
	EG6	6/10/2015	7.36	--	229		91		2.5	U	0.5	U	2.69		2.69		25.8		19.7		190	J	100	U	1340		1280		6.08		1.83		1110		1080	
	EG6	9/30/2015	7.22	98	20	U	20	U	2.5	U	0.5	U	0.71	J	0.794		3.98	J	4.22		100	U	100	U	96.8		94.3		0.869	J	0.796		430		429	
	EG6	6/28/2016	7.44	7133	113		80.5		2.5	U	0.5	U	2.07		1.94		11.4		9.09		100	U	100	U	417		415		2.19		1.05		671		716	
	EG6	9/28/2016	7.48	373	112		54.5		2.5	U	0.5	U	1.22		1.19		13.9		9.34		100	U	100	U	251		248		3.85		0.76		430		456	
Pride of the West Mine	A50	6/7/2016	7.75	--	201		36.8	J	2.5	U	0.5	U	11.8		12.2		54.5		16.6		209	J	100	U	401		394		42.2		7.77		2190		2130	
	A50	9/28/2016	7.67	--	137		39.3	J	2.5	U	0.5	U	7.51		7.39		26.3		9.88		122	J	100	U	239		238		17.6		4.15		1360		1350	
	CU4	6/7/2016	7.39	--	1380		57		2.5	U	0.5	U	0.5	U	0.1	U	2.8	J	0.723	J	1420		100	U	152		4.21	J	27.5		0.298		13.2	J	10	U
	CU4	9/28/2016	7.45	6610	23.3	J	20	U	2.5	U	0.5	U	0.5	U	0.1	U	6.62		0.628	J	100	U	100	U	4.47	J	3.63	J	1.9		0.149	J	10	U	10	U
	CU4A	6/7/2016	7.36	--	658		60.7		2.5	U	0.5	U	0.5	U	0.1	U	3.88	J	0.93	J	770		100	U	174		4.84	J	46.4		0.488		35.1		10	U
	CU4A	9/28/2016	7.23	6739	33.9	J	20	U	2.5	U	0.5	U	0.5	U	0.152	J	2.5	U	0.882	J	100	U	100	U	6		4.03	J	1.27		0.296		24.3		28.6	

Notes:
Q - qualifier
"--" - data not available
T - total recoverable
D - dissolved

(dark shading) - value exceeds WQCC acute standards
(light shading) - value exceeds WQCC chronic standards
J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample
U - Indicates compound was analyzed for, but not detected in sample. Value shown is quantitation limit of method
gpm - gallons per minute
µg/L - micrograms per liter

Table 4-2
CDMG Waste Rock Volume and Leachability Metals
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

Mine Site	Location	CDMG Volume of Waste Material (CY)	USGS Volume of Waste Material (CY)	Aluminum	Cadmium	Copper	Iron	Manganese	Lead	Zinc
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Mineral Creek										
Longfellow Mine	Longfellow Mine	10,000	5,500	--	--	--	--	--	--	--
Junction Mine	Junction Mine	NA	NA	NA	NA	NA	NA	NA	NA	NA
Koehler Tunnel	Koehler Tunnel Waste Rock: Removed	--	--	--	--	--	--	--	--	--
Brooklyn Mine	Brooklyn Recent	--	15,000	34,452	455	4,534	592,762	69,771	2,748	70,610
	Brooklyn Upper	--		37,895	177	2,186	568,294	10,068	226	9,327
	Brooklyn Lower	--		18,895	110	1,478	115,585	20,941	190	18,129
Bandora Mine	Bandora Mine	5,500	5,500	BDL	54	10	14	842	124	7,920
Cement Creek										
Grand Mogul Mine	Grand Mogul - West (of stope)	8,000	9,000	13,600	60	5,560	59,900	4	1,760	12,700
	Grand Mogul - East	9,000		13,000	557	8,120	207,000	5	2,570	107,000
Natalie/Occidental Mine	Natalie/Occidental Mine	6,800	6,800	11,100	9	372	44,000	0	490	1,260
Henrietta Mine	Henrietta 7 Mine North Pile (8 level)	30,000	5,600	1,030	8	198	3,470	0	617	1,730
	Henrietta 7 Mine South Pile		30,000	12,500	104	3,070	209,000	1	2,490	19,700
	Henrietta 3 Mine	--	2,000	37,200	127	18,300	853,000	3	2,230	19,400
Mammoth Tunnel	Mammoth Tunnel	--	100	900	3	56	300	1	BDL	410
Anglo Saxon Mine	Anglo Saxon Mine	2,200	2,200	32,000	107	5,350	524,000	5	545	17,600
Yukon Tunnel	Yukon Tunnel	18,000	18,000	2,390	8	120	510	4	5	1,170
Animas River										
Boston Mine	Boston (Lower Burrows Gulch Shaft)	900	900	88	4	32	230	120	100	710
London Mine	London Mine	3,300	3,300	230	10	140	830	270	4,000	1,700
Ben Butler Mine	Ben Butler Mine	500	500	12,000	350	3,500	97,000	530	3,000	71,000
Mountain Queen Mine	Mountain Queen Shaft	5,100	1,900	220	20	280	2,300	64	6,500	3,300
	Mountain Queen Adit			280	28	390	230	460	2,000	5,100
Vermillion Mine	Vermillion Mine	5,100	5,100	2,300	84	590	7,200	1,400	2,500	18,000
Sunbank Group Mine	Sunbank Group Mine	NA	NA	NA	NA	NA	NA	NA	NA	NA
Frisco/Bagley Tunnel	Bagley Tunnel	41,000	20,500	76	8	38	81	1,000	380	2,100
	Bagley Mill Tailings			130	9	180	160	190	13,000	1,800
Columbus Mine	Columbus Adit	24,000	24,000	440	54	660	190	2	1,000	10,000
Silver Wing Mine	Silver Wing Mine	10,000	10,000	12,000	120	15,000	48,000	21,000	2,500	16,000
Tom Moore Mine	Tom Moore Mine	4,000	4,000	12,000	270	760	6,000	34,000	1,000	58,000
Ben Franklin Mine	Ben Franklin Prospect	NA	NA	80	2	32	258	106	10,676	432
	Ben Franklin Mine	500	500	32,293	154	5,106	243,286	39,544	1,804	37,768
Terry Tunnel	Terry Tunnel	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pride of the West	Pride of the West	NA	NA	NA	NA	NA	NA	NA	NA	NA
Campground 4	Campground 4	1,200	NA	264	38	169	272	5,608	222	7,702

Notes:
All results shown are from the CDMG leaching tests; USGS test data is not provided
CDMG - Colorado Division of Minerals and Geology
USGS - United States Geologic Survey
NA - mine site not identified within CDMG/USGS dataset
"--" - mine site identified but has no data within CDMG or USGS dataset
CY - cubic yards
µg/L - micrograms per liter
BDL - Below Detection Limit
T - total recoverable metals
- sample exceeds WQCC acute criteria
- sample exceeds WQCC chronic criteria
*Although the metals results shown in this table are for total metals, the standards for dissolved metals are discussed in this report as a guideline for analysis and consistency to the surface water discussions
**Since data is not available, hardness is calculated assuming (conservatively) calcium and magnesium concentrations of 5000 µg/L, which are the basis for the WQCC standards calculations

Table 4-3
Total Metals Concentrations for 2015 and 2016 EPA/ESAT SPLP Samples
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

Sample Location	Mine Location	Sample Date	Aluminum (µg/L)		Arsenic (µg/L)		Cadmium (µg/L)		Copper (µg/L)		Iron (µg/L)		Manganese (µg/L)		Lead (µg/L)		Mercury (µg/L)		Zinc (µg/L)	
Mineral Creek																				
WR-M02B	Longfellow Mine	7/28/2016	200	U	13.3		5	U	25	U	411		52.4		88.9		0.2	U	60	U
WR-M02D	Junction Mine	7/28/2016	235		14.1		6.4		186		701		351		1410		0.2	U	943	
WR-M02C (10 sieve)	Koehler Tunnel	7/28/2016	317		541		5	U	25	U	5140		74.2		142		0.2	U	60	U
WR-M02C (60 sieve)		7/28/2016	347		560		5	U	34.1		6950		118		122		0.2	U	118	
WR-M12	Brooklyn Mine	7/28/2016	528		10	U	5	U	57		1010		644		186		0.2	U	419	
WR1-M12		7/28/2016	5280		10	U	15.7		411		18100		4800		1940		0.25	J+	2800	
WR2-M12		7/28/2016	1810		10	U	11.6		158		2960		3210		271		0.061	J+	2270	
WR1-M24	Bandora Mine	7/28/2016	531		10	U	136		43.6		1940		1240		453		0.1	J+	16300	
WR2-M24		7/28/2016	200	U	10	U	24.8		709		2170		404		7780		0.057	J+	3510	
WR3-M24		7/28/2016	205		10	U	112		63.7		1270		510		817		0.046	J+	8380	
WR4-M24		7/28/2016	200	U	10	U	4	J	25	U	355		23		50.7		0.16	J+	1140	
Cement Creek																				
WR-CC01C	Grand Mogul Mine	7/27/2016	492		10	U	22.9		686		549		405		9720		0.24	J+	4990	
WR-CC01C2		7/27/2016	397		10	U	19.2		342		1560		393		7970		0.24	J+	4140	
WR-CC02A		7/27/2016	429		4.8	J	5	U	76.8		1060		307		303		0.2	U	678	
WR-CC14A	Natalie/Occidental Mine	7/27/2016	766		10	U	5	U	25	U	1720		50.8		84.3		0.2	U	60	U
WR-CC14B		7/27/2016	1710		16.5		5	U	25	U	5500		206		313		0.2	U	153	
WR-CC22	Henrietta Mine	7/27/2016	235		10	U	5	U	25	U	1120		79.3		300		0.2	U	60	U
WR-CC29	Mammoth Tunnel	--	--		--		--		--		--		--		--		--		--	
WR-CC37 (10 sieve)	Anglo Saxon Mine	7/27/2016	200	U	10	U	5	U	25	U	473		1380		52.6		0.2	U	153	
WR-CC37 (60 sieve)		7/27/2016	3870		6.8	J	5	U	37		33100		2340		365		0.2	U	280	
WR-CC38B (10 sieve)		7/27/2016	3090		10	U	5.7		341		6950		164		1590		0.2	U	1300	
WR-CC38B (60 sieve)		7/27/2016	3470		4	J	6.8		410		7690		180		2030		0.52		1660	
WR-CC43	Yukon Tunnel	7/27/2016	8030		4.6	J	6.2		501		14200		991		1630		0.2	U	1200	
Animas River																				
WR-BSN	Boston Mine	7/26/2016	200	U	10	U	6.4		25	U	644		40.1		110		0.081	J+	876	
WR1-LND	London Mine	7/26/2016	373		10	U	4.9	J	106		1270		50.7		284		0.15	J+	409	
WR2-LND		7/26/2016	200	U	10	U	7.9		29.7		100	U	511		395		0.1	J+	1510	
AE18		8/5/2015	39.3	J	10	U	12		62.2		54.7	J	103		3870	J-	0.19	J-	2370	
WR-BB	Ben Butler Mine	7/26/2016	200	U	10	U	43.2		104		1230		140		7930		0.11	J+	7450	
AE1	Mountain Queen Mine	8/5/2015	89.9	J	10	U	12.4		173		503		34.6		10200	J-	0.2	UJ	2050	
AE2		8/5/2015	60	J	10	U	5	U	12		47	J	222		24.5	J-	0.2	UJ	81.8	
AE9A	Vermillion Mine	7/27/2016	443		18.9		0.13	J	26.1		2480		15	U	1120		2	J+	85.1	
AE44	Sunbank Group Mine	8/6/2015	200	U	10	U	0.5	J	5	J	100	U	609		26	J-	0.2	U	49.1	J
AE45		8/6/2015	2550		10	U	9.2		217		133		4980		235	J-	0.2	UJ	1480	
AE46		8/6/2015	985		10	U	7.2		210		51	J	4210		49	J-	0.2	UJ	1340	
AE10	Frisco/Bagley Tunnel	8/5/2015	200	U	10	U	12.9		1.9	J	100	UJ	1300		9	J-	0.2	U	2850	J
AE10A		8/5/2015	200	U	10	U	0.9	J	3.6	J	100	U	1490		8	J-	0.2	U	12.3	J
AE13	Columbus Mine	8/4/2015	200	U	10	U	11.4		6.1	J	100	U	1110	J-	4.7	J	0.36		1680	J-
AE32A	Silver Wing Mine	8/4/2015	1630		7.6	J	11.6		1920		7750		736		4660		0.2	U	2490	
AE32B		8/4/2015	965		4.2	J	9.7		10000	J	1310		1140	J-	296	J	0.13	J	1830	J-
WR-TM	Tom Moore Mine	7/27/2016	1890		95.7		87.5		163		2790		3810		566	J	0.14	J+	17200	
BE4	Ben Franklin Mine	8/4/2015	505		10	U	7.7		251		1170		2680		1300		0.2	U	2250	
--	Terry Tunnel	--	--		--		--		--		--		--		--		--		--	
WR-PWN	Pride of the West Mine	7/27/2016	91	J	10	U	10.7		6.8	J	251		314		169	J	0.16	J+	303	
WR-PWS (10 Sieve)		7/27/2016	100	J	10	U	7.5		17.2	J	340		295		276	J	0.11	J+	330	
WR-PWS (60 Sieve)		7/27/2016	384		10	U	10.9		21.5	J	849		474		339	J	0.16	J+	576	

Notes:
J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample
J- - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample, likely to have a low bias
J+ - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample, likely to have a high bias
U - Indicates compound was analyzed for, but not detected in sample. Value listed is quantitation limit of method
UJ - The analyte was analyzed for, but was not detected. The reported value is approximate and may be inaccurate or imprecise
"U" samples are shown as their respective method reporting limit
µg/L - micrograms per liter
T - total recoverable
"--" - no data available
SPLP - synthetic precipitation leachate procedure
NA - not applicable
"10-sieve" - soil sample was passed through a number 10 sieve
"60-sieve" - soil sample was passed through a number 60 sieve
*Although the metals results shown in this table are for total metals, the provided standards for dissolved metals are discussed in this report as a guideline for analysis and consistency to the surface water discussions
- sample exceeds WQCC acute criteria
- sample exceeds WQCC chronic criteria

Sample Location	Mine Location	Waste Rock/Soil Sample Location	Sample Date	Aluminum (mg/kg)		Arsenic (mg/kg)		Cadmium (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Manganese (mg/kg)		Mercury (mg/kg)		Zinc (mg/kg)	
		Human Health Risk-Based Levels - Campground Soils [A]				*122*								*2,081*							
		Human Health Risk-Based Levels - Waste Rock [A]				*1,419*															
Mineral Creek																					
WR-M02B	Longfellow Mine	Longfellow Mine Waste Rock	7/28/2016	5920	J	3160		4.8	J-	669		45700	J	3680		528	J	0.56		1340	
WR-M02D	Junction Mine	Junction Mine Waste Rock	7/28/2016	8630	J	1720		5.4	J-	487		75900	J	10200		388	J	7.6		1980	
WR-M02C	Koehler Tunnel	Koehler Tunnel Waste Rock (10 sieve)	7/28/2016	6300	J	13700		3.3	J-	539		160000	J	3740		1700	J	3		910	
WR-M02C		Koehler Tunnel Waste Rock (60 sieve)	7/28/2016	7250	J	22200		5	UJ	470		203000	J	2930		1330	J	1.8		911	
M02E		Junction Mine / Koehler Tunnel Pond	10/7/2016	11700		125		2.5		175		28200		217		668		0.11		405	
M02		Junction Mine / Koehler Tunnel Downstream	10/7/2016	20400		14.6		0.056	U	30.2		33900		53.7		981		0.092	J	135	
WR-M12	Brooklyn Mine	Brooklyn Mine Adit Waste Rock	7/28/2016	7610	J	86.4		0.18	J-	47.4		47200	J	1920		571	J	0.14		145	
WR1-M12		Brooklyn Mine Waste Rock #1	7/28/2016	6060		72.5		1.8	J	123		51400		2950	J	422		0.2		903	
WR2-M12		Brooklyn Mine Waste Rock #2	7/28/2016	11600		137		0.51	J	117		65100		1310	J	847		0.0034	U	311	
M12C		Brooklyn Adit	9/30/2016	10400		103	J	0.052	U	99.2	J	56200		3370		456		1.2	J+	763	J
M12D		Brooklyn Drainage Channel	9/30/2016	6960		39.6	J	1.1		28.8	J	48500		405		1750		0.067	J+	314	J
M12E		Brooklyn Drainage Channel	10/7/2016	22600		7.2		0.048	U	23		41900		100		1900		0.011	J	186	
M12A		Brooklyn Drainage Channel Downstream	9/30/2016	9880	J	36.8	J	0.057	U	24.5		32300	J	62.5		764		0.035	J	88.3	J
M12B		Brooklyn Mine Upstream in Browns Gulch	9/30/2016	8260	J	34.5	J	0.049	UJ	15.9		27400	J	48.1		251		0.05	J	55.6	J
M12		Brooklyn Mine Downstream in Browns Gulch	9/29/2016	15700	J	16.4	J	1.9	J-	56.3		40900	J	241		3520		0.075	J	446	J
WR1-M24	Bandora Mine	Bandora Mine Waste Rock #1	7/28/2016	6580		85		86.3	J	1410		50200		14700	J	15700		0.37		12800	
WR2-M24		Bandora Mine Waste Rock #2	7/28/2016	8160		108		10.7	J	1710		64700		24400	J	1040		0.49		11100	
WR3-M24		Bandora Mine Waste Rock #3	7/28/2016	4640		150		147	J	1610		23500		23200	J	15100		0.71		66800	
WR4-M24		Bandora Mine Waste Rock #4	7/28/2016	12700		33.9		160	J	2790		126000		2450	J	72100		0.0049	U	16600	
M24D		Bandora Mine Drainage into South Fork	9/27/2016	21300		8.9		21.1		197		31300	J	349		6020	J	0.039	J	4120	
M23		Bandora Mine Upstream	9/27/2016	14600		4		0.21	J	13.9		23700	J	19		380	J	0.026	J	88.7	
M25		Bandora Mine Downstream	9/27/2016	18200		27.9		1.1		12		17300	J	55.3		709	J	0.039	J	174	
Cement Creek																					
WR-CC01C	Grand Mogul Mine	Grand Mogul Mine Waste Rock 1	7/27/2016	4970		106		15.2	J	2050		40800		19900	J	977		1.4		17900	
WR-CC01C2		Grand Mogul Mine Waste Rock 2	7/27/2016	3550		81		20.1	J	758		30800		12800	J	670		1.5		14700	
WR-CC02A		Grand Mogul Mine Western Waste Rock	7/27/2016	4390	J	72.9		4.7	J-	225		24300	J	5140		382	J	0.45		3510	
CC01F		Grand Mogul Mine Upstream	9/28/2016	12300		23	J	0.054	U	59.5	J	27200		462	J	1670		0.062	J+	173	J
CC01C		Grand Mogul Mine below Waste Rock 1	9/28/2016	10400		41.4	J	0.91		191	J	32700		1150	J	1560		0.31	J+	280	J
CC01C1		Grand Mogul Mine below Waste Rock 2	9/28/2016	11400		36.6	J	3.9		192	J	26000		1080	J	2460		0.1	J+	737	J
CC01C2		Grand Mogul Mine before Confluence with CC	9/28/2016	25300		36.3	J	54.5		995	J	33600		1650	J	35900		0.041	J+	5560	J
CC01H		Grand Mogul Mine after Confluence with CC	9/27/2016	16800		41.3	J	6.5		549	J	34000		896	J	6960		0.059	J+	629	J
CC02I		Grand Mogul Western Waste Rock Channel	9/27/2016	15000	J	28.4		3.2	J	131		36100	J	930		3910		0.055	J	567	
CC01U		Grand Mogul Mine Downstream in CC	9/27/2016	13000	J	50.5		2.5	J	241		39400	J	711		4130		0.038	J	642	
WR-CC14A	Natalie/Occidental Mine	Natalie/Occidental Mine Waste Rock 1	7/27/2016	11200	J	28.9		0.15	J-	48.3		38300	J	484		614	J	0.0033	U	310	
WR-CC14B		Natalie/Occidental Mine Waste Rock 2	7/27/2016	7390	J	35.9		0.29	J-	71.4		59800	J	845		712	J	0.18		223	
CC15		Natalie/Occidental Mine Upstream	9/29/2016	9570	J	14.8	J-	0.049	U	25.2	J	41900	J	78.6	J	453	J	0.012	J	53.7	J
CC15A		Natalie/Occidental Mine Downstream	9/29/2016	8220	J	20.5	J-	0.049	U	29.9	J	37700	J	259	J	359	J	0.027	J	146	J

Sample Location	Mine Location	Waste Rock/Soil Sample Location	Sample Date	Aluminum (mg/kg)		Arsenic (mg/kg)		Cadmium (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Manganese (mg/kg)		Mercury (mg/kg)		Zinc (mg/kg)	
		Human Health Risk-Based Levels - Campground Soils [A]				*122*								*2,081*							
		Human Health Risk-Based Levels - Waste Rock [A]				*1,419*															
WR-CC22	Henrietta Mine	Henrietta Mine Waste Rock	7/27/2016	7330	J	109		5.2	J-	264		27200	J	6700		366	J	0.31		4320	
CC22D	Henrietta Mine	Henrietta Mine Upstream	9/29/2016	6880	J	63.3	J	3.5	J	61.4	J	42100	J	568	J	289	J	0.096	J	898	J
CC22B	Henrietta Mine	Henrietta Mine Midpoint	9/29/2016	8670	J	77.5	J	0.84		46.7	J	46500	J	617		204	J	0.12		352	
CC24B	Henrietta Mine	Henrietta Mine Downstream	9/29/2016	5430	J	59.8	J	0.053	U	28	J	26900	J	165	J	190	J	0.028	J	35	J
WR-CC29	Mammoth Tunnel	Mammoth Tunnel Waste Rock	--	--		--		--		--		--		--		--		--		--	
WR-CC37	Anglo Saxon Mine	Anglo Saxon Mine Lower Waste Rock (10 sieve)	7/27/2016	10400	J	41.8		0.42	J-	71.4		87200	J	785		3780	J	0.0035	U	283	
WR-CC37	Anglo Saxon Mine	Anglo Saxon Mine Lower Waste Rock (60 sieve)	7/27/2016	11200	J	45		0.53	J-	96.1		122000	J	959		3810	J	0.12		414	
WR-CC38B	Anglo Saxon Mine	Anglo Saxon Mine Upper Waste Rock (10 sieve)	7/27/2016	4230	J	143		4.3	J-	283		61000	J	3340		300	J	0.42		1650	
WR-CC38B	Anglo Saxon Mine	Anglo Saxon Mine Upper Waste Rock (60 sieve)	7/27/2016	4850	J	232		2.3	J-	485		77400	J	4650		177	J	0.56		2240	
CC39B	Anglo Saxon Mine	Anglo Saxon Mine Upstream	9/28/2016	9290	J	42.8	J	2.7		122	J	70500	J	626		764	J	0.042	J	904	J
CC38C	Anglo Saxon Mine	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	11200	J	73.5	J	1.7		93.9	J	40500	J	1480		1150	J	0.031	J	546	J
CC38D	Anglo Saxon Mine	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	9870	J	48.8	J	3.7		76.5	J	42700	J	890		926	J	0.073	J	638	J
CC38	Anglo Saxon Mine	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	11000	J	46.3	J	0.66		54.3	J	40300	J	540		585	J	0.047	J	285	J
CC39	Anglo Saxon Mine	Anglo Saxon Mine Downstream	9/27/2016	9170	J	36.4	J	1		61.7	J	57400	J	414		650	J	0.02	J	577	J
WR-CC43	Yukon Tunnel	Yukon Tunnel Waste Rock	7/27/2016	9750	J	51.8		3.5	J-	2580		69800	J	3160		711	J	0.26		844	
CC41	Yukon Tunnel	Yukon Tunnel Upstream	9/27/2016	9410	J	45.2	J	2.1		77.9	J	56600	J	621		575	J	0.041	J	502	J
CC43E	Yukon Tunnel	Yukon Tunnel Downstream	9/27/2016	8380	J	57.2	J	0.82		48.9	J	53100	J	343		583	J	0.032	J	765	J
CC42	Yukon Tunnel	Yukon Tunnel in Illinois Gulch	9/27/2016	8230	J	7.3	J	0.47	J	58.2	J	27200	J	422		385	J	0.29		101	J
CC43D	Yukon Tunnel	Yukon Tunnel Pond	9/27/2016	14800	J	31.8	J	0.29	J	93.3	J	65700	J	205		960	J	0.028	J	177	J
Animas River																					
A07E	Boston Mine	Boston Mine Upstream	10/5/2016	13600	J	114		3.3		175	J	106000	J	505	J	7540	J	0.054	J	434	J
WR-BSN	Boston Mine	Boston Mine Waste Rock	7/26/2016	3270		245		15.8	J	81.8		25900		4660	J	122		1.7		4450	
A07D	Boston Mine	Boston Mine Downstream	10/5/2016	21700	J	59.2		3.2		59.2	J	23000	J	487	J	2710	J	0.051	J	818	J
WR1-LND	London Mine	London Mine Waste Rock 1	7/26/2016	3240		94		17.8	J	166		28900		3300	J	161		0.6		2250	
WR2-LND	London Mine	London Mine Waste Rock 2	7/26/2016	4980		169		33.3	J	143		25000		5490	J	713		0.53		7690	
AE18	London Mine	London Mine Waste Rock 3	8/5/2015	1130	J	119	J	34.7	J	197	J	14600	J	5660	J	107	J	0.66		9680	J
A07B	London Mine	London Mine Downstream	9/30/2016	48300		34.7		7		208		36800		561		10700		0.056	J	546	J
WR-BB	Ben Butler Mine	Ben Butler Mine Waste Rock	7/26/2016	6720		207		29.3	J	435		35500		24000	J	194		0.77		20200	
BB2	Ben Butler Mine	Ben Butler Mine Downstream	10/5/2016	14700	J	60.1		0.99		21.9	J	22900	J	473	J	910	J	0.028	J	328	J
AE1	Mountain Queen Mine	Mountain Queen Upper Shaft	8/5/2015	1920	J	227	J	95.8	J	664	J	32000	J	35700	J	54.3	J	1.5		12400	J
AE2	Mountain Queen Mine	Mountain Queen Adit	8/5/2015	1010	J	106	J	2.5	J	117	J	15700	J	1950	J	258	J	1.8		621	J
AE9A	Vermillion Mine	Vermillion Mine Waste Rock	7/27/2016	2610		147		23.8	J	213		25800		10400	J	60.4		1.1		8520	
CG6	Vermillion Mine	Vermillion Mine Downstream	9/30/2016	25400		29.9	J	1.6	J	156	J-	40100	J	162		7020	J	0.038	J	813	
AE44	Sunbank Group Mine	Sunbank Group Mine Upper Adit	8/6/2015	5310	J	148	J	1.1	J	422	J	47500	J	2040	J	3080	J	0.2		496	J
AE45	Sunbank Group Mine	Sunbank Group Mine	8/6/2015	6350	J	109	J	2.7	J	270	J	55100	J	2210	J	8240	J	0.24		640	J
AE46	Sunbank Group Mine	Sunbank Group Mine Waste Rock	8/6/2015	7580	J	170	J	0.68	J	246	J	102000	J	631	J	12800	J	0.26		295	J
A22	Sunbank Group Mine	Sunbank Group Mine Upstream	9/30/2016	21200		44.8	J	9.8	J	318	J-	24000	J	1500		19600	J	0.16		1600	
A21	Sunbank Group Mine	Sunbank Group Mine Downstream	9/30/2016	17000		79.3		5.7		518		37000		3390		4270		0.86		1460	J

Sample Location	Mine Location	Waste Rock/Soil Sample Location	Sample Date	Aluminum (mg/kg)		Arsenic (mg/kg)		Cadmium (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Manganese (mg/kg)		Mercury (mg/kg)		Zinc (mg/kg)	
Human Health Risk-Based Levels - Campground Soils [A]						*122*								*2,081*							
Human Health Risk-Based Levels - Waste Rock [A]						*1,419*															
AE10	Frisco/Bagley Tunnel	Bagley Tunnel Waste Rock - North	8/5/2015	2910	J	174	J	10	J	337	J	33800	J	7040	J	4040	J	1.2		1980	J
AE10A		Bagley Tunnel Waste Rock - South	8/5/2015	3810	J	150	J	14.9	J	143	J	37600	J	3400	J	2640	J	0.82		3200	J
A13		Bagley Tunnel Upstream	9/30/2016	15800		41.2	J	15.9	J	466	J-	28900	J	6000		14800	J	2.6		2100	
CG9		Bagley Tunnel Downstream	9/30/2016	16900		176	J	216	J	2890	J-	69700	J	1730		55900	J	0.2	J	30200	
GC-OPP		Bagley Tunnel - North of Mine	7/27/2016	17800		30.4	J-	0.98		26.9		23700	J	151		1700		0.0036	U	327	
AE13	Columbus Mine	Columbus Mine Waste Rock	8/4/2015	6000	J	91.9	J	6.4	J	512	J	41700	J	6060	J	1160	J	0.74		1750	J
CG11		Columbus Mine Upstream	9/30/2016	15500		41.7	J	5.9	J	182	J-	29300	J	1300		6080	J	1.2		857	
A10		Columbus Mine Downstream	9/29/2016	12800	J	60.2	J	1.3		141	J+	40500	J	1870	J	2350	J	0.64		404	J
CMP7	Campground 7	Campground 7	7/26/2016	13300		86.9	J-	10.6		339		23500	J	11800		1560		0.29		5290	
AE32A	Silver Wing Mine	Silver Wing Mine	8/4/2015	1480	J	702	J	10.5	J	3830	J	43400	J	7010	J	357	J	0.17		1340	J
AE32b		Silver Wing Mine	8/4/2015	1310	J	729	J	8.6	J	2530	J	38600	J	4710	J	289	J	0.51		1970	J
WR-TM	Tom Moore Mine	Tom Moore Mine	7/27/2016	4690		361		7.6	J	106	J	42400		8180		837	J	0.14		3080	
BE4	Ben Franklin Mine	Ben Franklin Mine	8/4/2015	3610	J	57.3	J	6.4	J	475	J	49100	J	6770	J	1130	J	0.47		2870	J
EG3A		Ben Franklin Mine Upstream	9/29/2016	17300	J	17.4	J	0.71		96.9	J+	55600	J	605	J	1620	J	0.23		282	J
EG5		Ben Franklin Mine Downstream	9/28/2016	18100		42.4		4.9	J	192	J	65400		730	J	5830	J	0.046	J	1050	
A39	Terry Tunnel	Terry Tunnel Upstream	9/28/2016	17700		18.6		12.2	J	456	J	60100		1010	J	9450	J	0.055	J	3640	
EG6		Terry Tunnel Downstream	9/28/2016	16000		31.7		11	J	439	J	67000		1770	J	15100	J	0.11	J	3450	
WR-PWN	Pride of the West Mine	Pride of the West Mine North	7/27/2016	7420		27.8		39.7		906	J	25200		13900		5450	J	0.0033	U	9920	
WR-PWS		Pride of the West Mine South (10 sieve)	7/27/2016	9090		85.7		46.8		1640	J	42700		16300		5860	J	0.27		12100	
WR-PWS		Pride of the West Mine South (60 sieve)	7/27/2016	10300		113		54.9		1540	J	50600		26700		6580	J	0.55		13100	
CU4		Pride of the West Upstream	9/28/2016	10500	J	23.4		2.2		105	J	21800	J	1760		2210	J	0.015	J	665	J
CU4A		Pride of the West Downstream	9/28/2016	13000	J	9.2		2		47.2	J	30200	J	820		1260	J	0.012	J	458	J
CMP4	Campground 4	Campground 4	7/26/2016	8550		62.9	J-	94.3		2510		37400	J	44200		910		6		17300	

Notes:

Waste rock samples are indicated by a "WR" in the sample location name

CC - Cement Creek

U - Indicates compound was analyzed for, but not detected in sample

UJ - The analyte was analyzed for, but was not detected. The reported value is approximate and may be inaccurate or imprecise

J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample

J- - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample, likely to have a low bias

A - human health risk-based levels are presented and discussed in Appendix B of the Focused Feasibility Study.

- level exceeds the lead human health risk-based value of 2,081 mg/kg for campgrounds. See Appendix B of the Focused Feasibility Study.
- level exceeds the arsenic human health risk-based value of 122 mg/kg for campgrounds. See Appendix B of the Focused Feasibility Study.
- level exceeds the arsenic human health risk-based value of 1,419 mg/kg for waste rock. See Appendix B of the Focused Feasibility Study.

mg/kg - milligrams per kilogram

"--" - no data available

"U" samples are reported as the method detection limit

Sample Location	Mine Location	Sample Location	Sample Date	Aluminum (mg/kg)		Arsenic (mg/kg)		Cadmium (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Manganese (mg/kg)		Mercury (mg/kg)		Zinc (mg/kg)	
		Sediments Ecological Risk-Based Screening Levels		*26000*		*9.79*		*0.99*		*31.6*		*188400*		*35.8*		*631*		*0.18*		*121*	
Mineral Creek																					
M02E	Junction Mine	Junction Mine / Koehler Tunnel Pond	10/7/2016	8150		3080		12.4		972		184000		458		257		0.35		1700	
M12C	Brooklyn Mine	Brooklyn Mine Adit Discharge	9/30/2016	6850		62.6		0.059	U	52.8		38500		2950		299		0.66		228	
M12B		Brooklyn Mine Upstream in Browns Gulch	9/30/2016	12100		60.1		0.7		40.7		40000		126		662		0.033	J	184	
M12		Brooklyn Mine Downstream in Browns Gulch	9/29/2016	12900		25.6		0.32	J	27.5		39700		115		535		0.039	J	102	
M12E		Brooklyn Mine Discharge Channel 1	10/7/2016	2020		279		0.039	U	102		390000		101		320		0.018	J	139	
M12D		Brooklyn Mine Discharge Channel 2	9/30/2016	37200		113		1.7		140		109000		1340		5390		0.0085	U	892	
M12A		Brooklyn Mine Discharge Channel 3	9/30/2016	9870		49.5		0.13	J	31		41100		51.4		474		0.043	J	71.9	
M23	Bandora Mine	Bandora Mine Upstream	9/27/2016	8490		5.1		0.23	J	18.1		18500		9.4		631		0.0043	U	109	
M25		Bandora Mine Downstream	9/27/2016	12900		5.8		2.1		46.5		19700		36.1		559		0.0045	U	402	
Cement Creek																					
CC01C	Grand Mogul Mine	Grand Mogul Mine at toe of Waste Rock	9/28/2016	4310		458		0.99		168		198000		612		2750		0.11	J	333	
CC01C1		Grand Mogul Mine at toe of Waste Rock	9/28/2016	4210		455		1.3		202		59600		959		10700		0.079	J	348	
CC01C2		Grand Mogul Mine upstream of Cement Creek	9/28/2016	18700		386		49.8		1230		79600		2070		42300		0.043	J	3770	
CC01F		Upstream of Grand Mogul Mine	9/28/2016	13400		27.1		10.9		1200		32000		1400		5770		0.026	J	2550	
CC01H		Cement Creek after Confluence with Grand Mogul East Drainage Channel	9/27/2016	13000		39.6		5		710		34800		1240		5150		0.041	J	1150	
CC02I		Grand Mogul Western Waste Rock Drainage Channel	9/27/2016	11000		51		1.3	J	132		26100		384		2710		0.0053	J	419	
CC01U		Downstream of Grand Mogul and Queen Anne in Cement Creek	9/27/2016	9910		39.1		1.5	J	131		25000		326		3610		0.013	J	471	
CC15	Natalie/Occidental Mine	Upstream of Natalie/Occidental Mine	9/29/2016	10400		11.8		0.056	U	34.2		52300		44.3		424		0.016	J	86.3	
CC15A		Downstream of Natalie/Occidental Mine	9/29/2016	8730		11.8		0.059	U	48.4		98300		93.6		444		0.011	J	111	
CC22D	Henrietta Mine	Upstream of Henrietta Mine	9/29/2016	9110		46.6		1.4		155		31800		664		353	J	0.089	J	613	
CC22B		Midpoint of Henrietta Mine	9/29/2016	12900		58.2		1.6		166		37800		807		365		0.16	J	511	
CC24B		Downstream of Henrietta Mine	9/29/2016	6400		52.2		1		47.2		40500		466		221		0.12	J	299	
CC38	Anglo Saxon Mine	Porcupine Gulch Immediately Before Cement Creek Confluence	9/28/2016	16400		156		5.5	J	482		926000		687		3870		0.044	J	6180	
CC38C		Porcupine Gulch Upstream of Anglo Saxon Mine	9/28/2016	18600		55.8		3.5		182		58800		2080		2500		0.059	J	2040	
CC38D		Porcupine Gulch Between Upper and Lower Anglo Saxon Adit	9/28/2016	9170		118		5.4		431		178000		897		2870		0.021	J	1760	
CC39		Cement Creek below Anglo Saxon Mine	9/27/2016	9010		41.6		0.98		46.1		93700		307		620		0.0044	U	299	
CC39B		Cement Creek above Anglo Saxon Mine	9/28/2016	8800		36.3		2.6		141	J	86700		359		668		0.0081	J	799	
CC41	Yukon Tunnel	Cement Creek above Yukon Tunnel	9/27/2016	7700		56.4		0.86		26.1		52000		493		345		0.043	J	312	
CC42		Illinois Gulch at mouth to Cement Creek	9/27/2016	16800		64.9		4.8		416		83800		134		18600		0.01	J	1310	
CC42F		Illinois Gulch Above Yukon Tunnel Discharge Pipe	9/27/2016	11100		11.5		0.35	J	52.1		31400		119		811		0.0044	U	142	
CC43E		Cement Creek Below Yukon Tunnel	9/27/2016	8500		75.1		1.2		38.3		70300		390		426		0.063	J	402	
Animas River																					
A07E	Boston Mine	Upstream of Boston Mine	10/5/2016	20500	J	73.2		2.2		94.3		28600	J	734		6920		0.056	J	359	
A07D		Downstream of Boston Mine	10/5/2016	18000	J	95.5		5.9		126		43900	J	884		16600		0.047	J	681	
A07B	London Mine	London Mine Downstream	9/30/2016	25200		28.1		9		126		27500		372		10100		0.029	J-	553	
A07B		London Mine Downstream	9/30/2015	27500		59.3		10.8		301		58800		889	J	16900		0.024		889	
A07B		London Mine Downstream	8/5/2015	16100	J	43.8	J	12.9	J	235	J	39400	J	760	J	14200	J	0.038	J	716	J
BB2	Ben Butler Mine	Below Ben Butler Waste Rock	10/5/2016	14500	J	88.7		11.2		397		26100	J	1130		5750		0.042	J	2640	
A19	Mountain Queen Mine	Mountain Queen Mine Upstream	8/5/2015	7460	J	62.6	J	0.88	J	114	J	36100	J	1130	J	1960	J	0.034	J	163	J
A18		Mountain Queen Mine Downstream	8/5/2015	14900	J	26.3	J	2.1	J	327	J	44400	J	195	J	1910	J	0.083	J	376	J

Table 4-5
Metals Concentrations for 2016 EPA/ESAT Sediment Samples
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

Sample Location	Mine Location	Sample Location	Sample Date	Aluminum (mg/kg)		Arsenic (mg/kg)		Cadmium (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Manganese (mg/kg)		Mercury (mg/kg)		Zinc (mg/kg)	
		Sediments Ecological Risk-Based Screening Levels		*26000*		*9.79*		*0.99*		*31.6*		*188400*		*35.8*		*631*		*0.18*		*121*	
CG4	Vermillion Mine	Vermillion Mine Upstream	10/6/2016	17800		17		1.3		123		32900		77.5		5010		0.0042	U	390	
CG4		Vermillion Mine Upstream	8/5/2015	15900	J	17.2	J	1.3	J	152	J	30900	J	74.9	J	4460	J	0.016	J	338	J
CG6		Vermillion Mine Downstream	9/30/2016	19600		15.3		0.89	J-	106		34200		92.9		3690		0.019	J	436	
CG6		Vermillion Mine Downstream	8/5/2015	18500	J	23.3	J	2.1	J	177	J	34100	J	92.8	J	8300	J	0.014	J	424	J
A22	Sunbank Group Mine	Sunbank Group Mine Upstream	9/30/2016	9580		82.3		21.7		446		24100		4060		21000		0.51		2690	
A22		Sunbank Group Mine Upstream	9/29/2015	7690	J-	46.6		25.4		771		24000		5120		19000		0.639		6250	
A22		Sunbank Group Mine Upstream	8/6/2015	5440	J	39.8	J	41.8	J	896	J	17800	J	5420	J	20500	J	1.1		8970	J
A21		Sunbank Group Mine Downstream	9/30/2016	14400		73.2		17		644		29200		4310		7050		12.8		5720	
A21		Sunbank Group Mine Downstream	9/29/2015	26800	J-	44		51.5		1560		32600		9180	J	31600		0.701		11900	
A21		Sunbank Group Mine Downstream	8/6/2015	6940	J	40.1	J	30.9	J	911	J	18900	J	6470	J	21600	J	1.2		9450	J
A13	Frisco/Bagley Tunnel	Bagley Tunnel Upstream	9/30/2016	15200		32.9		7.4		238		24700		2100		18500		0.12		1150	
A13		Bagley Tunnel Upstream	9/29/2015	20400		29		4.58		239		33200		911	J	9860		0.033		1120	
A12		Bagley Tunnel Adit Drainage	9/28/2016	23700		61.6	J-	28.4		171		209000	J-	271	J-	45600	J	0.106	J-	12500	
CG9		Bagley Tunnel Downstream	9/30/2016	15700		69.3		10.4		473		36100		2600		11300		0.082	J	2980	
CG11	Columbus Mine	Columbus Mine Upstream	9/30/2016	11400		35.9		8		162		21900		1170		10300		0.078	J	1830	
A10		Columbus Mine Downstream	9/29/2016	8170		18.3		1.2		57.2		18700		455		1660	J	0.11		359	
A10		Columbus Mine Downstream	9/29/2015	44600		41.7		7.46		477		28400		2190	J	9230		0.234		2240	
A10		Columbus Mine Downstream	8/4/2015	10200	J	30.9	J	7	J	295	J	23300	J	1220	J	15600	J	0.11	J	821	J
A28	Silver Wing Mine	Silver Wing Mine Upstream	9/30/2015	10100	J-	63		12.2		280		30900		1130	J	7640		0.049		2790	
A28		Silver Wing Mine Upstream	8/4/2015	8590	J	36.2	J	5.7	J	195	J	19700	J	304	J	6380	J	0.013	U	959	J
A30		Silver Wing Mine Downstream	9/30/2015	13900	J-	37.8		10.9		355		21200		766	J	10500		0.019	J	2740	
A30		Silver Wing Mine Downstream	8/4/2015	9750	J	50.3	J	14.2	J	324	J	26700	J	629	J	7300	J	0.014	U	1520	J
A30A	Tom Moore Mine	Tom Moore Mine Upstream	9/29/2016	8750		68.1		5.2		312		26000		848		20300		0.016	J	1510	
A30B		Tom Moore Mine Downstream	9/29/2016	9780		38.5		7.1		158		24500		454		4740		0.0039	U	1150	
EG3A	Ben Franklin Mine	Ben Franklin Mine Upstream	9/29/2016	18000		18.3		5.4		146		43300		266		4770		0.023	J	1500	
EG3A		Ben Franklin Mine Upstream	9/29/2015	12300		17.8	J	5.18		242		44100		948	J-	4280		0.336		1610	
EG3A		Ben Franklin Mine Upstream	8/4/2015	16400	J	16.7	J	7.3	J	179	J	40600	J	304	J	5020	J	0.025	J	1090	J
EG5		Ben Franklin Mine Downstream	9/28/2016	14100		69.3		10.9		472		55500		12100		47300		0.037	J	11400	
EG5		Ben Franklin Mine Downstream	9/30/2015	21800		19.7	J	19.2		318		76700		2070	J-	7060		0.075		6460	
EG5		Ben Franklin Mine Downstream	8/4/2015	14600	J	21.6	J	34.4	J	637	J	47800	J	1070	J	9890	J	0.046	J	2360	J
A39	Terry Tunnel	Terry Tunnel Upstream	9/28/2016	14800		32.1		11.5		432		61200		1940		7080		0.055	J	3640	
EG6		Terry Tunnel Downstream	9/28/2016	16200		28.7		16.3		419		46800		1090		9120		0.046	J	3660	
EG6		Terry Tunnel Downstream	9/30/2015	12900		18.1	J	14.4		334		38600		1040	J-	10800		0.035		4360	
EG6		Terry Tunnel Downstream	8/4/2015	14000	J	23.9	J	17.3	J	535	J	42500	J	1090	J	12000	J	0.092	J	3290	J
CU4	Pride of the West Mine	Pride of the West Mine Upstream	9/28/2016	13900		4		0.63	J	10.5		33100		98.5		1830		0.004	U	161	J
CU4A		Pride of the West Mine Downstream	9/28/2016	13400		6.8		2		20.2		29500		378		1350		0.0045	U	502	
A50		Pride of the West Mine Adit	9/28/2016	6790		31.4		28.9		837		21400		8910		9510		0.055	J	11300	

Notes:
J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample
U - Indicates compound was analyzed for, but not detected in sample
J- - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample, likely to have a low bias
mg/kg - milligrams per kilogram
"--" - no data available
"U" samples are reported as the method detection limit
(highlighted) - level exceeds the ecological risk-based screening levels for sediments

CDM Smith

Figures

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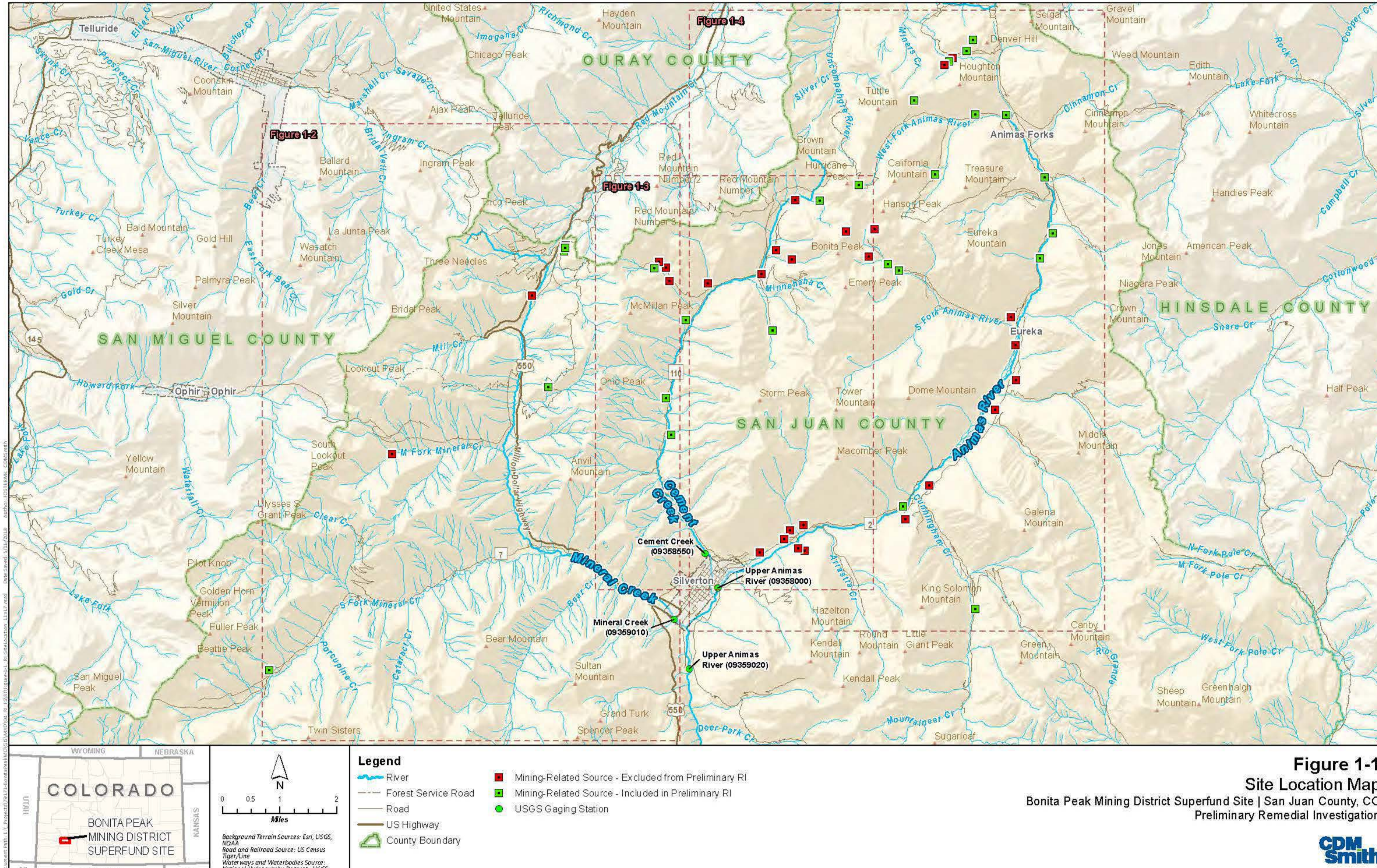


Figure 1-1
Site Location Map
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

Figure 1-2
Mining-Related Sources - Mineral Creek Drainage Basin

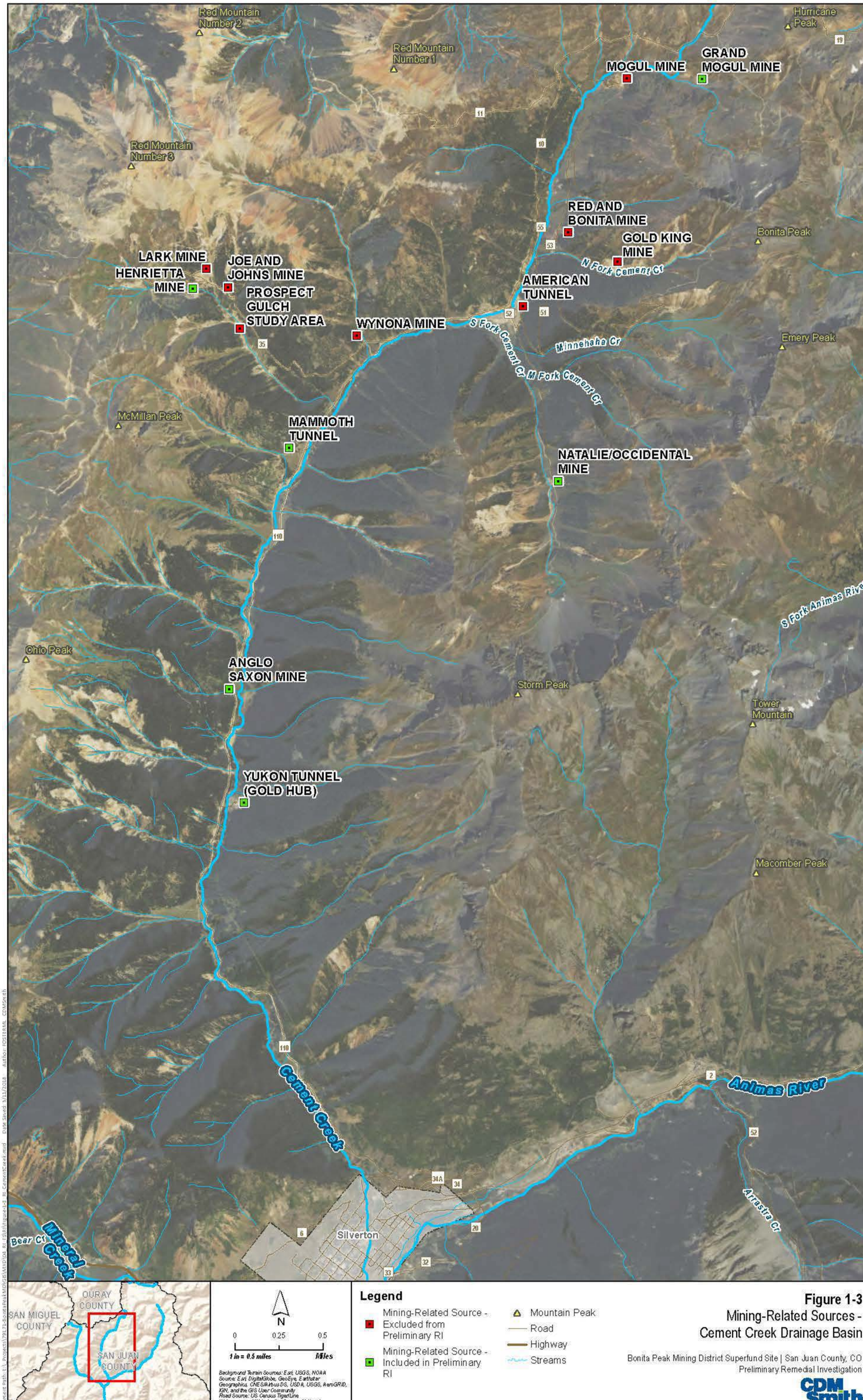


Figure 1-3
Mining-Related Sources - Cement Creek Drainage Basin

Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

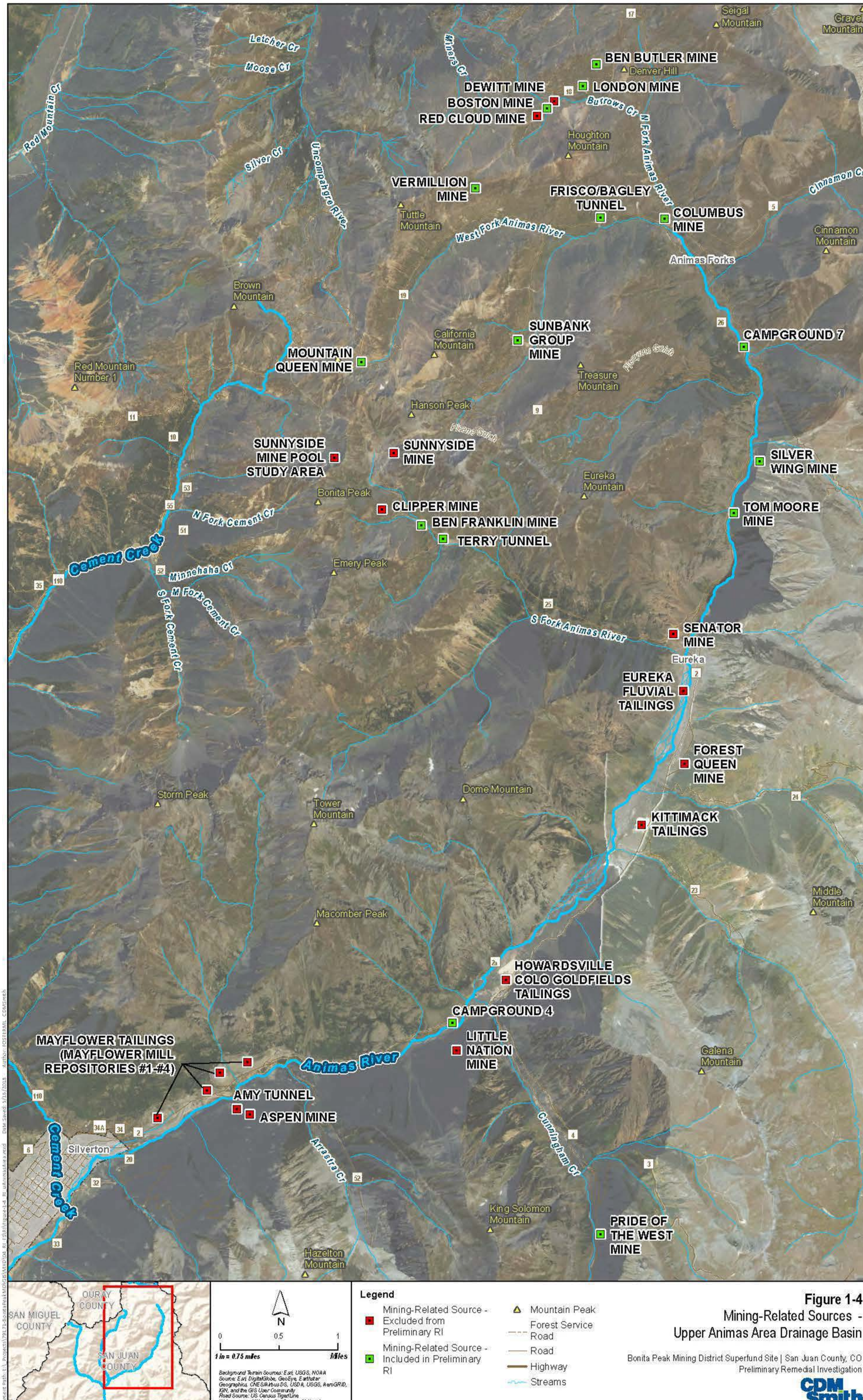


Figure 1-4
Mining-Related Sources - Upper Animas Area Drainage Basin

Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 30 60 120

Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-1
Longfellow Mine, Junction Mine, and Koehler Tunnel
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

Background Terrain Esri, HERE, Garmin, © OpenStreetMap contributors
Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source:

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-2

Brooklyn Mine

Bonita Peak Mining District Superfund Site | San Juan County, CO

Preliminary Remedial Investigation

N

0 50 100 200
Feet

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road and Railroad Source: US Census

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-3
Bandora Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

Figure 4-4
Grand Mogul Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 20 40 80
Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015.
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

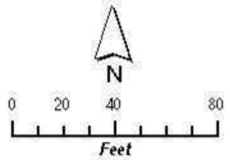
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-5
Natalie/Occidental Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

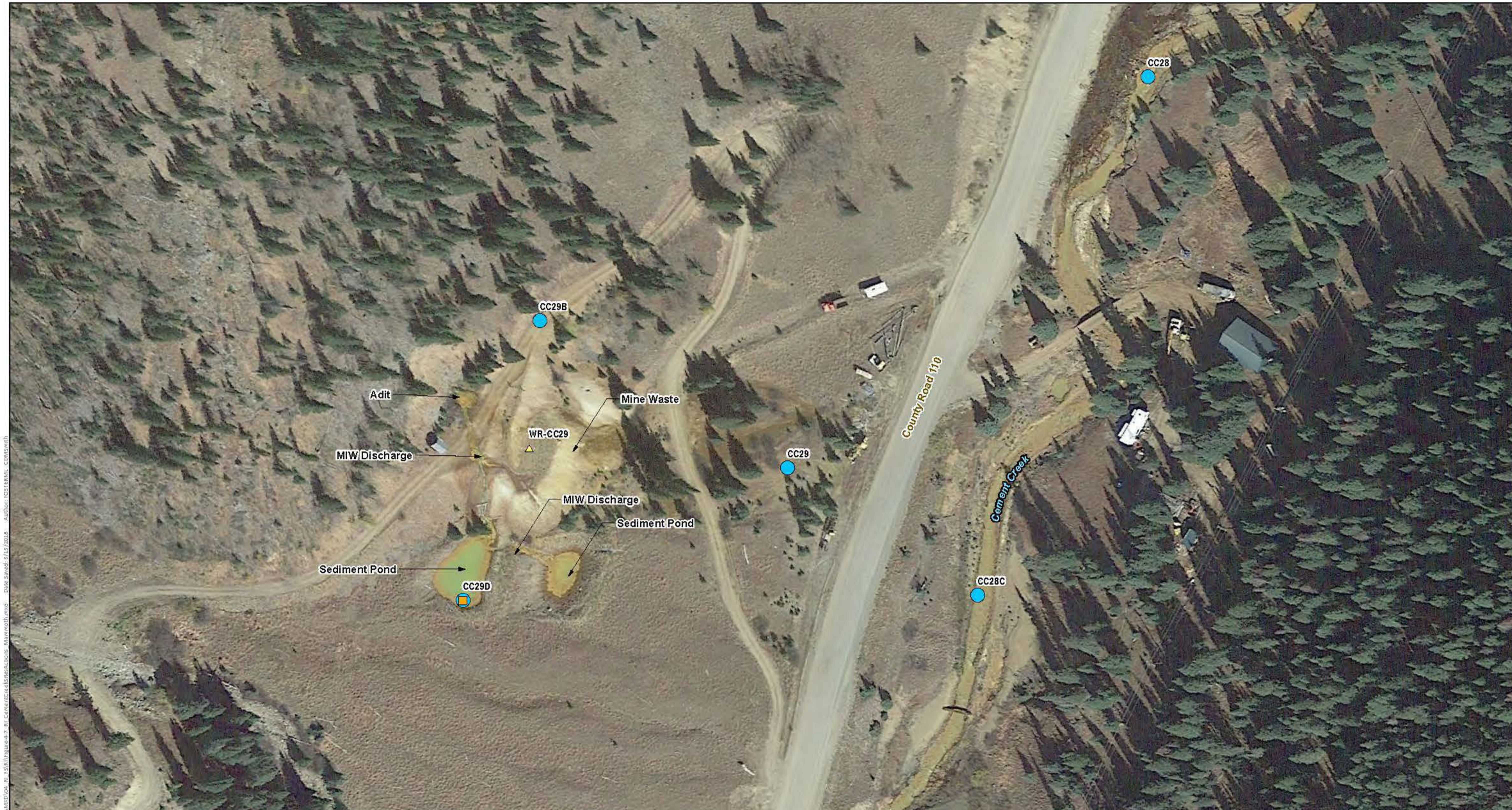
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-6
Henrietta Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 25 50 100
Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

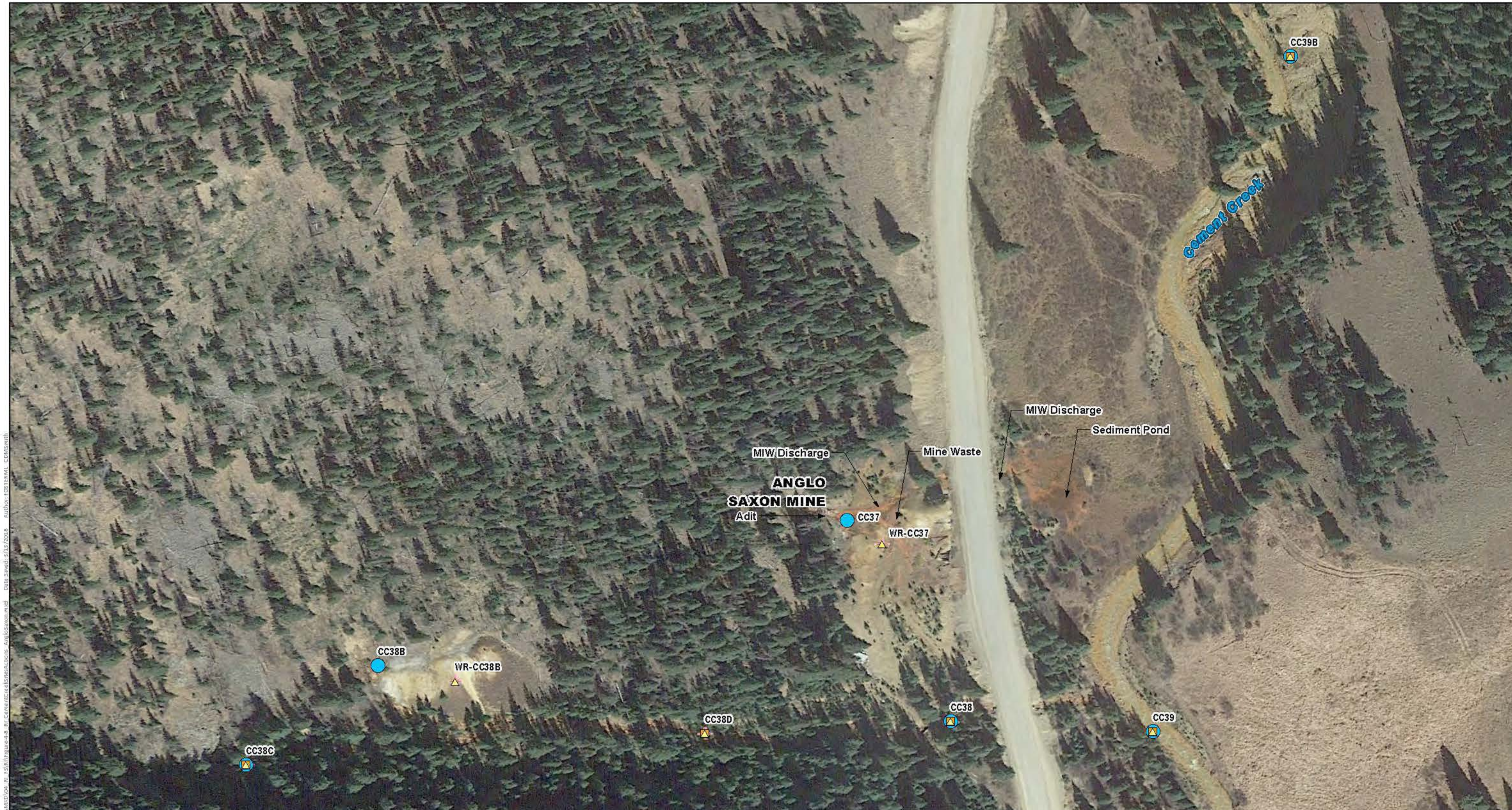
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-7
Mammoth Tunnel
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 30 60 120

Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

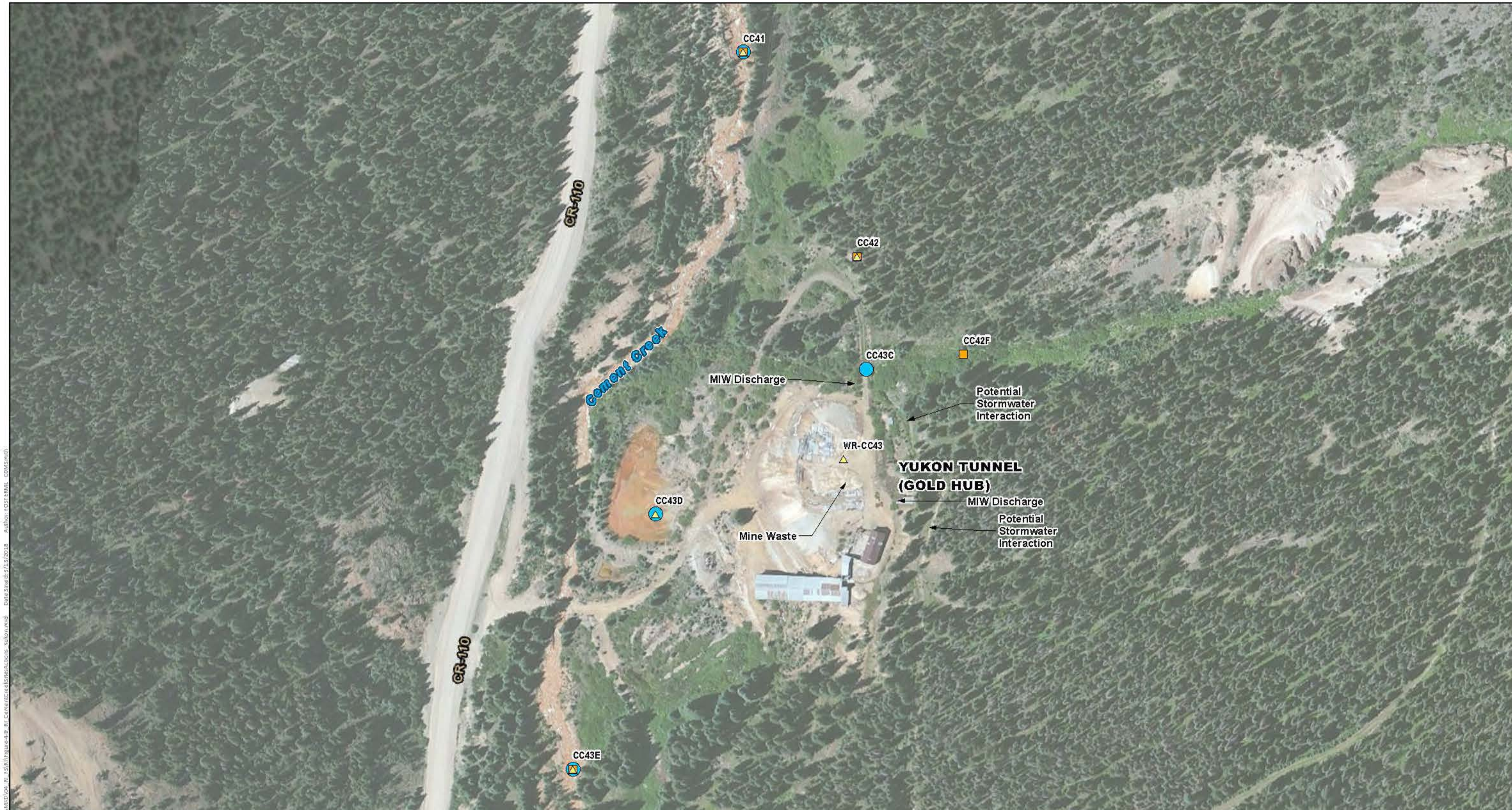
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-8
Anglo Saxon Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 45 90 180
Feet

Background Terrain Esri, HERE, Garmin, © OpenStreetMap contributors
Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

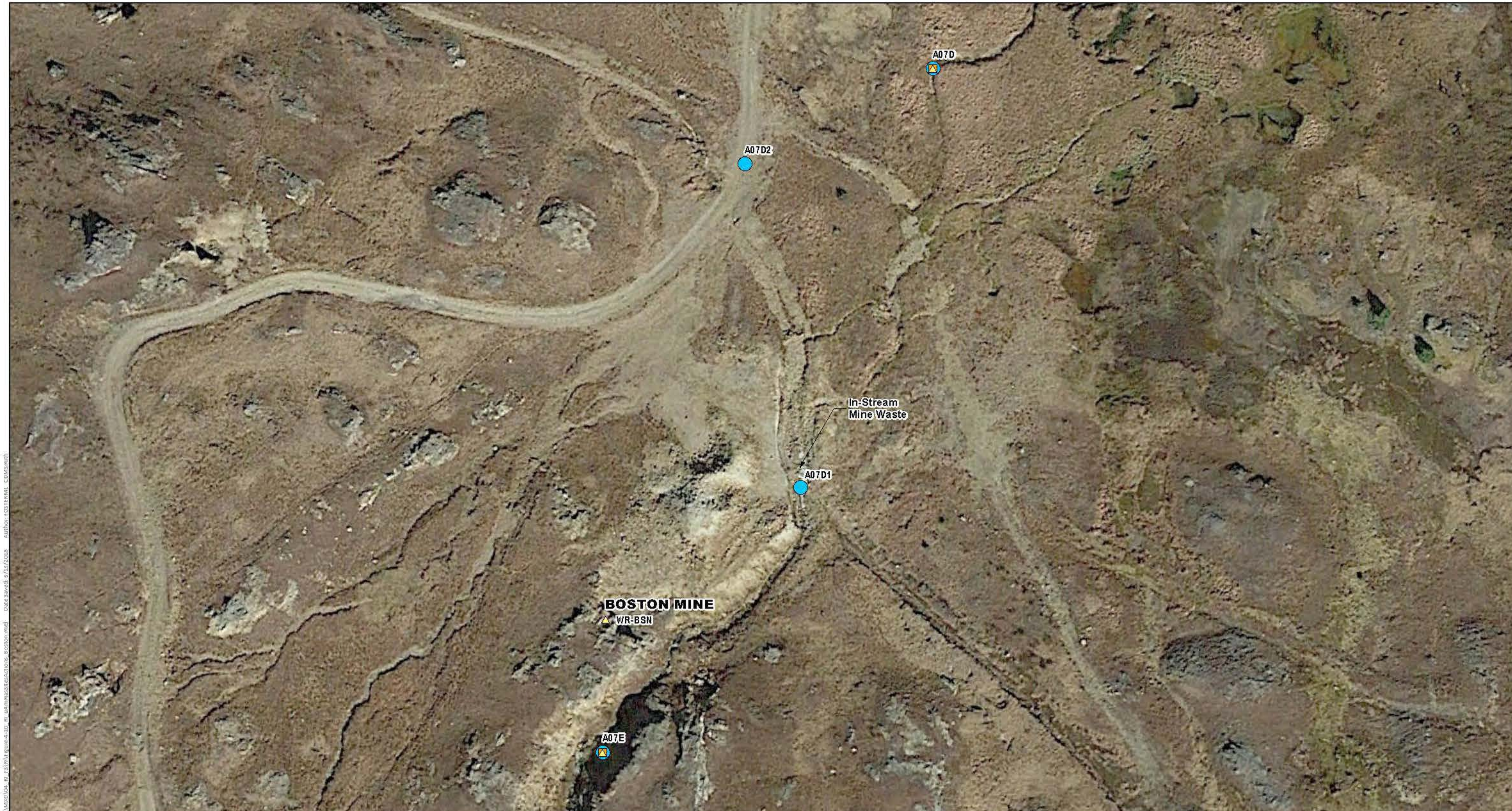
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-9
Yukon Tunnel
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 15 30 60

Feet

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

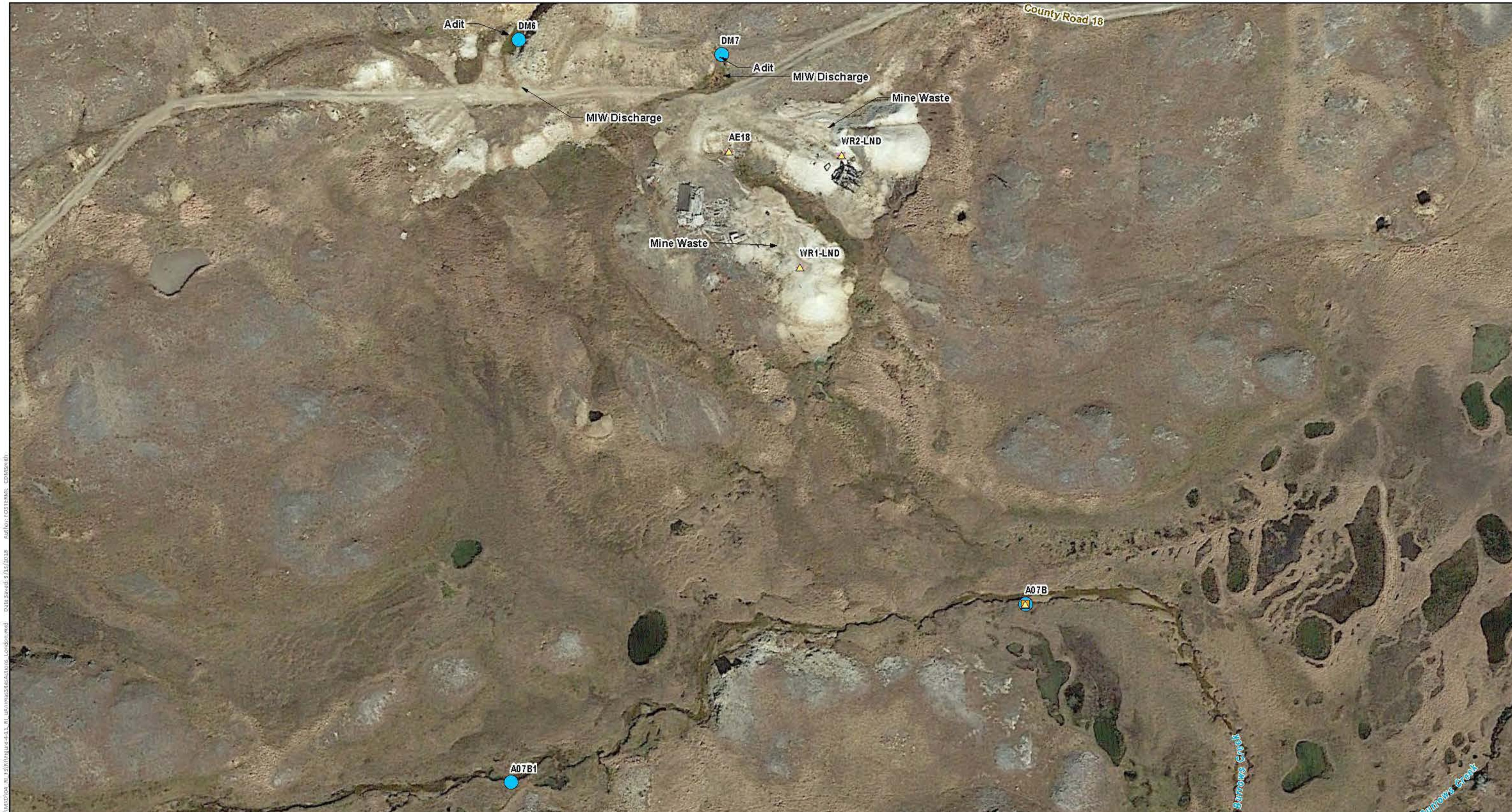
Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Figure 4-10
Boston Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 20 40 80

Feet

Background Terrain: Google Earth Pro Imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

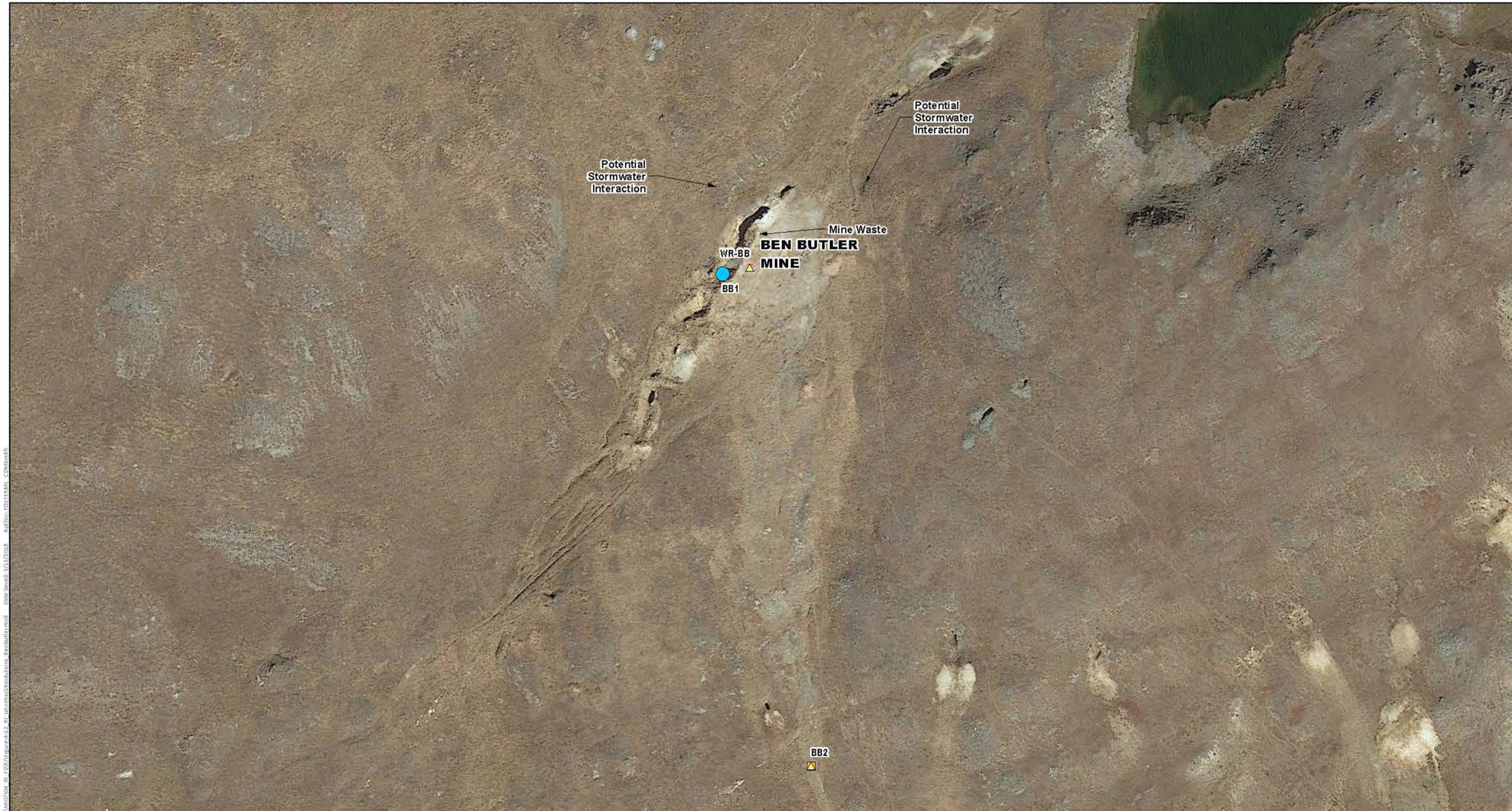
Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-11
London Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 30 60 120

Feet

Background Terrain: Google Earth Pro, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Figure 4-12

Ben Butler Mine

Bonita Peak Mining District Superfund Site | San Juan County, CO

Preliminary Remedial Investigation

CDM Smith

N

0 50 100 200

Feet

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-13
Mountain Queen Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 80 160 320

Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-14
Vermillion Mine

Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 65 130 260

Feet

Background Terrain: Google Earth Pro Imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil Sample

Note:
MIW = mining-influenced water

Figure 4-15
Sunbank Group Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

N

0 40 80 160

Feet

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-16
Frisco/Bagley Tunnel
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 20 40 80
Feet

Background Terrain: Google Earth Pro Imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-17
Columbus Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 20 40 80

Feet

Background Terrain: Google Earth Pro Imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

△ Waste Rock and Soil

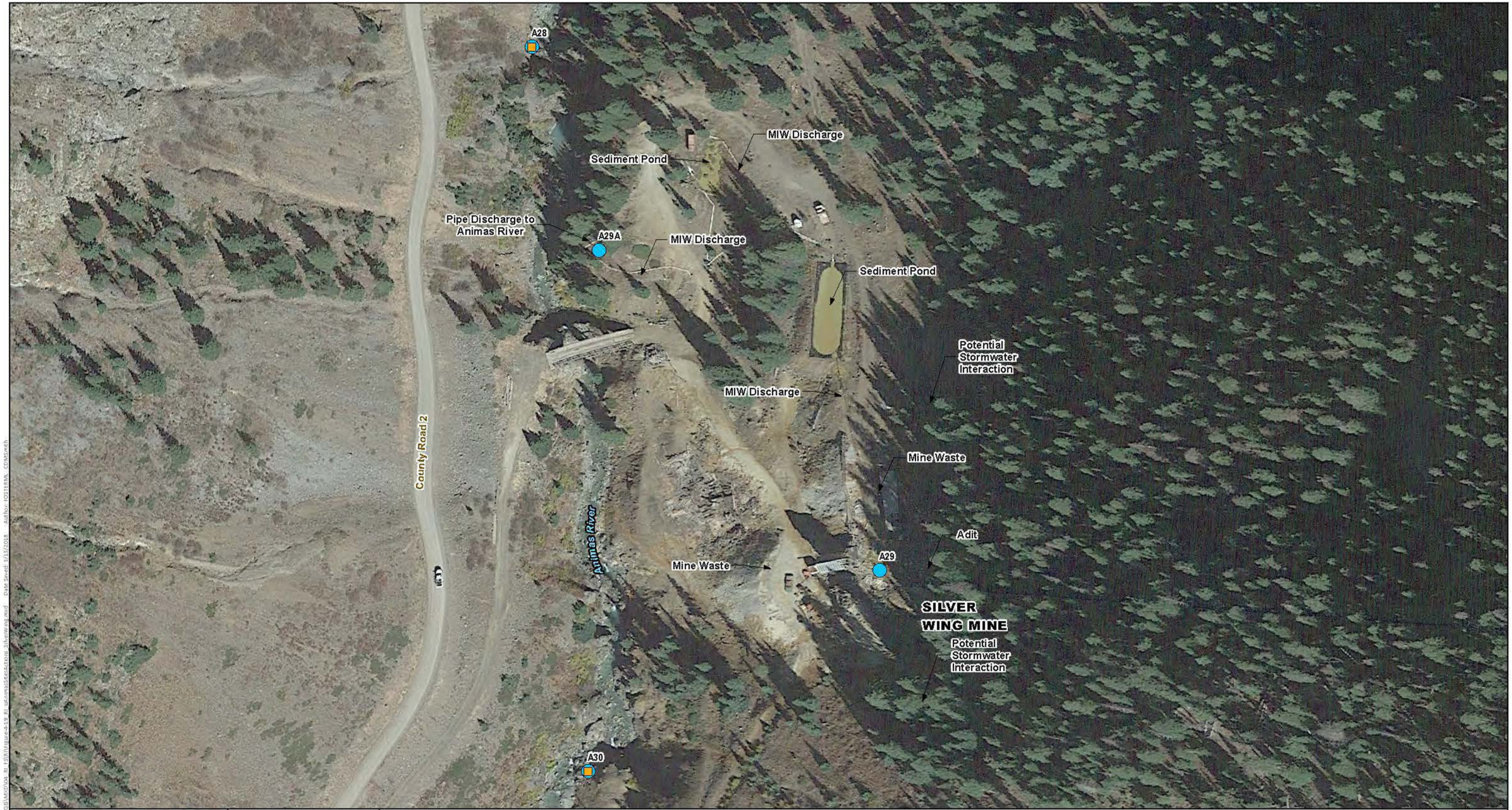
Figure 4-18

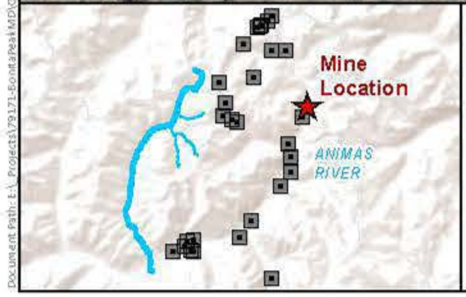
Campground 7

Bonita Peak Mining District Superfund Site | San Juan County, CO

Preliminary Remedial Investigation

CDM Smith





N

0 30 60 120
Feet

Background Image: Google Earth Pro, 10/12/2015; Background Terrain Sources: Esri, USGS, NOAA; Road and Railroad Source: US Census Tiger/Line; Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

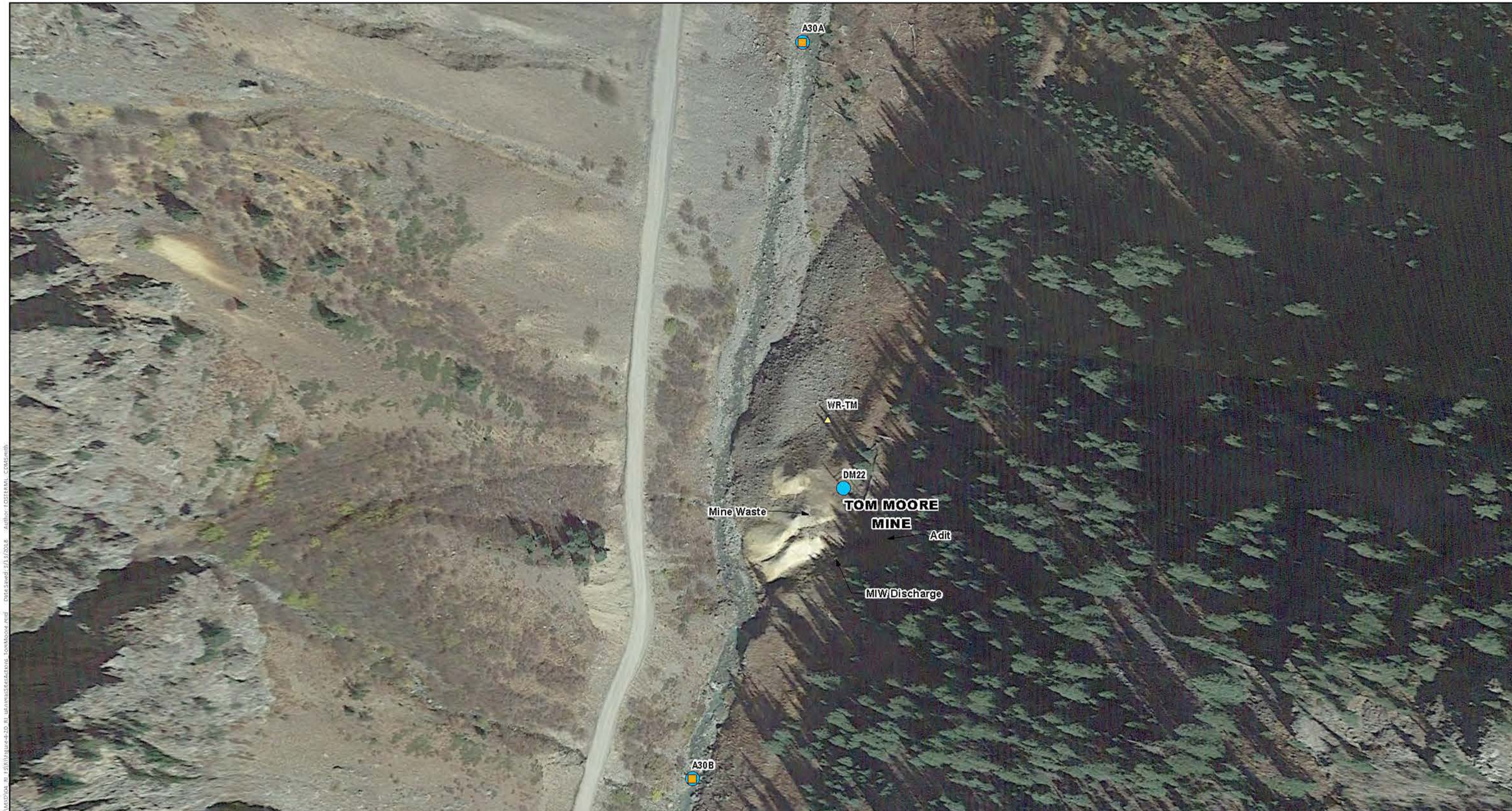
Samples

- Surface Water
- Sediment

Note:
MIW = mining-influenced water

Figure 4-19
Silver Wing Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith



N

0 30 60 120
Feet

Background Terrain: Google Earth Pro imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-20
Tom Moore Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 25 50 100

Feet

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-21
Ben Franklin Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 30 60 120
Feet

Background Terrain: Google Earth Pro Imagery, 10/12/2015
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-22
Terry Tunnel
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 75 150 300
Feet

Background Terrain Sources: Esri, USGS, NOAA
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Samples

- Surface Water
- Sediment
- Waste Rock and Soil

Note:
MIW = mining-influenced water

Figure 4-23
Pride of the West Mine
Bonita Peak Mining District Superfund Site | San Juan County, CO
Preliminary Remedial Investigation

CDM Smith

N

0 30 60 120
Feet

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road and Railroad Source: US Census

Legend

Samples

△ Waste Rock and Soil

Figure 4-24

Campground 4

Bonita Peak Mining District Superfund Site | San Juan County, CO

Preliminary Remedial Investigation

CDM Smith

Attachment A

Total and Dissolved Metals, Anions, Alkalinity, and Hardness Data for 2015 and 2016 EPA/ESAT Surface Water Samples

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					Metal Concentrations (µg/L)																																											
					Aluminum				Antimony				Arsenic				Beryllium				Cadmium				Calcium				Chromium				Copper				Iron				Magnesium			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Site	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Longfellow Mine	M02D	6/29/2016	6.61	15	286		33.4	J	2.5	U	0.5	U	3.85	J	2.64		2	U	2	U	0.5	U	0.1	U	10100		9870		5	U	1	U	8.91		7.2		650		179	J	2590		2420	
	M02D	10/7/2016	6.83	4.9	183		22.4	J	2.5	U	0.5	U	2.5	U	1.67	J	2	U	2	U	0.5	U	0.1	U	12400		11700		5	U	1	U	5.04		4.14		577		146	J	2990		2770	
Junction Mine	M02B	6/29/2016	6.15	12	1720		227		2.5	U	0.864	J	143		57.2		2	U	2	U	7.17		7.46		29500		28300		5	U	1	U	261		182		16600		13500		8400		7900	
	M02B	10/7/2016	3.86	2.9	7110		6320		2.5	U	0.536	J	303		213		2	U	2	U	25.1		26.1		56300		52900		5	U	1.28	J	777		794		64000		56100		12300		11300	
Koehler Tunnel	M02K1	6/29/2016	4.54	0.1	3870		3720		2.5	U	2.5	U	2.5	U	2.5	U	2.02	J	2.07	J	40.7		40.5		170000		164000		5	U	5	U	3170		3310		324		309		26000		24900	
	M02C	10/7/2016	6.12	4.5	12900		1950		2.5	U	2.5	U	3000		1020		3.41	J	2	U	86.2		89.4		391000		370000		5.72	J	5	U	3140		2100		177000		152000		54600		51500	
	M02E	6/29/2016	--	--	3500		2460		2.5	U	0.5	U	177		30.4		2	U	2	U	19.4		21.1		103000		99600		5	U	1	U	891		863		17600		13000		15600		14700	
	M02E	10/7/2016	3.6	9.0	8100		7590		2.5	U	2.5	U	234		67.4		2	U	2	U	47.2		42.8		231000		198000		5	U	5	U	1610		1410		40400		33800		33500		29600	
	M02	6/29/2016	5.76	150	2590		422		2.5	U	0.5	U	119		15.1		2	U	2	U	12.2		12.5		74800		73300		5	U	1	U	522		449		10000		6710		11600		11200	
	M02	10/7/2016	8.03	23	6770		6190		2.5	U	2.5	U	90.3		30.3		2	U	2	U	35.7		36.4		195000		179000		5	U	5	U	1290		1320		17100		15200		28100		26200	
Brooklyn Mine	M12	6/7/2016	4.55	--	3460		290		2.5	U	0.5	U	7.59	J	0.5	U	2	U	2	U	0.726	J	0.719		11800		11400		5	U	1	U	15.6		6.08		7400		136	J	2190		1830	
	M12	6/29/2016	5.08	438	3370		3030		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.94		4.02		30000		29300		5	U	1	U	33.9		34.4		911		410		5320		5080	
	M12	9/29/2016	4.17	165	9130		8700		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	6.07		6.2		50300		48800		5	U	1	U	53.4		54.4		1210		1040		9020		8800	
	M12A	6/29/2016	4.51	--	3850		3120		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.05		1.11		24500		23500		5	U	1	U	22.9		22.3		1590		362		4490		4090	
	M12A	9/30/2016	4.45	151	10200		9630		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.28		1.49		42400		41400		5	U	1	U	31.7		32.2		1200		627		7500		7350	
	M12B	6/29/2016	4.76	223	3940		3510		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.266		20500		19500		5	U	1	U	11.1		11.2		966		419		3830		3630	
	M12B	9/30/2016	4.55	151	11900		11000		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.307		37300		36300		5	U	1	U	19.6		20.1		1770		1050		7210		6840	
	M12C	6/29/2016	3.63	7.3	1890		1010		2.5	U	0.5	U	20.7		0.5	U	2	U	2	U	14.9		15.6		89800		86800		5	U	1	U	236		177		26400		4070		17400		16700	
	M12C	9/29/2016	3.84	1.1	3620		2920		2.5	U	0.5	U	39.3		1.63	J	2	U	2	U	19.1		18.7		94700		93700		5	U	1.18	J	348		300		58800		16300		17700		17500	
	M12C	9/30/2016	3.84	1.1	3020		2450		2.5	U	0.5	U	20.6		2.7		2	U	2	U	19		18.8		93600		90600		5	U	1.07	J	319		302		33700		16600		17100		16400	
	M12D	9/30/2016	3.72	2.2	2770		2170		2.5	U	0.5	U	20.1		1.4	J	2	U	2	U	18.9		19		93200		91700		5	U	1	U	328		317		27600		10400		17100		16500	
	M12F	10/7/2016	7.79	--	83.1		48.1	J	2.5	U	0.5	U	2.5	U	0.908	J	2	U	2	U	0.5	U	0.1	U	99800		94900		5	U	1	U	2.5	U	0.945	J	105	J	100	U	6470		6140	
	M12G	10/7/2016	4.07	--	642		576		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.433		13300		12500		5	U	1	U	22.1		23.8		591		502		1960		1860	
Bandora Mine	M23	9/27/2016	5.98	7351	2070		554		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.349		24200		22900		5	U	1	U	2.5	U	1.33		162	J	100	U	4070		3940	
	M24A	9/28/2016	6.96	--	957		36	J	3.05	J	0.5	U	12.8		0.5	U	3.01	J	2	U	67.8		35.8		90300		84700		5	U	1	U	1070		3.15		74900		195	J	6730		6470	
	M24B	9/28/2016	6.71	24	210		37.8	J	2.5	U	0.5	U	2.5	U	0.507	J	2	U	2	U	49.3		48		90300		84200		5	U	1	U	233		19.3		16100		5300		6570		6320	
	M24C	9/28/2016	7.41	--	31.2	J	30.1	J	2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	0.5	U	0.5	U	138000		127000		5	U	5	U	2.5	U	2.5	U	112	J	141	J	7280		7030	
	M24D	9/27/2016	6.87	--	200		20	U	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	42.4		35.2		90500		84000		5	U	1	U	189		2.23		11500		100	U	6580		6330	
	M25	6/29/2016	6.28	21553	696		49.7	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.336		16200		15800		5	U	1	U	2.5	U	1.28		100	U	100	U	2960		2840	
	M25	9/27/2016	6.12	9317	1840		266		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.54	J	0.622		25900		24400		5	U	1	U	2.5	U	1.2		159	J	100	U	3990		3760	
Grand Mogul Mine	CC01C	6/29/2016	3.59	--	2010		1850		2.5	U	0.5	U	2.5	U	1.56	J	2	U	2	U	18.7		17.6		12700		12000		5	U	1	U	470		462		2410		2210		2240		2080	
	CC01C	9/28/2016	4.1	3.6	10300		9720		2.5	U	2.5	U	37.1		39		2	U	2	U	95.4		97		21900		20900		5	U	5	U	2620		2620		57900		55100		9040		8660	
	CC01C1	6/29/2016	3.17	--	4570		4190		2.5	U	0.5	UJ	3.85	J	5.54		2	U	2	U	41.7		35.1	J	14000		13200		5	U	1	U	1440		1360		10000		12700		4250		3920	
	CC01C1	9/28/2016	3.96	2.8	15000		14100		2.5	U	2.5	U	20.3		21.8		2	U	2	U	127		130		23100		21800		5.56	J	5	U	5080		5070		54600		52200		12000		11600	
	CC01C2	6/29/2016	3.42	73	2960		2750		2.5	U	0.5	U	2.5	U	0.617	J	2	U	2	U	23.1		21.5		13200		12300		5	U	1	U	733		708		3030		2850		2690		2520	
	CC01C2	9/28/2016	4.12	9.0	8090		7730		2.5	U	0.5	U	2.5	U	2.94		2	U	2	U	69.1		62.9		17700		16600		5	U	1.13	J	2220		2130		9380		8900		6610		6340	
	CC01F	6/29/2016	7.27	--	238		97.6		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.19		1.2		30900		29100		5	U	1	U	31.1		20.6		100	U	100	U	2850		2660	
	CC01F	9/28/2016	7.16	--	372		114		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.7		2.77		52800		49700		5	U	1	U	59		29.7		100	U	100	U	4600		4380	
	CC01H	6/29/2016	6.12	2904	721		197		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	5.39		5.41		27000		25300		5	U	1	U	163		133		611		100	U	2780		2610	
	CC01H	9/27/2016	6.31	368	663		213		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	7.13		7.34		45700		43700		5	U	1	U	161		141		582		100	U	4420		4300	
	CC02I	6/28/2016	4.69	7.3	979		924		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	6.17		6.11		34700		33100		5	U	1	U	24		24.4		100	U	100	U	4620		4370	
	CC02I	9/27/2016	5.90	350	1880		1000		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	11.2		12		55900		53100		5	U	1	U	128		116		224	J	100	U	7170		6980	
	CC01U	6/28/2016	6.16	5327	1120		197		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	4.18		4.3		32600		30800		5	U	1	U	69.2		51.5		299		100	U	4220		3920	
	CC01U	9/27/2016	5.72	378	1860		926		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	12.1		12.1		57200		54000		5	U	1	U	131		117		244	J	100	U	7280		7140	
Natalie/Occidental Mine	CC14	6/10/2015	6.09	--	1830		1150		2.5	U	0.5	U	4.46	J	1.88	J	2	U	2	U	5.25		4.68		159000		158000		5	U	1	U	86.9		67.6		19800		18000		7790		7490	
	CC14	9/29/2015	6.32	--	920		664		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	1.82		1.78		206000		185000		5	U	5	U	7.78		3.51	J	19600		18100		9110		8600	
	CC14	6/9/2016	6.13	--	2440		1900		2.5	U	5	U	2.5	U	5	U	2	U	2	U	5.59		5.9		184000		189000		5	U	10	U	90.8		75.9		27200		27200		9830		9940	
	CC14	9/29/2016	5.39	407	955		791		2.5	U	2.5	U	2.53	J	2.94	J	2	U	2	U	1.87		1.87		209000		198000		5	U	5	U	7.17		3.16	J	18600		17600		9040		8770	
	CC15	6/9/2016	--	7277	643		91.6		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.271		18700		19500		5	U	1	U	8.71		4.97		796		100	U	1490		1530	
	CC15	9/29/2016	7	301	446		95.8		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.226		36600		34200		5	U	1	U	5.38		2.92		145	J	100	U	2090		2020	
	CC15A	6/9/2016	--	7206	751		177		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.787	J	0.831		35600		36200		5	U	1	U	15.8		10.2		2920		2530		2310		2350	
	CC15A	9/29/2016	6.8	1170	868		267		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	1.16		1.2		128000		121000		5	U	5	U	8.95		4.21	J	9330		8340		5860		5700	
Henrietta Mine	CC24G	6/30/2016	4.61	--	1840		1790		2.5	U	0.5	U	2.72	J	3.5		2	U	2	U	0.5	U	0.293		3010		3170		5	U	1	U	36.9		35.8		20900		20400		1080		1060	
	CC22D	6/8/2016	5.76	--	488		84.4		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.65		1.61		9920		10100		5	U	1	U	46.1		37.1		944		127	J	1310		1340	
	CC22D	9/29/2016	5.79	73	1130		124		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.7		1.74		41600		38300		5	U	1	U	42.6		28.9		1440		211	J	4880		4670	
	CC22B	6/8/2016	4.73	--	811		622		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.11		1.22		9510		9570		5	U	1	U	34		33.8		663		312		1370		1370	
	CC22B	9/29/2016	4.33	131	3600		3120		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.43		1.61		37400		35600		5	U	1	U	33.6		33.3		533		347		5520		5270	
	CC24B	6/8/2016	4.37	--	904		666		2.5	U	0.5	U	2.5	U	0.848	J	2	U	2	U	1.08		1.29		10300		10400		5	U	1	U	58.9		57.9		1210		769		1440		1520	
	CC24B	9/29/2016	3.93	166	2790		2460		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.03		2.32		39700		38700		5	U	1	U	106		107		1740		1450		5440		5260	
Anglo Saxon Mine	CC37	6/7/2016	--	41	500		477		2.5	U	2.5	U	7.91	J	6.93	J	2.03	J	2	U	2.75		2.52		297000		304000		5	U	5	U	7.68		7.03		28200		28400		18300		19000	
	CC37	9/28/2016	6.53	41	458		433		2.5	U	2.5	U	7.17	J	6.78	J	2	U	2	U	2.26		2.36		306000		299000		5	U	5	U	5.21		4.09	J	28700		25700		18500		18300	
	CC38	6/7/2016	7.43	--	1160		86.5		2.5	U	0.5	U	2.6	J	0.5	U	2	U	2	U	0.5	U	0.363		15800		15800		5	U	1	U	11.9		6.54		2260		556		1720		1670	
	CC38B	6/7/2016	6.15	59	885		790		2.5	U	2.5	U	6.39	J	3.32	J	2	U	2	U	2.06		2.08		218000		216000		5	U	5	U	58.8		65.9		20500		16300		13400		13800	
	CC38B	9/28/2016	6.67	36	638		211		2.5	U	2.5	U	5.93	J	3.36	J	2	U	2	U	1.95		1.81		279000		273000		5	U	5	U	24.4		7.69		21800		17300		16900		16600	
	CC38C	6/7/2016	7.07	--	1530		104		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.206		5720		5540		5	U	1	U	19.9		5.06		2160		100	U	1120		1030	
	CC38C	9/28/2016	7.32	15	266		95.8		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.2		2.46		24900		24200		5	U	1	U	20.2		10.9		107	J	100	U	5110		4940	
	CC39	6/7/2016	5.26	--	2140		643		2.5	U	0.5	U	4.72	J	0.5	U	2	U	2	U	2.26		2.19		29000		29100		5	U	1	U	70.1		53.9		6800		2100		2690		2470	
	CC39	9/27/2016	3.62	7970	6770		5930		2.5	U	2.5	U	6.93	J	2.6	J	2	U	2	U	5.72		5.78		164000		158000		5	U	5	U	108		99.7		14800		10000		9930		9560	
	CC39B	6/7/2016	5.1	--	2230		913		2.5	U	0.5	U	5.76	J	0.5	U	2	U	2	U	2.41		2.33		30700		29800		5	U	1	U	69.3		58.7		6790		2330		2830		2480	
	CC39B	9/28/2016	3.82	6993	6180		5760		2.5	U	2.5	U	4.78	J	2.5	U	2	U	2	U	5.43		5.49		162000		158000		5	U	5	U	55		59		13700		12500		9870		9520	

					Metal Concentrations (µg/L)																																							
					Aluminum				Antimony				Arsenic				Beryllium				Cadmium				Calcium				Chromium				Copper				Iron				Magnesium			
					T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D	
Mine Site	Station Name	Sample Date	pH	Flow (gpm)	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Yukon Tunnel	CC41	6/7/2016	5.16	--	2410		907		2.5	U	0.5	U	4.12	J	0.5	U	2	U	2	U	2.98		2.91		33000		33000		5	U	1	U	99.4		72.6		8110		2460		2960		2720	
	CC41	9/27/2016	3.55	6939	6220		5520		2.5	U	2.5	U	6.49	J	2.5	U	2	U	2	U	6.63		6.36		172000		162000		5	U	5	U	141		96.3		12500		7480		10200		9660	
	CC43C	6/7/2016	6.82	--	533		171		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	0.5	U	0.5	U	228000		233000		5	U	5	U	11.6		3.98	J	2460		1190		6810		7120	
	CC43C	9/27/2016	6.68	--	486		168		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	0.5	U	0.5	U	223000		215000		5	U	5	U	12.2		2.94	J	2440		1110		6770		6500	
	CC43D	6/7/2016	2.98	--	30900		28200		2.5	U	0.5	U	2.5	U	0.81	J	3.11	J	2.41	J	21.4		18.4		93500		91700		5	U	3.82		3610		2770		42900		39300		23400		21900	
	CC43E	6/7/2016	5.37	--	3020		891		2.5	U	0.5	U	5.63	J	0.5	U	2	U	2	U	3		3.19		34900		34700		5	U	1	U	104		82.3		10000		2250		3280		2760	
	CC43E	9/27/2016	3.88	7069	5630		5240		2.5	U	2.5	U	3.6	J	2.5	U	2	U	2	U	5.06		5.01		167000		160000		5	U	5	U	84.9		81.9		10100		7080		9420		9210	
Boston Mine	A07D	6/28/2016	4.23	--	5970		5550		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	7.55		7		7830		7130		5	U	1	U	38.9		34.6		242	J	149	J	1130		1060	
	A07D	10/5/2016	4.11	9.0	16000		15100		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	19.1		19.5		15500		14700		5	U	1	U	92.5		92.5		100	U	100	U	2950		2790	
	A07D1	6/28/2016	4.26	55	19300		18000		2.5	U	0.5	U	2.5	U	0.5	U	3.41	J	3.31	J	33.2		32.4		14200		13100		5	U	1	U	55.5		51.3		100	U	100	U	2340		2170	
	A07D2	6/28/2016	4.31	--	2340		2150		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	25.5		23.8		3300		3090		5	U	1	U	96.2		90		100	U	100	U	334		310	
	A07E	6/28/2016	4.18	--	4830		4570		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	5.02		4.93		7080		6700		5	U	1	U	35.4		33		234	J	141	J	1030		986	
	A07E	10/5/2016	3.86	49	13800		13000		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	12.3		13.3		14900		14300		5	U	1	U	64.6		68.8		311		304		2770		2620	
London Mine	DM6	6/28/2016	6.13	3.2	121		88.5		2.5	U	1.67		2.5	U	0.5	U	2	U	2	U	8.17		8.7		9170		8920		5	U	1	U	30.3		30		443		324		529		527	
	DM6	9/30/2016	3.21	0.7	1220		1100		2.5	U	0.911	J	2.5	U	1.36	J	2	U	2	U	84.4		71.4		26200		24900		5	U	1	U	260		218		6180		4870		1680		1580	
	DM7	6/8/2016	6.69	--	360		23.1	J	3.18	J	1.64		4.25	J	0.595	J	2	U	2	U	13.8		12.8		22400		22800		5	U	1	U	41.3		4.53		2150		100	U	1520		1490	
	DM7	6/28/2016	6.05	1.1	644		41.2	J	4.77	J	2.89		11.9		2.58		2	U	2	U	46.2		43.2		54500		52000		5	U	1	U	107		9.99		4700		255		3480		3390	
	DM7	9/30/2016	6.41	--	929		37.9	J	4.06	J	2.25		14.8		2.86		2	U	2	U	49.4		42		57800		56800		5	U	1	U	123		6.57		7400		312		3880		3780	
	A07B1	6/28/2016	4.28	1329	7230		6790		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	11.3		10.8		9140		8610		5	U	1	U	43.5		39.8		148	J	103	J	1340		1250	
	A07B	9/30/2015	4.3	21	14000		13400		2.5	U	0.5	U	2.5	U	0.5	U	5.81		5.98		21.7		23		32600		31400		5	U	1	U	49.8		51.5		166	J	102	J	4760		4530	
	A07B	6/28/2016	4.323	1206	6860		6440		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	10.4		10.7		9030		8550		5	U	1	U	42.2		38.9		134	J	108	J	1310		1240	
	A07B	9/30/2016	4.08	186	17100		17000		2.5	U	0.5	U	2.5	U	0.5	U	4.92	J	4.86	J	26.4		24.1		25300		24500		5	U	1	U	61.6		56.6		170	J	161	J	3950		3830	
Ben Butler Mine	BB1	6/28/2016	3.97	--	546		502		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	10.7		10.6		5230		5000		5	U	1	U	192		189		373		303		451		428	
Mountain Queen Mine	A18	10/6/2016	7.3	--	520		87.5		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	2.53		2.53		114000		108000		5	U	5	U	46.4		27.9		123	J	100	U	15700		14900	
	A19A	9/30/2015	3.7	0.8	3310		3200		2.5	U	0.5	U	2.5	U	1.42	J	2	U	2	U	44.5		45.7		15800		15000		5	U	1	U	1270		1270		5110		5050		2010		2000	
	A19A	9/28/2016	--	2.7	3270		3180		2.5	U	0.5	U	2.5	U	1.32	J	2	U	2	U	43		37.9		15200		14100		5	U	1	U	1260		1150		5470		5100		1790		1720	
Vermillion Mine	CG4	9/30/2015	5.01	247	16300		15500		2.5	U	0.5	U	2.5	U	0.5	U	21.7		22		18.2		18.7		64700		60200		5	U	1	U	47.2		72.6		140	J	127	J	13900		13600	
	CG4	6/28/2016	6.58	6127	3820		2790		2.5	U	0.5	U	2.5	U	0.5	U	5.41		4.6	J	5.49		5.81		31800		31100		5	U	1	U	18.5		16		108	J	100	U	5610		5470	
	CG4	10/6/2016	5.47	1006	14900		12100		2.5	U	0.5	U	2.5	U	0.5	U	19.5		16.8		13.8		14.2		49800		45900		5	U	1	U	36.6		34.8		495		183	J	11100		10200	
	CG5	6/28/2016	5.48	--	628		602		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	7.84		7.67		3730		3680		5	U	1	U	61.3		60.5		100	U	100	U	446		436	
	CG6	9/30/2015	5.17	189	13700		12000		2.5	U	0.5	U	2.5	U	0.5	U	18.3		17		15.9		16.4		67200		63500		5	U	1	U	41.2		35.9		151	J	106	J	12500		12500	
	CG6	6/28/2016	6.46	7803	3620		2540		2.5	U	0.5	U	2.5	U	0.5	U	5.31		4.24	J	5.74		5.65		31600		30600		5	U	1	U	18.3		15.8		111	J	100	U	5400		5210	
	CG6	9/30/2016	4.97	785	11900		10400		2.5	U	0.5	U	2.5	U	0.5	U	18.6		17.5		12.2		11.1		49300		48000		5	U	1	U	31.8		25.6		100	U	100	U	9660		9370	
	CG6A	6/29/2016	6.57	5679	4500		2390		2.5	U	0.5	U	2.5	U	0.5	U	5.15		3.89	J	5.57		5.58		31000		29600		5	U	1	U	23.4		14.9		1150		100	U	5530		5150	
Sunbank Group Mine	A21	9/29/2015	5.54	76	2290		815		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.85		3.93		46500		44300		5	U	1	U	14.2		12.6		1020		801		4620		4570	
	A21	6/29/2016	6.94	4916	1050		125		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.88		3.55		25300		22900		5	U	1	U	42.3		27.3		100	U	100	U	2990		2820	
	A21	9/30/2016	5.93	515	1490		304		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	4.03		3.65		38900		36400		5	U	1	U	18.1		12.4		289		248	J	3870		3780	
	A22	9/29/2015	5.97	61	340		29.7	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.84		1.99		52900		50300		5	U	1	U	8.15		4.71		100	U	100	U	4570		4490	
	A22	6/29/2016	6.99	3576	1090		148		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.65		3.62		25000		23300		5	U	1	U	43		31.1		100	U	100	U	3030		2880	
	A22	9/30/2016	6.46	531	1160		76.1		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.11		2.96		40000		37600		5	U	1	U	14.1		7.3		100	U	100	U	3780		3680	
	A21A	9/29/2015	4.79	16	13600		13500		2.5	U	0.5	U	2.5	U	1.4	J	2.41	J	2.49	J	12.1		12.1		15800		15400		5	U	1	U	2.5	U	1.44		16400		16300		5040		5080	
	A21A	6/29/2016	5.51	--	14100		13200		2.5	U	0.5	U	2.5	U	1.29	J	2.38	J	2.42	J	11.9		10.9		17000		15900		5	U	1	U	2.5	U	0.774	J	19200		16500		5150		4870	
	A21A	9/30/2016	3.78	--	15100		15000		2.5	U	0.5	U	2.5	U	1.76	J	2.83	J	2.75	J	13.3		13		15800		15000		5	U	1	U	2.5	U	1.04		18000		17100		5320		5210	
Frisco/Bagley Tunnel	A12	6/9/2015	7.14	83	285		107		2.5	U	0.5	U	2.5	U	1.34	J	2	U	2	U	4.69		4.69		70500		78800		5	U	1	U	5.29		4.7		2390		2210		4970		4550	
	A12	10/1/2015	6.25	18	434		285		2.5	U	0.5	U	2.5	U	2.47		2	U	2	U	4.47		4.77		148000		147000		5	U	1.69	J	2.5	U	2.36		4390		3550		9490		9480	
	A12	6/7/2016	6.48	18	642		550		2.5	U	0.5	U	2.5	U	2.14		4.9	J	2.01	J	7.76		8.51		141000		141000		5	U	2.4		7.36		6.95		4450		4170		9230		9370	
	A12	9/28/2016	--	58	356		325		2.5	U	0.5	U	2.5	U	1.86	J	2	U	2	U	5.43		4.94		149000		142000		5	U	2.12		2.93	J	2.62		2450		2210		9320		9280	
	A13	6/9/2015	6.2	25192	1120		305		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.39		2.26		8660		10000		5	U	1	U	22.9		11.5		239	J	100	U	1360		1260	
	A13	9/29/2015	5.31	521	7530		5590		2.5	U	0.5	U	2.5	U	0.5	U	10.3		9.29		9.78		10.2		54600		53400		5	U	1	U	31.4		28.3		292		203	J	8590		8440	
	A13	6/7/2016	6.57	--	2060		966		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.87		2.49		9590		9660		5	U	1	U	28.2		8.33		633		100	U	1700		1610	
	A13	9/30/2016	5.43	2053	6270		4680		2.5	U	0.5	U	2.5	U	0.5	U	9.51		8.12		7.17		6.88		39700		38200		5	U	1	U	22.7		17.2		152	J	117	J	6220		6140	
	CG9	6/9/2015	6.28	23919	1020		267		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2		2.07		9490		9830		5	U	1	U	17.9		10.3		206	J	100	U	1390		1360	
	CG9	9/29/2015	5.48	610	7140		4020		2.5	U	0.5	U	2.5	U	0.5	U	9.58		7.09		9.53		10.3		67200		62200		5	U	1	U	31.8		26.8		479		297		8870		8640	
	CG9	6/7/2016	6.5	--	1810		551		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.77		2.2		9660		9660		5	U	1	U	38.9		8.83		556		100	U	1510		1480	
	CG9	9/30/2016	5.27	2182	5590		3680		2.5	U	0.5	U	2.5	U	0.5	U	8.07		6.64		6.92		6.41		41900		40700		5	U	1	U	23.1		16.5		196	J	167	J	6180		5880	

Metal Concentrations (µg/L)

Mine Site	Station Name	Sample Date	pH	Flow (gpm)	Aluminum				Antimony				Arsenic				Beryllium				Cadmium			
					T		D		T		D		T		D		T		D		T		D	
					Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Columbus Mine	A10	6/9/2015	6.18	--	991		247		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.62		3.02	
	A10	9/29/2015	5.43	634	6280		3800		2.5	U	0.5	U	2.5	U	0.5	U	8.46		6.56		11.1		11.6	
	A10	6/7/2016	--	16137	1480		774		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.54		2.72	
	A10	9/29/2016	5.13	2387	5480		3790		2.5	U	0.5	U	2.5	U	0.5	U	8.57		7.01		7.69		7.48	
	A11A	6/9/2015	3.05	37	3370		3160		2.5	U	0.5	U	8.65	J	6.38		2	U	2	U	194		193	
	A11A	9/29/2015	2.89	0.1	31000		29500		2.5	U	0.5	U	12		12		8.11		8.33		1090		896	
	A11A	6/7/2016	4.16	27	3360		3450		2.5	U	0.5	U	5.91	J	5.43		2	U	2	U	180		173	
	A11A	9/30/2016	2.85	0.3	25600		24900		2.5	U	2.5	U	14		11		6.22		6.13		1030		938	
	CG11	6/9/2015	6.26	21799	1000		222		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.11		2.28	
	CG11	9/29/2015	5.34	572	6610		3830		2.5	U	0.5	U	2.5	U	0.5	U	8.81		6.5		9.54		10.2	
	CG11	6/7/2016	6.46	--	1480		587		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.29		2.17	
	CG11	9/30/2016	5.34	3305	5390		3510		2.5	U	0.5	U	2.5	U	0.5	U	7.68		6.25		6.89		6.28	
Silver Wing Mine	A28	6/9/2015	7.57	--	137		43.5	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.04		1.78	
	A28	9/30/2015	7.03	1754	1400		39.5	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	4.69		4.43	
	A28	6/28/2016	7.62	--	848		52		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.25		2.46	
	A30	6/9/2015	7.52	--	454		44.7	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.07		1.85	
	A30	9/30/2015	5.82	2503	1390		42.9	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	4.79		4.44	
	A30	6/7/2016	7.54	--	747		54.6		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.9		1.92	
	A29	6/9/2015	6.42	--	1380		428		2.5	U	2.5	U	99.7		2.5	U	2	U	2	U	14		14.1	
	A29	9/30/2015	5.74	--	1860		958		3.43	J	1.16		132		4.4		2	U	2	U	16.6		15.1	
	A29	6/7/2016	6.49	7.3	1590		762		4.15	J	1.16		161		2.87		2	U	2	U	16.1		16.4	
	A29	9/28/2016	--	--	1590		603		2.5	U	0.748	J	110		3.1		2	U	2	U	14.8		14.6	
	A29A	6/9/2015	6.96	--	825		31.5	J	2.5	U	2.5	U	39.7		2.5	U	2	U	2	U	13.4		13.5	
	A29A	6/7/2016	7.08	--	1800		98.5		5.38		0.944	J	143		1.17	J	2	U	2	U	14.7		15.3	
Tom Moore Mine	A30A	6/8/2016	7.29	--	659		45.8	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.86		1.82	
	A30A	9/29/2016	6.94	--	1740		74.2		2.5	U	0.5	U	2.5	U	0.5	U	2.27	J	2	U	4.25		3.98	
	A30B	6/8/2016	7.45	--	602		47.3	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.68		1.71	
	A30B	9/29/2016	6.97	7096	1810		67.5		2.5	U	0.5	U	2.5	U	0.5	U	2.37	J	2	U	4.09		3.98	
	DM22	6/28/2016	7.31	--	29.6	J	23.3	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.14		1.18	
	DM22	9/28/2016	--	21	27.1	J	23.9	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.77	J	0.811	
Ben Franklin Mine	ARD1	9/29/2015	3.1	--	7180		6370		2.5	U	0.5	U	2.5	U	0.558	J	2	U	2	U	57.5		55.6	
	ARD1	6/28/2016	2.76	--	3860		3630		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	43.8		41	
	ARD1	9/28/2016	3.12	--	9980		9650		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	79.7		72.9	
	EG3A	9/29/2015	7.25	35	63		31.7	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.551	J	0.588	
	EG3A	6/28/2016	6.24	4657	153		87.3		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.33		3.35	
	EG3A	9/29/2016	6.94	--	31.9	J	24.1	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.228	
	EG5	9/30/2015	7.14	--	31.8	J	25.6	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.535	
	EG5	6/28/2016	7.01	--	132		91.2		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.11		3.33	
	EG5	9/28/2016	7.7	222	96.5		64.4		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.18		1.18	
	A39A	6/28/2016	7.59	--	133		99		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.25		3.19	
Terry Tunnel	A38	6/28/2016	7.14	--	66.2		63.1		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.148	J
	A38	9/28/2016	7.07	--	82.3		76.3		2.5	U	2.5	U	2.5	U	2.5	U	2	U	2	U	0.726	J	0.5	U
	A39	9/30/2015	7.1	--	118		48.8	J-	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.2		1.08	
	A39	6/28/2016	7.55	--	133		88.6		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	3.06		3.06	
	A39	9/28/2016	7.51	--	180		109		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.73		1.61	
	EG6	6/10/2015	7.36	--	229		91		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.69		2.69	
	EG6	9/30/2015	7.22	98	20	U	20	U	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.71	J	0.794	
	EG6	6/28/2016	7.44	7133	113		80.5		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	2.07		1.94	
	EG6	9/28/2016	7.48	373	112		54.5		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	1.22		1.19	
Pride of the West Mine	A50	6/7/2016	7.75	--	201		36.8	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	11.8		12.2	
	A50	9/28/2016	7.67	--	137		39.3	J	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	7.51		7.39	
	CU4	6/7/2016	7.39	--	1380		57		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.1	U
	CU4	9/28/2016	7.45	6610	23.3	J	20	U	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.1	U
	CU4A	6/7/2016	7.36	--	658		60.7		2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.1	U
	CU4A	9/28/2016	7.23	6739	33.9	J	20	U	2.5	U	0.5	U	2.5	U	0.5	U	2	U	2	U	0.5	U	0.152	J

Station Name	Sample Date	Calcium				Chromium				Copper				Iron				Magnesium			
		T		D		T		D		T		D		T		D		T		D	
		Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
A10	6/9/2015	10400		10400		5	U	1	U	23.1		16.2		199	J	100	U	1460		1460	
A10	9/29/2015	65300		62500		5	U	1	U	41.2		39.4		401		306		8820		8480	
A10	6/7/2016	11800		11900		5	U	1	U	20.5		12.9		195	J	100	U	1810		1830	
A10	9/29/2016	43200		41100		5	U	1	U	30.9		25.1		204	J	136	J	6130		5980	
A11A	6/9/2015	4340		4830		5	U	1	U	2510		2510		11700		12200		1460		1390	
A11A	9/29/2015	38200		36400		5	U	3.93		6800		6790		61100		61100		12600		11900	
A11A	6/7/2016	4230		4390		5	U	1	U	2350		2310		11300		11600		1460		1510	
A11A	9/30/2016	30100		28400		6.12	J	5	U	6960		6300		54700		51600		9650		9400	
CG11	6/9/2015	10100		9980		5	U	1	U	15.8		9.39		179	J	100	U	1450		1410	
CG11	9/29/2015	66600		62200		5	U	1	U	31.5		27.9		440		324		8780		8550	
CG11	6/7/2016	10300		10500		5	U	1	U	24.9		8.96		306		100	U	1560		1570	
CG11	9/30/2016	40800		40300		5	U	1	U	22.4		17.1		173	J	163	J	5970		5790	
A28	6/9/2015	12100		12900		5	U	1	U	7.23		6.88		100	U	100	U	1290		1220	
A28	9/30/2015	56000		51600		5	U	1	U	12.2		3.56		100	U	100	U	5470		5180	
A28	6/28/2016	18500		18000		5	U	1	U	11.3		4.73		100	U	100	U	2140		2060	
A30	6/9/2015	11800		13100		5	U	1	U	23.5		13.4		115	J	100	U	1250		1210	
A30	9/30/2015	57000		52900		5	U	1	U	83.2		19.3		180	J	100	U	5550		5200	
A30	6/7/2016	12800		13400		5	U	1	U	18.6		7.99		204	J	100	U	1410		1460	
A29	6/9/2015	117000		129000		5	U	5	U	6190		2320		10900		2470		4890		4800	
A29	9/30/2015	134000		123000		5	U	1	U	10200		4200		16000		6130		5440		5130	
A29	6/7/2016	131000		141000		5	U	1.32	J	6280		2730		13700		3870		5390		5580	
A29	9/28/2016	138000		131000		5	U	1	U	6970		2770		11700		2790		5360		5240	
A29A	6/9/2015	117000		126000		5	U	5	U	3820		712		5570		100	U	4940		4870	
A29A	6/7/2016	127000		132000		5	U	1	U	6660		509		15600		137	J	5150		5400	
A30A	6/8/2016	12500		12800		5	U	1	U	15.6		6.44		201	J	100	U	1410		1360	
A30A	9/29/2016	44900		42500		5	U	1	U	35.2		7.45		102	J	100	U	4430		4330	
A30B	6/8/2016	13900		14100		5	U	1	U	14.5		5.98		204	J	100	U	1530		1530	
A30B	9/29/2016	45600		42700		5	U	1	U	53.4		7.79		128	J	100	U	4410		4290	
DM22	6/28/2016	71200		68800		5	U	2.92		2.5	U	0.515	J	100	U	100	U	1970		1910	
DM22	9/28/2016	78400		75900		5	U	1.53	J	2.5	U	0.598	J	100	U	100	U	2250		2150	
ARD1	9/29/2015	37900		33700		5	U	1	U	1940		1970		3560		2390		10300		9470	
ARD1	6/28/2016	25800		24200		5	U	1	U	1990		1880		5520		5190		5080		4820	
ARD1	9/28/2016	38300		37300		5	U	5	U	2690		2420		4080		3940		11300		11000	
EG3A	9/29/2015	33700		33200		5	U	1	U	11.4		9.78		100	U	100	U	2650		2610	
EG3A	6/28/2016	23600		22900		5	U	1	U	12.9		11.6		100	J	100	U	1890		1810	
EG3A	9/29/2016	39200		37800		5	U	1	U	2.79	J	1.79		100	U	100	U	3960		3610	
EG5	9/30/2015	34000		33700		5	U	1	U	6.27		5.53		100	U	100	U	2610		2590	
EG5	6/28/2016	23100		22800		5	U	1	U	14.8		12.2		100	U	100	U	1820		1810	
EG5	9/28/2016	37600		37200		5	U	1	U	12.2		8.05		100	U	100	U	3470		3380	
A39A	6/28/2016	23400		21900		5	U	1	U	16.2		13.8		100	U	100	U	1820		1710	
A38	6/28/2016	207000		196000		5	U	3.17		2.5	U	1.26		237	J	100	U	11200		10700	
A38	9/28/2016	215000		213000		5	U	5	U	2.5	U	2.5	U	940		100	U	11700		11900	
A39	9/30/2015	32700		32100		5	U	1	U	22.8		14.6		100	U	100	U	2740		2650	
A39	6/28/2016	22700		21600		5	U	1	U	15.6		13.7		100	U	100	U	1790		1690	
A39	9/28/2016	36600		35300		5	U	1	U	29.7		17.9		100	U	100	U	3400		3340	
EG6	6/10/2015	17200		17000		5	U	1	U	25.8		19.7		190	J	100	U	1440		1410	
EG6	9/30/2015	44200		43700		5	U	1	U	3.98	J	4.22		100	U	100	U	2950		2910	
EG6	6/28/2016	20300		20100		5	U	1	U	11.4		9.09		100	U	100	U	1680		1610	
EG6	9/28/2016	31900		31100		5	U	1	U	13.9		9.34		100	U	100	U	2810		2730	
A50	6/7/2016	67200		68700		5	U	1.99	J	54.5		16.6		209	J	100	U	4710		4860	
A50	9/28/2016	76700		76000		5	U	1.98	J	26.3		9.88		122	J	100	U	5230		5280	
CU4	6/7/2016	10100		9350		5	U	1	U	2.8	J	0.723	J	1420		100	U	1340		967	
CU4	9/28/2016	22500		22100		5	U	1	U	6.62		0.628	J	100	U	100	U	1990		1920	
CU4A	6/7/2016	10600		9690		5	U	1	U	3.88	J	0.93	J	770		100	U	1160		960	
CU4A	9/28/2016	24200		24000		5	U	1	U	2.5	U	0.882	J	100	U	100	U	2030		1990	

Notes:

Q - qualifier
"--" - data not available
T - total recoverable
D - dissolved

J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample
U - Indicates compound was analyzed for, but not detected in sample. Value shown is quantitation limit of method
gpm - gallons per minute
µg/L - micrograms per liter

Attachment A
Total and Dissolved Metals, Anions, Alkalinity, and Hardness Data for 2015 and 2016 EPA/ESAT Surface Water Samples
Bonita Peak Mining District, San Juan County, Colorado
Preliminary Remedial Investigation Report

			Metal Concentrations (µg/L)																																Chloride (mg/L)		Fluoride (mg/L)		Sulfate as SO4 (mg/L)		Total Alkalinity (mg $CaCO_3$ /L)		Nitrate/Nitrite as N (mg/L)		Hardness (mg/L)	
			Manganese				Lead				Nickel				Selenium				Silver				Strontium				Thallium				Zinc															
			T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		T		T		T		T		D	
Mine Site	Station Name	Sample Date	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Longfellow Mine	M02D	6/29/2016	80		51.9		1.45		0.213		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	273		259		5	U	1	U	10	U	10	U	0.7	J	0.1	U	16.6		20.2		0.1	U	35	
	M02D	10/7/2016	88.1		64.7		0.931	J	0.185	J	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	361		344	J	5	U	1	U	10	U	10	U	0.4	J	0.1	U	19.9		23.3		0.1	U	41	
Junction Mine	M02B	6/29/2016	348		365		131		5.26		3.75	J	4.03		5	U	1	U	2.5	U	0.5	U	1240		1180		5	U	1	U	1640		1770		0.8		0.4		120		5	U	0.1	U	103	
	M02B	10/7/2016	1780		1740		304		300		16.6		17		5	U	1	U	2.5	U	0.5	U	3180		3000	J	5	U	1	U	6590		6510		4	U	1.7	J	336		5	U	1	U	179	
Koehler Tunnel	M02K1	6/29/2016	16600		16400		3.19		3.29		71.9		77.8		5	U	5	U	2.5	U	2.5	U	6330		5980		5	U	5	U	17700		18100		2.8	J	2		642		5	U	0.4	U	513	
	M02C	10/7/2016	37600		37300		152		1.51		182		185		5	U	5	U	2.5	U	2.5	U	13100		12400	J	5.79	J	6.27	J	41500		41400		4	U	3.6		1630		5	U	1	U	1140	
	M02E	6/29/2016	7220		7020		100		36.6		32.3		32.4		5	U	1	U	2.5	U	0.5	U	3160		2950		5	U	1	U	7870		7930		3.1	J	0.8		385		5	U	0.4	U	309	
	M02E	10/7/2016	20800		17200		59.8		73.4		2.5		80.5		5	U	5	U	2.5	U	2.5	U	7320		6360	J	5	U	5	U	22400		18700		4	U	2.3		45		5	U	1	U	617	
	M02	6/29/2016	4120		4050		75.3		8.87		17.6		18.8		5	U	1	U	2.5	U	0.5	U	2430		2340		5	U	1	U	4590		4690		1.6		0.4		272		5	U	0.2	U	229	
	M02	10/7/2016	16200		15600		35.5		35.1		70.5		72.5		5	U	5	U	2.5	U	2.5	U	5910		5600	J	5	U	5	U	16800		16400		4	U	1.4	J	735		5	U	1	U	555	
Brooklyn Mine	M12	6/7/2016	488		301		14.6		0.198	J	2.5	U	1.44		5	U	1	U	2.5	U	0.5	U	154		139		5	U	1	U	174		156		0.7	J	0.1	J	34.7		5	U	0.1	U	36	
	M12	6/29/2016	1320		1300		3.3		2.52		6.04		6.55		5	U	1	U	2.5	U	0.5	U	384		366		5	U	1	U	861		887		0.8		0.3		118		5	U	0.1	U	4	
	M12	/29/2016	2280		2280		3.88		4.02		12.1		11.4		5	U	1	U	2.5	U	0.5	U	59		579		5	U	1	U	1300		1370		0.8	U	0.6		231		5	U	0.2	U	158	
	M12A	6/29/2016	79		763		7.04		1.44		4.17	J	4.28		5	U	1	U	2.5	U	0.5	U	397		368		5	U	1	U	282		276		0.8		0.3		6.3		5	U	0.1	U	76	
	M12A	/30/2016	1440		1440		1.66		1.55		8.86		8.4		5	U	1	U	2.5	U	0.5	U	612		598		5	U	1	U	347		363		0.8	J	0.6		205		5	U	0.2	U	134	
	M12B	6/29/2016	545		535		1.11		0.65		2.97	J	3.37		5	U	1	U	2.5	U	0.5	U	334		315		5	U	1	U	61		54.6		0.8		0.3		84.7		5	U	0.1	U	64	
	M12B	/30/2016	1190		1190		0.81	J	0.631		7.84		7.48		5	U	1	U	2.5	U	0.5	U	570		546		5	U	1	U	81		81.5		0.9	J	0.6		197		5	U	0.2	U	119	
	M12C	6/29/2016	5240		5100		25.1		1.69		7.88		.21		5	U	1	U	2.5	U	0.5	U	2570		2420		5	U	1	U	4670		4600		3.9		1.4		591		5	U	0.4	U	286	
	M12C	/29/2016	6440		6430		116		20.7		12.9		11.8		5	U	1	U	2.5	U	0.5	U	2440		2410		5	U	1	U	5780		6060		0.8	U	1		392		--		--		306	
	M12C	/30/2016	6380		6390		25		18.2		12.9		12.1		5	U	1	U	2.5	U	0.5	U	2340		2270		5	U	1	U	5690		5950		1.6	U	0.9		402		5	U	0.4	U	293	
	M12D	/30/2016	6300		6300		24.7		19.5		11.7		11.2		5	U	1	U	2.5	U	0.5	U	2410		2320		5	U	1	U	5810		6100		1.6	U	0.9		380		5	U	0.4	U	297	
	M12F	10/7/2016	193		4.09	J	0.5	U	0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	2630		2470	J	5	U	1	U	10	U	10	U	0.8	U	0.4		229		58.9		0.2	U	262	
	M12G	10/7/2016	38		15		126		125		2.71	J	3.79		5	U	1	U	2.5	U	0.5	U	188		176	J	5	U	1	U	117		121		0.4	U	0.2		51.7		5	U	0.1	U	39	
Bandora Mine	M23	/27/2016	200		200		0.5	U	0.246		4.96	J	4.97		5	U	1	U	2.5	U	0.5	U	149		138		5	U	1	U	32.5		40		0.4	J	0.2		79.9		5	U	0.1	J	73	
	M24A	/28/2016	6770		4870		77		0.147	J	10.5		7.7		5	U	1	U	2.5	U	0.5	U	603		549		5	U	1	U	13500		8750		0.8	U	0.9		259		32.6		0.2	U	238	
	M24B	/28/2016	5290		4940		201		3.69		8.79		8.14		5	U	1	U	2.5	U	0.5	U	588		543		5	U	1	U	11200		11200		--		--		--		--		--		236	
	M24C	/28/2016	2100		2030		0.663	J	0.581	J	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U	816		750		5	U	5	U	540		541		1.6	U	0.7	J	275		104		0.4	U	346	
	M24D	/27/2016	4780		4630		177		0.1	U	8.83		8.14		5	U	1	U	2.5	U	0.5	U	588		542		5	U	1	U	10700		250		0.8	U	0.8		257		29.3		0.2	U	236	
	M25	6/29/2016	0.7		89.8		0.5	U	0.1	U	2.82	J	3.12		5	U	1	U	2.5	U	0.5	U	112		106		5	U	1	U	58.4		64.1		0.9		0.2		50.5		5	U	0.1	J	51	
	M25	/27/2016	207		202		0.5	U	0.1	U	4.72	J	4.75		5	U	1	U	2.5	U	0.5	U	167		152		5	U	1	U	104		111		0.4	J	0.2		83.1		5	U	0.1	J	76	
Grand Mogul Mine	CC01C	6/29/2016	1720		1660		39.7		38.2		2.65	J	2.86		5	U	1	U	2.5	U	0.5	U	33.7		31.1		5	U	1	U	3650		3660		0.8		0.6		67.9		5	U	0.1	J	39	
	CC01C	/28/2016	6120		6050		27.9		26.4		14.2		13.3		5	U	5	U	2.5	U	2.5	U	68		63.4		5	U	5	U	24500		25100		1.6	U	2.6		401		5	U	0.4	U	88	
	CC01C1	6/29/2016	3760		3570		33.7		33		5.51		5.43		5	U	1	U	2.5	U	0.5	UJ	34.4		32.3		5	U	1	U	8850		8550		0.8		0.9		157		5	U	0.1	J	49	
	CC01C1	/28/2016	11400		11300		7.59		7.12		15.7		15.3		5	U	5	U	2.5	U	2.5	U	48.5		45.8		5	U	5	U	31300		31600		1.6	U	2.9		478		5	U	0.4	U	102	
	CC01C2	6/29/2016	2180		2090		28.1		26.9		3.14	J	3.36		5	U	1	U	2.5	U	0.5	U	48.9		45.8		5	U	1	U	4680		4660		0.8		0.6		88		5	U	0.2		41	
	CC01C2	/28/2016	5730		5610		22.1		21.5		.01		8.86		5	U	1.32	J	2.5	U	0.5	U	70.7		67.2		5	U	1	U	14900		14700		0.8	U	1.7		200		5	U	0.2	U	68	
	CC01F	6/29/2016	82.5		78.2		8.04		3.8		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	284		269		5	U	1	U	267		261		0.7	J	0.2		71.8		16.2		0.2		84	
	CC01F	/28/2016	126		123		2.93		0.843		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	528		497		5	U	1	U	475		454		0.4	U	0.3		134		21		0.1	J	142	
	CC01H	6/29/2016	474		450		10		2.98		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	236		223		5	U	1	U	1120		1100		0.7	J	0.2		74.7		6.81	J	0.2		74	
	CC01H	/27/2016	417		407		2.14		0.348		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	413		391		5	U	1	U	1600		1610		0.4	U	0.4		131		8.31	J	0.1	J	127	
	CC02I	6/28/2016	121		122		8.84		8.46		4.95	J	5.2		5	U	1	U	2.5	U	0.5	U	166		157		5	U	1	U	1750		1770													
	CC02I	/27/2016	2330		2280		2.93		1.8		8.34		4.08		5	U	1	U	2.5	U	0.5	U	362		341		5	U	1	U	2140		2110													
	CC01U	6/28/2016	1890		1810		8.95		2.04		2.5	U	1.53		5	U	1	U	2.5	U	0.5	U	225		214		5	U	1	U	815		802		0.7	J	0.4		101		5.05	J	0.2		3	
	CC01U	/27/2016	2310		2260		4.53		3.11		8.34		4.21		5	U	1	U	2.5	U	0.5	U	361		349		5	U	1	U	2200		2160		0.4	U	0.9		182		5	U	0.1	J	164	
Natalie/Occidental Mine	CC14	6/10/2015	1980		1940		7.3		0.339		5.47		5.38		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	843		884		--		--		--		--		--		424	
	CC14	/29/2015	2630		2680		3.41		0.557	J	2.5	U	3.65	J	5	U	5	U	2.5	U	2.5	U	--		--		2.5	U	2.5	U	732		751		8	U	3.2	J	684	J	.27	J	2	U	498	
	CC14	6/9/2016	2670		2680		.84		1.63	J	4.63	J	5.15	J	5	U	10	U	2.5	U	5	U	2260		2190		5	U	10	U	1130		1150		6.4	J	3.3		501		6.42	J	1	U	512	
	CC14	/29/2016	2520		2480		3.17		0.536	J	3.01	J	2.5	U	5	U	5	U	2.5	U	2.5	U	2380		2300		5	U	5	U	704		673		--		--		--		--		--		531	
	CC15	6/9/2016	84.3		81.2		0.579	J	0.1	U	2.5	U	1.06		5	U	1	U	2.5	U	0.5	U	143		144		5	U	1	U	61.6		64.6		0.7	J	0.3		48.8		5.03	J	0.2		55	
	CC15	/29/2016	64.2		63.5		0.5	U	0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	333		317		5	U	1	U	36		36.1		0.4	U	0.5		1.9		.79	J	0.1	J	4	
	CC15A	6/9/2016	325		331		1.28		0.1	U	2.5	U	1.33		5	U	1	U	2.5	U	0.5	U	343		342		7.34	J	1	U	165		171		0.7	J	0.5		7.5		5.09	J	0.2		100	
	CC15A	/29/2016	1410		1390		1.93		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U	1440		1380		5	U	5	U	403		391		0.8	U	1.7		344		.05	J	0.2	U	326	
Henrietta Mine	CC24G	6/30/2016	72.9		75.6		3.3		3.17		8.66		8.39		5	U	1.42	J	2.5	U	0.5	U	17.1		16.4		5	U	1	U	116		123		0.9		0.1	U	119		5	U	0.1	J	12	
	CC22D	6/8/2016	2.1		73.4		31.4		8.1		2.5	U	1.03		5	U	1	U	2.5	U	0.5	U	244		240		5	U	1	U	406		432		0.7	J	0.1	U	28.4		5	U	0.1	U	31	
	CC22D	/29/2016	307		289		59.9		18.3		2.63	J	2.39		5	U	1	U	2.5	U	0.5	U	1050		1040		5	U	1	U	435		400		0.4	J	0.2		128		5	U	0.1	U	115	
	CC22B	6/8/2016	110		109		23.9		18.1		2.5	U	1.63		5	U	1	U	2.5	U	0.5	U	207		202		5	U	1	U	302		333		0.7	J	0.1	J	31.3		5	U	0.1	U	30	
	CC22B	/29/2016	584		567		43.8		40.3		5.65		5.5		5	U	1	U	2.5	U	0.5	U	819		824		5	U	1	U	376		372		0.4	U	0.3		144		5	U	0.1	U	111	
	CC24B	6/8/2016	124		119		25.6		18.9		2.5	U	1.77		5	U	1	U	2.5	U	0.5	U	214		208		5	U	1	U	330		342		0.7	J	0.1	J	35.2		5	U	0.1	U	32	
	CC24B	/29/2016	506		498		44.5		44.2		4.9	J	4.76		5	U	1	U	2.5	U	0.5	U	887		857		5	U	1	U	549		571		0.4	J	0.3		147		5	U	0.1	U	118	
Anglo Saxon Mine	CC37	6/7/2016	8940		050		10.3		2.04		3.95	J	2.5	U	5	U	5	U	2.5	U	2.5	U	4690		4670		8.95	J	5	U	2930		3040		--		--		--		--		--		837	
	CC37	/28/2016	8700		8580		8.44		0.964	J	3.63	J	2.5	U	5	U	5	U	2.5	U	2.5	U	4790		4640		5	U	5	U	2830		2850		--		--		--		--		--		822	
	CC38	6/7/2016	640		592		31.1		2.73		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	251		239		10.1		1	U	179		162		0.7	J	0.2		38.6		7.65	J	0.1	U	46	
	CC38B	6/7/2016	11600		11600		.54		0.542	J	4.09	J	10.7		5	U	5	U	2.5	U	2.5	U	3260		3200		5	U	5	U	2290		2450		--		--		--		--		--		595	
	CC38B	/28/2016	12400		12100		3.89		0.5	U	2.8	J	2.5	U	5	U	5	U	2.5	U	2.5	U	4330		4170		5	U	5	U	2530		2480		--		--		--		--		--		749	
	CC38C	6/7/2016	105		18.2		110		2.85		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	7.9		88.1		5	U	1	U	103		49.5		0.8		0.1	U	11.6		8.34	J	0.1	U	18	
	CC38C	/28/2016	1		89.9		24.4		.58		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	453		431		5	U	1	U	533		555		0.4	J	0.1	J	73		13.6		0.1	U	81	
	CC39	6/7/2016	32		869		50.9		5.29		2.9	J	1.74		5	U	1	U	2.5	U	0.5	U	324		316		5	U	1	U	669		658		0.9		0.4		1		5	U	0.1	U	83	
	CC39	/27/2016	4460		4400		44.7		20.5		10.9		10.2		5	U	5	U	2.5	U	2.5	U	1820		1720		10.8		5	U	2400		2330		1.6	U	1.8		542		5	U	0.4	U	433	
	CC39B	6/7/2016	17		834		58.8		8.64		3.19	J	2.24		5	U	1	U	2.5	U	0.5	U	324		300		5	U	1	U	657		679		2.6		0.4		5		5	U	0.1	J	85	
	CC39B	/28/2016	4690		4700		13.7		13.5		10.2		10.4		5	U	5	U	2.5	U	2.5	U	1890		1800		11.6		5	U	2140		2170		1.6	U	1.8		554		5	U	0.4	U	435	

			Metal Concentrations (µg/L)																			
			Manganese				Lead				Nickel				Selenium				Silver			
			T		D		T		D		T		D		T		D		T		D	
Mine Site	Station Name	Sample Date	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Yukon Tunnel	CC41	6/7/2016	1060		978		43.1		5.73		2.85	J	2.12		5	U	1	U	2.5	U	0.5	U
	CC41	9/27/2016	5110		4920		27.2		17.1		10.6		9.09		5	U	5	U	2.5	U	2.5	U
	CC43C	6/7/2016	793		768		2.76		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U
	CC43C	9/27/2016	1130		1090		2.65		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U
	CC43D	6/7/2016	6530		6170		3.89		4.11		39		30.7		5	U	1.43	J	2.5	U	0.5	U
	CC43E	6/7/2016	1100		977		59.4		4.52		2.89	J	2.17		5	U	1	U	2.5	U	0.5	U
	CC43E	9/27/2016	4170		4150		15.2		13.9		9.19		7.68		5	U	5	U	2.5	U	2.5	U
Boston Mine	A07D	6/28/2016	2160		2100		11.6		9.47		4.73	J	4.45		5	U	1	U	2.5	U	0.5	U
	A07D	10/5/2016	4860		4810		7.22		7.47		10.7		10.6		5	U	1	U	2.5	U	0.5	U
	A07D1	6/28/2016	6080		5890		1.52		1.26		15.6		14.4		5	U	1	U	2.5	U	0.5	U
	A07D2	6/28/2016	824		793		22.5		18.7		2.5	U	1.95		5	U	1	U	2.5	U	0.5	U
	A07E	6/28/2016	1820		1780		11.6		9.77		3.99	J	3.5		5	U	1	U	2.5	U	0.5	U
	A07E	10/5/2016	5090		4950		14		15.4		8.99		9.06		5	U	1	U	2.5	U	0.5	U
London Mine	DM6	6/28/2016	189		197		61.7		48.3		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U
	DM6	9/30/2016	1640		1550		226		202		5.27		3.99		5	U	1	U	2.5	U	0.5	U
	DM7	6/8/2016	277		234		13.3		0.1	J	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U
	DM7	6/28/2016	1030		984		22.1		0.23		2.5	U	0.57	J	5	U	1	U	2.5	U	0.5	U
	DM7	9/30/2016	1230		1230		27.9		0.1	U	2.5	U	0.739	J	5	U	1	U	2.5	U	0.5	U
	A07B1	6/28/2016	2540		2480		11.2		9.57		5.82		5.51		5	U	1	U	2.5	U	0.5	U
	A07B	9/30/2015	5890		6110		8.87		9.44		13.5		13.9		5	U	1	U	2.5	U	0.5	U
	A07B	6/28/2016	2380		2340		10.8		9.34		6.65		5.23		5	U	1	U	2.5	U	0.5	U
	A07B	9/30/2016	5980		5920		10.5		9.35		14.4		13.7		5	U	1	U	2.5	U	0.5	U
Ben Butler Mine	BB1	6/28/2016	92.8		89.6		830		819		2.5	U	0.627	J	5	U	1	U	6.01		6.2	
Mountain Queen Mine	A18	10/6/2016	498		476		0.996	J	0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U
	A19A	9/30/2015	5750		5700		192		208		4.91	J	4.74		5	U	1	U	2.5	U	0.889	J
	A19A	9/28/2016	4190		4030		139		137		4.69	J	4.29		5	U	1	U	2.5	U	0.679	J
Vermillion Mine	CG4	9/30/2015	36400		36600		0.567	J	0.552		19.2		19.9		5	U	1	U	2.5	U	0.5	U
	CG4	6/28/2016	9020		9210		1.16		0.452		4.32	J	4.39		5	U	1	U	2.5	U	0.5	U
	CG4	10/6/2016	27300		26600		1.36		0.644		14.7		14.5		5	U	1	U	2.5	U	0.5	U
	CG5	6/28/2016	472		479		47.7		44.8		2.5	U	1.16		5	U	1	U	2.5	U	0.5	U
	CG6	9/30/2015	31600		31500		1.41		0.597		17.4		16.4		5	U	1	U	2.5	U	0.5	U
	CG6	6/28/2016	8750		8630		2.16		1.21		4.5	J	4.18		5	U	1	U	2.5	U	0.5	U
	CG6	9/30/2016	25600		25700		0.889	J	0.414		13.6		11.5		5	U	1	U	2.5	U	0.5	U
	CG6A	6/29/2016	8350		8360		26.2		1.4		4.58	J	4.29		5	U	1	U	2.5	U	0.5	U
Sunbank Group Mine	A21	9/29/2015	1880		1900		34.1		32.6		2.5	U	1.51		5	U	1	U	2.5	U	0.5	U
	A21	6/29/2016	3120		2980		9.02		2.35		4.67	J	4.1		5	U	1	U	2.5	U	0.5	U
	A21	9/30/2016	1550		1480		103		7.61		3.76	J	3.45		5	U	1	U	2.5	U	0.5	U
	A22	9/29/2015	346		348		4.52		2.01		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U
	A22	6/29/2016	3370		3250		6.09	J	1.05		4.61	J	4.33		5	U	1	U	2.5	U	0.5	U
	A22	9/30/2016	1250		1190		4.32		0.863		4.02	J	3.46		5	U	1	U	2.5	U	0.5	U
	A21A	9/29/2015	9460		9600		194		198		10.4		9.95		5	U	1	U	2.5	U	0.5	U
	A21A	6/29/2016	8980		8750		253		216		11		9.3		5	U	1	U	2.5	U	0.5	U
	A21A	9/30/2016	9160		8980		188		190		11.4		10.1		5	U	1	U	2.5	U	0.5	U
Frisco/Bagley Tunnel	A12	6/9/2015	7950		8190		4.02		0.591		2.5	U	2.64		5	U	1	U	2.5	U	0.5	U
	A12	10/1/2015	16500		16600		1.39	J	0.482		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U
	A12	6/7/2016	16300		16300		1.61		0.355		2.5	U	1.62		5	U	1	U	2.5	U	0.5	U
	A12	9/28/2016	13900		13700		0.5	U	0.1	U	2.5	U	0.898	J	5	U	1	U	2.5	U	0.5	U
	A13	6/9/2015	1960		1980		28.9		2.82		2.5	U	1.58		5	U	1	U	2.5	U	0.5	U
	A13	9/29/2015	18200		18900		8.85		7.83		8.88		9.47		5	U	1	U	2.5	U	0.5	U
	A13	6/7/2016	3510		3280		106		2.44		2.5	U	1.75		5	U	1	U	2.5	U	0.5	U
	A13	9/30/2016	13400		13400		4.2		2.56		8.36		7.31		5	U	1	U	2.5	U	0.5	U
	CG9	6/9/2015	1910		1880		15.3		2.12		2.5	U	1.67		5	U	1	U	2.5	U	0.5	U
	CG9	9/29/2015	18300		18000		8.7		6.16		8.93		9.73		5	U	1	U	2.5	U	0.5	U
	CG9	6/7/2016	2780		2530		152		2.87		2.5	U	1.49		5	U	1	U	2.5	U	0.5	U
	CG9	9/30/2016	12600		12600		4.05		2.59		6.76		5.84		5	U	1	U	2.5	U	0.5	U

			Metal Concentrations (µg/L)												Chloride (mg/L)		Fluoride (mg/L)		Sulfate as SO4 (mg/L)		Total Alkalinity (mg $CaCO_3$ /L)		Nitrate/Nitrite as N (mg/L)		Hardness (mg/L)	
			Strontium				Thallium				Zinc															
			T		D		T		D		T		D		T		T		T		T		T		D	
Mine Site	Station Name	Sample Date	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Yukon Tunnel	CC41	6/7/2016	332		323		5	U	1	U	858		854		0.8		0.4		105		5	U	0.1	J	93	
	CC41	9/27/2016	1970		1860		5	U	5	U	2610		2420		1.6	U	1.8		554		5	U	0.4	U	444	
	CC43C	6/7/2016	4910		4780		5	U	5	U	109		100		--		--		--		--		--		611	
	CC43C	9/27/2016	4710		4610		5	U	5	U	121		108		--		--		--		--		--		564	
	CC43D	6/7/2016	1300		1240		5	U	1	U	5810		5720		6.4	J	4.4		563		5	U	1	U	319	
	CC43E	6/7/2016	387		362		5	U	1	U	912		919		0.8		0.4		106		5	U	0.1	J	98	
	CC43E	9/27/2016	2080		2050		5	U	5	U	2070		2050		1.6	U	1.7		535		5	U	0.4	U	437	
Boston Mine	A07D	6/28/2016	13.5		12.3		5	U	1	U	1130		1140		0.7	J	0.2		58.8		5	U	0.1	U	22	
	A07D	10/5/2016	21		19.9		7.76	J	1	U	2840		2830		0.4	U	0.6		155		5	U	0.1	J	48	
	A07D1	6/28/2016	19.1		17.5		5	U	1	U	6020		5870		0.9		0.7		168		5	U	0.1	U	42	
	A07D2	6/28/2016	13.6		12.5		5	U	1	U	3740		3680		0.8		0.1	J	28		5	U	0.2		9	
	A07E	6/28/2016	12.9		12		5	U	1	U	715		718		0.7	J	0.2		51.2		5	U	0.1	U	21	
	A07E	10/5/2016	19.2		18.2		8.15	J	1	U	2150		2120		0.4	U	0.6		143		5	U	0.2		46	
London Mine	DM6	6/28/2016	50.6		48.4	J	5	U	1	U	1540		1680		1		0.1	U	25.1		5	U	0.1	U	24	
	DM6	9/30/2016	257		225		5	U	1	U	17200		17200		0.8	U	0.4		135		5	U	0.2	U	69	
	DM7	6/8/2016	290		292		5	U	1	U	2930		2870		1		0.4		51		16		0.1	U	63	
	DM7	6/28/2016	765		730	J	5	U	1	U	8130		8120		1.7		0.8		137		33.7		0.1	U	144	
	DM7	9/30/2016	845		784		5	U	1	U	8170		8280		1.4	J	1.1		153		34.9		0.2	U	157	
	A07B1	6/28/2016	19.6		18.1		13.5		1	U	1810		1790		0.7	J	0.4		72		5	U	0.1	U	27	
	A07B	9/30/2015	--		--		2.5	U	0.5	U	3990		4340		1.6	U	1.9		217	J	5	U	0.4	U	97	
	A07B	6/28/2016	22.7		20.9		12.3		1	U	1690		1720		0.8		0.4		68.2		5	U	0.1	U	26	
	A07B	9/30/2016	66		64.8		5	U	1	U	4260		4280		0.4	U	1.8		191		5	U	0.1	J	77	
Ben Butler Mine	BB1	6/28/2016	25.5		24		5	U	1	U	2080		2050		1.2		0.1	U	30.3		5	U	0.5		14	
Mountain Queen Mine	A18	10/6/2016	1020		970		5	U	5	U	374		360		0.8	U	0.8		328		27.4		0.2	J	332	
	A19A	9/30/2015	--		--		2.5	U	0.5	U	5630		6230		0.8	U	1.4		128	J	5	U	0.2	U	46	
	A19A	9/28/2016	55.4		53.5		10		1	U	5060		4920		--		--		--		--		--		42	
Vermillion Mine	CG4	9/30/2015	--		--		2.5	U	0.5	U	6030		6270		4	U	12.3		487	J	5	U	1	U	207	
	CG4	6/28/2016	198		190		5	U	1	U	1550		1660		0.7	J	2.2		128		5	U	0.1	J	100	
	CG4	10/6/2016	209		197		5	U	1	U	4380		4240		0.8	U	9.2		277		5	U	0.2	U	157	
	CG5	6/28/2016	11.1		10.7		5	U	1	U	1730		1900		0.7	J	0.1	U	19.3		5	U	0.1	U	11	
	CG6	9/30/2015	--		--		2.5	U	0.5	U	5260		5310		4	U	11.3		447	J	5	U	1	U	210	
	CG6	6/28/2016	201		193		12.7		1	U	1560		1620		0.7	J	2.3		124		5	U	0.1	J	98	
	CG6	9/30/2016	255		242		5	U	1	U	3510		3700		0.4	U	9.1		251		5	U	0.1	U	158	
	CG6A	6/29/2016	194		182		5	U	1	U	1580		1690		0.7	J	2.1		121		5	U	0.1	J	95	
Sunbank Group Mine	A21	9/29/2015	--		--		2.5	U	0.5	U	1700		1780		0.8	U	0.7		167	J	5	U	0.2	U	129	
	A21	6/29/2016	181		168		5	U	1	U	1410		1340		0.7	J	0.5		75		5	U	0.1	J	69	
	A21	9/30/2016	266		256		5	U	1	U	1610		1560		0.4	U	0.7		114		5	U	0.1	J	106	
	A22	9/29/2015	--		--		2.5	U	0.5	U	1050		1150		0.8	U	0.6		159	J	13.8		0.2	U	144	
	A22	6/29/2016	196		186		5	U	1	U	1360		1360		0.7	J	0.5		76.4		5.49	J	0.1	J	70	
	A22	9/30/2016	292		281		5	U	1	U	1430		1380		0.4	U	0.9		112		6.94	J	0.1	J	109	
	A21A	9/29/2015	--		--		2.5	U	1.72		4590		4930		4	U	1	U	255	J	5	U	1	U	59	
	A21A	6/29/2016	55.4		51.5		5	U	1.54	J	4300		4270		0.8		1		195		5	U	0.1	U	60	
	A21A	9/30/2016	48		46.3		5	U	1.61	J	4710		4670		0.4	U	1.2		206		5	U	0.1	U	59	
Frisco/Bagley Tunnel	A12	6/9/2015	--		--		2.5	U	0.5	U	3500		3830		--		--		--		--		--		215	
	A12	10/1/2015	--		--		2.5	U	0.5	U	5470		6080		4	U	1.1	J	466	J	63		1	U	406	
	A12	6/7/2016	724		711		5	U	1	U	6640		6980		1.5	J	1.2		414		37.4		0.2	U	391	
	A12	9/28/2016	841		816		5	U	1	U	5090		5060		--		--		--		--		--		394	
	A13	6/9/2015	--		--		2.5	U	0.5	U	757		802		--		--		--		--		--		30	
	A13	9/29/2015	--		--		12.8		0.5	U	3500		3920		1.6	U	6		263	J	5	U	0.4	U	168	
	A13	6/7/2016	41.2		40.3		5	U	1	U	950		859		0.7	J	0.9		36.3		5	U	0.1	U	31	
	A13	9/30/2016	225		221		5	U	1	U	2360		2360		0.4	J	4.5		168		5	U	0.1	U	121	
	CG9	6/9/2015	--		--		2.5	U	0.5	U	701		727		--		--		--		--		--		30	
	CG9	9/29/2015	--		--		2.5	U	0.5	U	3980		3880		1.6	U	6.2		306	J	5	U	0.4	U	191	
	CG9	6/7/2016	42.6		42.2		5	U	1	U	881		777		0.7	J	0.6		33.3		5	U	0.1	U	30	
	CG9	9/30/2016	246		229		5	U	1	U	2300		2430		0.4	J	4.1		170		5	U	0.1	U	126	

			Metal Concentrations (µg/L)																																Chloride (mg/L)		Fluoride (mg/L)		Sulfate as SO4 (mg/L)		Total Alkalinity (mg $CaCO_3$ /L)		Nitrate/Nitrite as N (mg/L)		Hardness (mg/L)	
			Manganese				Lead				Nickel				Selenium				Silver				Strontium				Thallium				Zinc															
			T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		T		T		T		T		D	
Mine Site	Station Name	Sample Date	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Columbus Mine	A10	6/9/2015	2100		2080		14.4		2.81		2.5	U	1.83		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	967		969		--		--		--		--		--		32	
	A10	9/29/2015	17500		18000		8.13		7.22		7.9		8.38		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	4130		4560		1.6	U	5.4		279	J	5	U	0.4	U	191	
	A10	6/7/2016	3160		3100		37.3		3.67		2.5	U	1.87		5	U	1	U	2.5	U	0.5	U	52.7		52.6		5	U	1	U	934		932		0.7	J	0.8		41.8		5	U	0.1	U	37	
	A10	9/29/2016	13000		12700		5.66		4.31		7.42		6.68		5	U	1	U	2.5	U	0.5	U	237		232		5	U	1	U	2670		2630		0.4	U	4.2		170		5	U	0.1	U	127	
	A11A	6/9/2015	1840		1900		1010		947		7.64		8.34		5	U	3.71		2.5	U	0.5	U	--		--		2.5	U	0.5	U	47000		51200		--		--		--		--		--		18	
	A11A	9/29/2015	17600		17900		254		289		66.5		65.8		17.4		15.8		2.5	U	0.5	U	--		--		2.5	U	0.676	J	278000		302000		8	U	2	U	1440	J	5	U	2	U	140	
	A11A	6/7/2016	1710		1720		911		913		7.65		7.7		5	U	1.17	J	2.5	U	0.5	U	15.9		16.2		5	U	1	U	40300		43100		1.3	J	0.2	J	178		5	U	0.3	J	17	
	A11A	9/30/2016	12400		12100		302		254		58.5		52.6		19.1		12.5		2.5	U	2.5	U	95		90.4		5	U	5	U	229000		223000		4	U	1.1	J	950		5	U	1	U	110	
	CG11	6/9/2015	1910		1970		10.8		1.87		2.5	U	1.72		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	696		762		--		--		--		--		--		31	
	CG11	9/29/2015	17700		17600		7.29		5.96		8.98		8.94		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	3930		3930		1.6	U	6		303	J	5	U	0.4	U	191	
	CG11	6/7/2016	2690		2550		89.9		2.74		2.5	U	1.68		5	U	1	U	2.5	U	0.5	U	45.7		45.8		5	U	1	U	765		759	J	0.7	J	0.7		35.9		5	U	0.1	U	33	
	CG11	9/30/2016	12200		12100		4.15		3.23		6.68		5.52		5	U	1	U	2.5	U	0.5	U	239		226		5	U	1	U	2280		2380		0.4	J	4		165		5	U	0.1	U	124	
Silver Wing Mine	A28	6/9/2015	736		721		1.81		0.763		2.5	U	0.826	J	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	452		480		--		--		--		--		--		37	
	A28	9/30/2015	3870		3800		3.85		0.442		2.5	U	0.525	J	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	1360		1330		0.8	U	1.2		160	J	23.5		0.2	U	150	
	A28	6/28/2016	1850		1780		3.48		0.613		2.5	U	0.921	J	5	U	1	U	2.5	U	0.5	U	116		112		11		1	U	587		569		0.7	J	0.4		48.1		11.1		0.1	J	53	
	A30	6/9/2015	745		715		7.76		0.918		2.5	U	0.778	J	5	U	1	U	2.5	U	0.5	U	--		--		12		0.5	U	507		496		--		--		--		--		--		38	
	A30	9/30/2015	3810		3750		4.82		0.313		2.73	J	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		15.5	J+	0.5	U	1440		1410		0.8	U	1.2		163	J	23.2		0.2	U	154	
	A30	6/7/2016	1250		1190		14.6		0.672		2.5	U	0.595	J	5	U	1	U	2.5	U	0.5	U	65.8		64.5		5	U	1	U	505		504		0.7	J	0.4		29.8		9.78	J	0.1	J	39	
	A29	6/9/2015	3100		3120		25.8		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U	--		--		2.5	U	2.5	U	3950		4010		--		--		--		--		--		341	
	A29	9/30/2015	3520		3480		25.5		0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		15	J+	0.5	U	4320		4500		4	U	3.6		407	J	25.1		1	U	329	
	A29	6/7/2016	3300		3170		22.7		0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	1620		1710		5	U	1	U	4220		4260		1.4	J	3.4		350		31.2		0.2	U	375	
	A29	9/28/2016	3290		3250		19.1		0.159	J	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	1730		1670		5	U	1	U	4020		3870		--		--		--		--		--		349	
	A29A	6/9/2015	3030		3040		12.8		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U	--		--		12		2.5	U	3790		3830		--		--		--		--		--		335	
	A29A	6/7/2016	3070		3130		61.8		0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	1580		1610		5	U	1	U	3900		3960		0.7	J	1.7		171		27.6		0.1	U	352	
Tom Moore Mine	A30A	6/8/2016	1200		1120		11.5		0.582		2.5	U	0.557	J	5	U	1	U	2.5	U	0.5	U	64.9		65.9		5	U	1	U	469		474		0.7	J	0.4		29.3		10		0.1	J	38	
	A30A	9/29/2016	3760		3670		3.22		0.321		2.5	U	1.43		5	U	1	U	2.5	U	0.5	U	264		257		5	U	1	U	1130		1030		0.4	U	1.3		120		16.8		0.2		124	
	A30B	6/8/2016	1100		1010		12.1		0.532		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	75.1		74.3		5	U	1	U	433		433		0.7	J	0.3		31.3		11.4		0.1	J	42	
	A30B	9/29/2016	3670		3580		3.48		0.339		2.5	U	1.25		5	U	1	U	2.5	U	0.5	U	267		259		5	U	1	U	1120		1020		0.4	U	1.3		120		16.7		0.2		124	
	DM22	6/28/2016	409		411		0.826	J	0.284		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	694		662	J	5	U	1	U	627		673		0.8		1		85.3		100		0.1	U	180	
	DM22	9/28/2016	165		156		0.5	U	0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	774		719		5	U	1	U	572		619		--		--		--		--		--		198	
Ben Franklin Mine	ARD1	9/29/2015	22300		22300		840		861		12.8		11.8		5	U	1.12	J	2.5	U	1.71		--		--		2.5	U	0.5	U	19900		19500		4	U	1.1	J	351	J	5	U	1	U	123	
	ARD1	6/28/2016	12700		12300		745		720		8.89		7.98		5	U	1	U	2.5	U	2.32		166		157		5	U	1	U	12500		12300		--		--		--		--		--		80	
	ARD1	9/28/2016	26000		26100		747		686		15.4		13.6		5	U	5	U	2.5	U	2.5	U	242		231		5	U	5	U	23000		24300		2	U	1.8		338		5	U	0.5	U	138	
	EG3A	9/29/2015	116		107		4.18		2.45		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	217		215		0.8	U	0.2	U	69.7	J	31		0.2	U	94	
	EG3A	6/28/2016	633		650		2.63		0.691		2.5	U	0.803	J	5	U	1	U	2.5	U	0.5	U	186		179	J	5	U	1	U	1120		1210		--		--		--		--		--		65	
	EG3A	9/29/2016	18.3		16.2		0.5	U	0.152	J	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	346		312		5	U	1	U	79.8		85.7		0.4	U	0.1	J	89.6		25.2		0.1	J	109	
	EG5	9/30/2015	53.2		53.2		1.68		1.12		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	221		228		0.8	U	0.2	U	67.1	J	34.3		0.2	U	95	
	EG5	6/28/2016	636		655		2.56		1.74		2.5	U	0.73	J	5	U	1	U	2.5	U	0.5	U	182		184	J	10.6		1	U	1120		1200		--		--		--		--		--		64	
	EG5	9/28/2016	144		144		3.11		1.48		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	359		329		5	U	1	U	493		529		0.4	U	0.3		89.8		23.9		0.1	U	107	
	A39A	6/28/2016	607		593		3.06		2.14		2.5	U	0.6	J	5	U	1	U	2.5	U	0.5	U	192		182		5	U	1	U	1040		1030		0.7	J	0.2		49.2		17.4		0.1	J	62	
Terry Tunnel	A38	6/28/2016	10600		10400		2.36		0.1	U	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	4040		3860		12		1	U	1180		1150		1.6		1.1		490		100		0.2	J	534	
	A38	9/28/2016	11000		10700		8.53		0.5	U	2.5	U	2.5	U	5	U	5	U	2.5	U	2.5	U	4170		4180		5	U	5	U	1340		1220		4	U	1.4	J	504		103		1	U	580	
	A39	9/30/2015	256		250		5.01		2.23		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	385		393		0.8	U	0.2	U	70.8	J	31		0.2	U	91	
	A39	6/28/2016	589		568		3.13		2.12		2.5	U	0.594	J	5	U	1	U	2.5	U	0.5	U	192		180		5	U	1	U	1000		1010		0.7	J	0.2		48.2		17.2		0.1	J	61	
	A39	9/28/2016	310		305		7.6		2.09		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	339		331		5	U	1	U	618		630		0.4	U	0.3		86.9		23		0.1	U	102	
	EG6	6/10/2015	1340		1280		6.08		1.83		2.5	U	1.13		5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	1110		1080		--		--		--		--		--		48	
	EG6	9/30/2015	96.8		94.3		0.869	J	0.796		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	--		--		2.5	U	0.5	U	430		429		0.8	U	0.2	U	105	J	25.9		0.2	U	121	
	EG6	6/28/2016	417		415		2.19		1.05		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	170		176	J	11.5		1	U	671		716		0.7	J	0.2		42.6		16.3		0.1	U	57	
	EG6	9/28/2016	251		248		3.85		0.76		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	335		305		5	U	1	U	430		456		0.4	U	0.2		73.2		22		0.1	U	89	
Pride of the West Mine	A50	6/7/2016	401		394		42.2		7.77		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	541		540		5	U	1	U	2190		2130		0.8		0.2		112		83		0.2		191	
	A50	9/28/2016	239		238		17.6		4.15		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	667		630		5	U	1	U	1360		1350		0.4	U	0.2		128		90.8		0.1	J	211	
	CU4	6/7/2016	152		4.21	J	27.5		0.298		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	114		106		5	U	1	U	13.2	J	10	U	0.7	J	0.1	U	5.9		24.6		0.1	U	27	
	CU4	9/28/2016	4.47	J	3.63	J	1.9		0.149	J	2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	284		265		5	U	1	U	10	U	10	U	0.4	J	0.1	U	19.9		45.8		0.1	U	63	
	CU4A	6/7/2016	174		4.84	J	46.4		0.488		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	117		108		5	U	1	U	35.1		10	U	0.7	J	0.1	U	6.2		25.2		0.1	U	28	
	CU4A	9/28/2016	6		4.03	J	1.27		0.296		2.5	U	0.5	U	5	U	1	U	2.5	U	0.5	U	292		279		5	U	1	U	24.3		28.6		0.4	J	0.1	U	23.2		47.8		0.1	U	68	

Notes:
Q - qualifier
"--" - data not available
T - total recoverable
D - dissolved

J - Indicates an estimated value. The associated numerical value is the approximate concentration of the analyte in the sample
U - Indicates compound was analyzed for, but not detected in sample. Value shown is quantitation limit of method
gpm - gallons per minute
µg/L - micrograms per liter

CDM Smith

Attachment B

Total Recoverable Metals Concentrations for 2015 and 2016 EPA/ESAT Waste Rock and Soil Samples

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Sample Location	Waste Rock/Soil Sample Location	Sample Date	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper	
Mineral Creek																						
WR-M02B	Longfellow Mine Waste Rock	7/28/2016	5920	J	49.2	J-	3160		133		0.3	U	4.8	J-	10500	J	3.8		4.9		669	
WR-M02D	Junction Mine Waste Rock	7/28/2016	8630	J	30.1	J-	1720		145		0.55	J	5.4	J-	1410	J	16.5		5		487	
WR-M02C	Koehler Tunnel Waste Rock (10 sieve)	7/28/2016	6300	J	18.5	J-	13700		101		1.8	U	3.3	J-	28500	J	6.2		8.9		539	
WR-M02C	Koehler Tunnel Waste Rock (60 sieve)	7/28/2016	7250	J	21.3	J-	22200		135		0.29		5	UJ	65300	J	10.9		9	J	470	
M02E	Junction Mine / Koehler Tunnel Pond	10/7/2016	11700		2.5	J	125		100		0.044	U	2.5		20800		3.4		7.1		175	
M02	Junction Mine / Koehler Tunnel Downstream	10/7/2016	20400		0.04	UJ	14.6		166		0.053	U	0.056	U	4250		6.5		10.5		30.2	
WR-M12	Brooklyn Mine Adit Waste Rock	7/28/2016	7610	J	2.7	J-	86.4		92.4		0.12	J	0.18	J-	3	UJ	9.9		2.2		47.4	
WR1-M12	Brooklyn Mine Waste Rock #1	7/28/2016	6060		12.7		72.5		91.5		0.14		1.8	J	1440		3.1		4.4		123	
WR2-M12	Brooklyn Mine Waste Rock #2	7/28/2016	11600		5.5		137		103		0.22		0.51	J	1930		5.3		4.8		117	
M12C	Brooklyn Adit	9/30/2016	10400		3.5	J	103	J	64.8	J	0.05	U	0.052	U	1280	J	2.9		3.3		99.2	J
M12D	Brooklyn Drainage Channel	9/30/2016	6960		1.6	J	39.6	J	127	J	0.047	U	1.1		679	J	10.5		15.6		28.8	J
M12E	Brooklyn Drainage Channel	10/7/2016	22600		0.034	UJ	7.2		106		0.046	U	0.048	U	2700		4.6		9.3		23	
M12A	Brooklyn Drainage Channel Downstream	9/30/2016	9880	J	0.041	UJ	36.8	J	161	J-	0.054	U	0.057	U	3360	J	3.4		14.3	J	24.5	
M12B	Brooklyn Mine Upstream in Browns Gulch	9/30/2016	8260	J	0.035	UJ	34.5	J	103	J-	0.047	U	0.049	UJ	3.3	UJ	1.1	J	4.8	J	15.9	
M12	Brooklyn Mine Downstream in Browns Gulch	9/29/2016	15700	J	0.037	UJ	16.4	J	170	J-	0.049	U	1.9	J-	3240	J	10.5		19.1	J	56.3	
WR1-M24	Bandora Mine Waste Rock #1	7/28/2016	6580		59.3		85		149		1.6		86.3	J	2970		3.9		20.4		1410	
WR2-M24	Bandora Mine Waste Rock #2	7/28/2016	8160		176		108		1110		0.47		10.7	J	18700		5.1		3.7		1710	
WR3-M24	Bandora Mine Waste Rock #3	7/28/2016	4640		118	J	150		58.1	J	0.58		147	J	9250		2.1		4.2	J	1610	
WR4-M24	Bandora Mine Waste Rock #4	7/28/2016	12700		4.5		33.9		184		4		160	J	1400		7.1		117		2790	
M24D	Bandora Mine Drainage into South Fork	9/27/2016	21300		0.85	J	8.9		93.8	J	0.79		21.1		5220	J	5.4		11.1	J	197	
M23	Bandora Mine Upstream	9/27/2016	14600		0.13	J	4		76.7	J	0.3	J	0.21	J	4920	J	5.9		5.8	J	13.9	
M25	Bandora Mine Downstream	9/27/2016	18200		0.31	J	27.9		141	J	0.47	J	1.1		12800	J	6.7		5.8	J	12	
Cement Creek																						
WR-CC01C	Grand Mogul Mine Waste Rock 1	7/27/2016	4970		65.8	J	106		64.9	J	0.17	J	15.2	J	596		3.8		1	J	2050	
WR-CC01C2	Grand Mogul Mine Waste Rock 2	7/27/2016	3550		64.6	J	81		66.1	J	0.27		20.1	J	2.9	U	2.2		0.59	J	758	
WR-CC02A	Grand Mogul Mine Western Waste Rock	7/27/2016	4390	J	28.4	J-	72.9		132		0.21		4.7	J-	3	UJ	1.6		0.47		225	
CC01F	Grand Mogul Mine Upstream	9/28/2016	12300		0.039	UJ	23	J	57.7		0.052	U	0.054	U	1260		5.8		10.2		59.5	J
CC01C	Grand Mogul Mine below Waste Rock 1	9/28/2016	10400		3.3	J	41.4	J	30.7		0.052	U	0.91		1010		4		4.9		191	J
CC01C1	Grand Mogul Mine below Waste Rock 2	9/28/2016	11400		0.048	UJ	36.6	J	99.5		0.064	U	3.9		1720		4.1		5.3		192	J
CC01C2	Grand Mogul Mine before Confluence with CC	9/28/2016	25300		0.046	UJ	36.3	J	136		1.7		54.5		996		6.6		39.5		995	J
CC01H	Grand Mogul Mine after Confluence with CC	9/27/2016	16800		0.044	UJ	41.3	J	62.8		0.83		6.5		615	J	5.5		19.5		549	J
CC02I	Grand Mogul Western Waste Rock Channel	9/27/2016	15000	J	2.5	J	28.4		129		0.056	U	3.2	J	2060	J	8.2	J	17.5		131	
CC01U	Grand Mogul Mine Downstream in CC	9/27/2016	13000	J	7.2	J	50.5		126		0.9		2.5	J	1660	J	5.6	J	10.8		241	
WR-CC14A	Natalie/Occidental Mine Waste Rock 1	7/27/2016	11200	J	0.81	J-	28.9		21.9		0.27		0.15	J-	1150	J	6.2		4.4		48.3	
WR-CC14B	Natalie/Occidental Mine Waste Rock 2	7/27/2016	7390	J	2.5	J-	35.9		67.5		0.28		0.29	J-	656	J	3.7		6.7		71.4	
CC15	Natalie/Occidental Mine Upstream	9/29/2016	9570	J	0.035	UJ	14.8	J-	68		0.047	U	0.049	U	833	J	2.6		4.1		25.2	J
CC15A	Natalie/Occidental Mine Downstream	9/29/2016	8220	J	0.035	UJ	20.5	J-	51.2		0.046	U	0.049	U	1040	J	2.6		3.9		29.9	J
WR-CC22	Henrietta Mine Waste Rock	7/27/2016	7330	J	12.9	J-	109		177		0.21		5.2	J-	86000	J	3.1		2.7		264	
CC22D	Henrietta Mine Upstream	9/29/2016	6880	J	2.1	J	63.3	J	35.2	J	0.17	J	3.5	J	1010	J	1.9		2.1	J	61.4	J
CC22B	Henrietta Mine Midpoint	9/29/2016	8670	J	6.2	J	77.5	J	148	J	0.13	J	0.84		283	J	3.8		2.3	J	46.7	J
CC24B	Henrietta Mine Downstream	9/29/2016	5430	J	2.8	J	59.8	J	224	J	0.12	J	0.053	U	3.5	U	3.8		2.4		28	J
WR-CC37	Anglo Saxon Mine Lower Waste Rock (10 sieve)	7/27/2016	10400	J	3.3	J-	41.8		118		0.48		0.42	J-	803	J	4.4		35.5		71.4	
WR-CC37	Anglo Saxon Mine Lower Waste Rock (60 sieve)	7/27/2016	11200	J	3.4	J-	45		118		0.49		0.53	J-	777	J	3.9		23.7		96.1	
WR-CC38B	Anglo Saxon Mine Upper Waste Rock (10 sieve)	7/27/2016	4230	J	58.7	J-	143		63.7		0.085	J	4.3	J-	2.9	UJ	1.2		1.2		283	
WR-CC38B	Anglo Saxon Mine Upper Waste Rock (60 sieve)	7/27/2016	4850	J	110	J-	232		103		0.13		2.3	J-	3	UJ	2		1.3		485	
CC39B	Anglo Saxon Mine Upstream	9/28/2016	9290	J	2.8	J	42.8	J	50.2		0.26	J	2.7		1160	J	5.1		5.1	J	122	J
CC38C	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	11200	J	2.7	J	73.5	J	95.3		0.3	J	1.7		1470	J	1.4		8.1	J	93.9	J
CC38D	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	9870	J	1.1	J	48.8	J	87.2		0.27	J	3.7		1120	J	2.2		5.5	J	76.5	J
CC38	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	11000	J	0.82	J	46.3	J	106		0.27	J	0.66		1260	J	2.7		3.4	J	54.3	J
CC39	Anglo Saxon Mine Downstream	9/27/2016	9170	J	2.2	J	36.4	J	48.8		0.14	J	1		887	J	4.5		3.1	J	61.7	J
WR-CC43	Yukon Tunnel Waste Rock	7/27/2016	9750	J	13	J-	51.8		52.3		0.083	J	3.5	J-	4160	J	3.4		4.2		2580	
CC41	Yukon Tunnel Upstream	9/27/2016	9410	J	3.5	J	45.2	J	60.3		0.22	J	2.1		779	J	4.4		4.9	J	77.9	J
CC43E	Yukon Tunnel Downstream	9/27/2016	8380	J	3.7	J	57.2	J	63		0.16	J	0.82		635	J	5		3.5	J	48.9	J
CC42	Yukon Tunnel in Illinois Gulch	9/27/2016	8230	J	1.8	J	7.3	J	106		0.11	J	0.47	J	1060	J	4		3.2	J	58.2	J
CC43D	Yukon Tunnel Pond	9/27/2016	14800	J	1	J	31.8	J	109		0.29	J	0.29	J	2570	J	9.2		8.8	J	93.3	J

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Sample Location	Waste Rock/Soil Sample Location	Sample Date	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper	
Animas River																						
A07E	Boston Mine Upstream	10/5/2016	13600	J	5.4	J	114		85	J	1.2		3.3		431	J	6.6		36.2	J	175	J
WR-BSN	Boston Mine Waste Rock	7/26/2016	3270		81.1	J	245		191	J	0.11	J	15.8	J	3.1	U	1.3		0.5	J	81.8	
A07D	Boston Mine Downstream	10/5/2016	21700	J	0.045	UJ	59.2		80.1	J	1		3.2		1050	J	5.4		8.8	J	59.2	J
WR1-LND	London Mine Waste Rock 1	7/26/2016	3240		99.3		94		73		0.085	J	17.8	J	3	U	2.3		0.74		166	
WR2-LND	London Mine Waste Rock 2	7/26/2016	4980		87.9		169		52.5		0.19	J	33.3	J	719		1.7		2.1		143	
AE18	London Mine Waste Rock 3	8/5/2015	1130	J	155	J-	119	J	48.1	J	0.004	UJ	34.7	J	111	J	0.76	J	0.75	J	197	J
A07B	London Mine Downstream	9/30/2016	48300		3.2	J	34.7		41.9		2.9		7		7.6	UJ	1.7	J	25		208	
WR-BB	Ben Butler Mine Waste Rock	7/26/2016	6720		128	J	207		58.6	J	0.14		29.3	J	3.1	U	2.1		0.97	J	435	
BB2	Ben Butler Mine Downstream	10/5/2016	14700	J	0.038	UJ	60.1		75	J	0.46	J	0.99		1600	J	4.9		4.4	J	21.9	J
AE1	Mountain Queen Upper Shaft	8/5/2015	1920	J	332	J-	227	J	182	J	0.004	UJ	95.8	J	104	UJ	1	J	0.26	J	664	J
AE2	Mountain Queen Adit	8/5/2015	1010	J	27.5	J-	106	J	150	J	0.004	UJ	2.5	J	132	J	0.61	J	0.27	J	117	J
AE9A	Vermillion Mine Waste Rock	7/27/2016	2610		20		147		59.3		0.16		23.8	J	2.9	U	1		0.27		213	
CG6	Vermillion Mine Downstream	9/30/2016	25400		0.047	UJ	29.9	J	39.9	J	6.1		1.6	J	2930		5.8	J	15.2	J	156	J-
AE44	Sunbank Group Mine Upper Adit	8/6/2015	5310	J	101	J-	148	J	77	J	0.64	J	1.1	J	183	UJ	4.9	J	18.7	J	422	J
AE45	Sunbank Group Mine	8/6/2015	6350	J	50	J-	109	J	93.4	J	0.49	J	2.7	J	242	UJ	4.1	J	21.5	J	270	J
AE46	Sunbank Group Mine Waste Rock	8/6/2015	7580	J	7.7	J-	170	J	115	J	0.005	UJ	0.68	J	503	UJ	6.1	J	34.9	J	246	J
A22	Sunbank Group Mine Upstream	9/30/2016	21200		3.1	J	44.8	J	169	J	2.8		9.8	J	3.7	U	6.7	J	13.4	J	318	J-
A21	Sunbank Group Mine Downstream	9/30/2016	17000		5.8	J	79.3		87.9		2.2		5.7		4	UJ	4.2		12.3		518	
AE10	Bagley Tunnel Waste Rock - North	8/5/2015	2910	J	13.8	J-	174	J	86.2	J	0.73	J	10	J	918	J	1.5	J	6.6	J	337	J
AE10A	Bagley Tunnel Waste Rock - South	8/5/2015	3810	J	7.6	J-	150	J	91.9	J	0.004	UJ	14.9	J	2800	J	1.5	J	4.8	J	143	J
A13	Bagley Tunnel Upstream	9/30/2016	15800		12	J	41.2	J	113	J	1.7		15.9	J	2530		4.1	J	6.5	J	466	J-
CG9	Bagley Tunnel Downstream	9/30/2016	16900		6.1	J	176	J	357	J	9		216	J	10800		3.4	J	63.6	J	2890	J-
GC-OPP	Bagley Tunnel - North of Mine	7/27/2016	17800		0.57		30.4	J-	105		0.97		0.98		4120		7.7		8.3		26.9	
AE13	Columbus Mine Waste Rock	8/4/2015	6000	J	5.6	J-	91.9	J	38.3	J	0.004	UJ	6.4	J	1170	J	5	J	5.8	J	512	J
CG11	Columbus Mine Upstream	9/30/2016	15500		4	J	41.7	J	59.3	J	1		5.9	J	2410		5.2	J	8.8	J	182	J-
A10	Columbus Mine Downstream	9/29/2016	12800	J	3.9	J	60.2	J	72	J	0.38	J	1.3		1540	J	5.9	J	6.3	J	141	J+
CMP7	Campground 7	7/26/2016	13300		42.5		86.9	J-	180		0.8		10.6		3620		8.1		5.9		339	
AE32A	Silver Wing Mine	8/4/2015	1480	J	273	J-	702	J	24.6	J	0.004	UJ	10.5	J	553	J	2.7	J	2.2	J	3830	J
AE32B	Silver Wing Mine	8/4/2015	1310	J	273	J-	729	J	86.3	J	0.004	UJ	8.6	J	214	J	0.97	J	0.84	J	2530	J
WR-TM	Tom Moore Mine	7/27/2016	4690		14.9	J	361		30.8	J	0.13	J	7.6	J	1060	J	1.6		0.71	J	106	J
BE4	Ben Franklin Mine	8/4/2015	3610	J	12.6	J	57.3	J	40.4	J	0.1	J	6.4	J	957	J	2.9	J	3.8	J	475	J
EG3A	Ben Franklin Mine Upstream	9/29/2016	17300	J	1.2	J	17.4	J	48	J	0.74		0.71		3890	J	8.8	J	18	J	96.9	J+
EG5	Ben Franklin Mine Downstream	9/28/2016	18100		1.2	J-	42.4		108	J	0.84		4.9	J	2790		7.7		14	J	192	J
A39	Terry Tunnel Upstream	9/28/2016	17700		2	J-	18.6		70.1	J	0.98		12.2	J	3890		5.9		15.7	J	456	J
EG6	Terry Tunnel Downstream	9/28/2016	16000		2.4	J-	31.7		85.3	J	0.86		11	J	2760		6.3		17.3	J	439	J
WR-PWN	Pride of the West Mine North	7/27/2016	7420		4		27.8		34.9		0.97		39.7		26800	J	3.3		9.1		906	J
WR-PWS	Pride of the West Mine South (10 sieve)	7/27/2016	9090		33.7		85.7		61.8		0.86		46.8		14600	J	5.4		10.6		1640	J
WR-PWS	Pride of the West Mine South (60 sieve)	7/27/2016	10300		18.5		113		77.8		1.1		54.9		8630	J	8.2		13.8		1540	J
CU4	Pride of the West Upstream	9/28/2016	10500	J	0.035	UJ	23.4		28.9		0.047	U	2.2		2490	J	2.4	J	5		105	J
CU4A	Pride of the West Downstream	9/28/2016	13000	J	3.8	J	9.2		115		0.049	U	2		4610	J	4.8	J	9.3		47.2	J
CMP4	Campground 4	7/26/2016	8550		46.8		62.9	J-	75.7		0.32		94.3		2310		4.3		9		2510	

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CDM Smith

Sample Location	Waste Rock/Soil Sample Location	Sample Date	Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
			Mineral Creek																									
WR-M02B	Longfellow Mine Waste Rock	7/28/2016	45700	J	3680		1760	J	528	J	0.56		5.2		4.7		1.9	J	27.2	J-	0.54		11		1340	
WR-M02D	Junction Mine Waste Rock	7/28/2016	75900	J	10200		2820	J	388	J	7.6		1.7	J	10.3		6	J	35.9	J-	0.89		27.3		1980	
WR-M02C	Koehler Tunnel Waste Rock (10 sieve)	7/28/2016	160000	J	3740		2910	J	1700	J	3		4.6	J	2.1	U	3	J	14.6	J-	3.4		70.3		910	
WR-M02C	Koehler Tunnel Waste Rock (60 sieve)	7/28/2016	203000	J	2930		4180	J	1330	J	1.8		6.7	J	5.4	U	2.8	J	10.4	J-	7.3		107		911	
M02E	Junction Mine / Koehler Tunnel Pond	10/7/2016	28200		217		3170		668		0.11		0.95	J	4.3		1.3	J	0.98		0.042	U	17.7		405	
M02	Junction Mine / Koehler Tunnel Downstream	10/7/2016	33900		53.7		5690		981		0.092	J	0.68	J	5.5		1.2	J	0.036	U	0.051	U	24.7		135	
WR-M12	Brooklyn Mine Adit Waste Rock	7/28/2016	47200	J	1920		4020	J	571	J	0.14		6.5		4.3		1.9	J	14.3	J-	0.32		19		145	
WR1-M12	Brooklyn Mine Waste Rock #1	7/28/2016	51400		2950	J	2070		422		0.2		5.4		2.9		2		27	J	0.4		13.6		903	
WR2-M12	Brooklyn Mine Waste Rock #2	7/28/2016	65100		1310	J	5720		847		0.0034	U	2.3		4.8		1.2		6.2	J	0.28		22.4		311	
M12C	Brooklyn Adit	9/30/2016	56200		3370		3730		456		1.2	J+	3.8		2.6		2	J	18.2		0.047	U	18.6		763	J
M12D	Brooklyn Drainage Channel	9/30/2016	48500		405		3260		1750		0.067	J+	1.6	J	8.9		1.8	J	2.8		0.044	U	27.1		314	J
M12E	Brooklyn Drainage Channel	10/7/2016	41900		100		9480		1900		0.011	J	0.79	J	5.3		1	J	0.031	U	0.044	U	20.8		186	
M12A	Brooklyn Drainage Channel Downstream	9/30/2016	32300	J	62.5		2210		764		0.035	J	1.2	J	7.7	J	1.6	J	1	J-	0.051	U	22.8		88.3	J
M12B	Brooklyn Mine Upstream in Browns Gulch	9/30/2016	27400	J	48.1		1030		251		0.05	J	0.7	J	1.8	J	1	J	0.032	U	0.044	U	10.1		55.6	J
M12	Brooklyn Mine Downstream in Browns Gulch	9/29/2016	40900	J	241		6170		3520		0.075	J	2.9		12.3	J	2.1	J	0.033	UJ	0.047	U	25.9		446	J
WR1-M24	Bandora Mine Waste Rock #1	7/28/2016	50200		14700	J	2110		15700		0.37		38.8		11.8		3		92.4	J	0.16		11.8		12800	
WR2-M24	Bandora Mine Waste Rock #2	7/28/2016	64700		24400	J	967		1040		0.49		36.9		1.6		7.7		40.4	J	0.18		19.7		11100	
WR3-M24	Bandora Mine Waste Rock #3	7/28/2016	23500		23200	J	1990		15100		0.71		48.8	J	8.2	J	3.3		48.4	J	0.2		8.3		66800	
WR4-M24	Bandora Mine Waste Rock #4	7/28/2016	126000		2450	J	2360		72100		0.0049	U	25		34.6		3		5.9	J	0.33		20.6		16600	
M24D	Bandora Mine Drainage into South Fork	9/27/2016	31300	J	349		6480		6020	J	0.039	J	2.5		10.2	J	1.5	J	1.6		0.042	U	22.5	J	4120	
M23	Bandora Mine Upstream	9/27/2016	23700	J	19		5620		380	J	0.026	J	2.2	J	7.1	J	1.2	J	0.035	U	0.049	U	26.1	J	88.7	
M25	Bandora Mine Downstream	9/27/2016	17300	J	55.3		4060		709	J	0.039	J	1	J	5.5	J	0.96	J	0.036	U	0.051	U	23.1	J	174	
			Cement Creek																									
WR-CC01C	Grand Mogul Mine Waste Rock 1	7/27/2016	40800		19900	J	2410		977		1.4		6.3	J	1.1	J	4		32.1	J	0.44		19.8		17900	
WR-CC01C2	Grand Mogul Mine Waste Rock 2	7/27/2016	30800		12800	J	1030		670		1.5		15.4	J	0.78	J	4.4		26.2	J	0.45		10.4		14700	
WR-CC02A	Grand Mogul Mine Western Waste Rock	7/27/2016	24300	J	5140		847	J	382	J	0.45		25		0.49		3.8	J	19.7	J-	0.39		9.9		3510	
CC01F	Grand Mogul Mine Upstream	9/28/2016	27200		462	J	5070		1670		0.062	J+	4.5		4.9	J	1	J	1.2		0.049	U	16.9		173	J
CC01C	Grand Mogul Mine below Waste Rock 1	9/28/2016	32700		1150	J	4650		1560		0.31	J+	4.8		3.3	J	1	J	3.1		0.05	U	17.4		280	J
CC01C1	Grand Mogul Mine below Waste Rock 2	9/28/2016	26000		1080	J	3050		2460		0.1	J+	1.8	J	4.1	J	1.1	J	2.9		0.06	U	12.6		737	J
CC01C2	Grand Mogul Mine before Confluence with CC	9/28/2016	33600		1650	J	6730		35900		0.041	J+	3.2		19	J	3.3	J	3.4		1		19.8		5560	J
CC01H	Grand Mogul Mine after Confluence with CC	9/27/2016	34000		896	J	4750		6960		0.059	J+	2.5	J	7.2	J	1.8	J	1.8		0.056	U	18.1		629	J
CC02I	Grand Mogul Western Waste Rock Channel	9/27/2016	36100	J	930		4050	J	3910		0.055	J	2.8		6.2		1.3	J	1.6		0.053	U	27.7	J	567	
CC01U	Grand Mogul Mine Downstream in CC	9/27/2016	39400	J	711		6850	J	4130		0.038	J	7.9		5		2.4	J	4.2		0.048	U	21.4	J	642	
WR-CC14A	Natalie/Occidental Mine Waste Rock 1	7/27/2016	38300	J	484		6060	J	614	J	0.0033	U	6.3		3.4		3.9	J	4	J-	0.21		30.5		310	
WR-CC14B	Natalie/Occidental Mine Waste Rock 2	7/27/2016	59800	J	845		3040	J	712	J	0.18		37.9		1.8		5.3	J	12.5	J-	0.24		24.9		223	
CC15	Natalie/Occidental Mine Upstream	9/29/2016	41900	J	78.6	J	3270	J	453	J	0.012	J	3.1		1.4		2	J	0.032	UJ	0.045	U	18.8		53.7	J
CC15A	Natalie/Occidental Mine Downstream	9/29/2016	37700	J	259	J	3080	J	359	J	0.027	J	6.7		1.9		2.4	J	1.5	J	0.044	U	17.1		146	J
WR-CC22	Henrietta Mine Waste Rock	7/27/2016	27200	J	6700		11500	J	366	J	0.31		0.91		3.7		4.8	J	13.8	J-	0.27		11.5		4320	
CC22D	Henrietta Mine Upstream	9/29/2016	42100	J	568	J	1970	J	289	J	0.096	J	0.91	J	1.3		1.6	J	1.3		0.041	U	12.1		898	J
CC22B	Henrietta Mine Midpoint	9/29/2016	46500	J	617		2790	J	204	J	0.12		1.7	J	1.6	J	2.9		5.8	J	0.044	U	19.8		352	
CC24B	Henrietta Mine Downstream	9/29/2016	26900	J	165	J	1470		190	J	0.028	J	1.7	J	1.8		2.4	J	0.9		0.048	U	20.4		35	J
WR-CC37	Anglo Saxon Mine Lower Waste Rock (10 sieve)	7/27/2016	87200	J	785		4620	J	3780	J	0.0035	U	10.9		3.6		4.5	J	4	J-	0.3		31.5		283	
WR-CC37	Anglo Saxon Mine Lower Waste Rock (60 sieve)	7/27/2016	122000	J	959		3660	J	3810	J	0.12		12.3		3		5.8	J	3.8	J-	0.24		26.7		414	
WR-CC38B	Anglo Saxon Mine Upper Waste Rock (10 sieve)	7/27/2016	61000	J	3340		1300	J	300	J	0.42		22.6		0.67		10.1	J	14.2	J-	0.46		13.8		1650	
WR-CC38B	Anglo Saxon Mine Upper Waste Rock (60 sieve)	7/27/2016	77400	J	4650		1040	J	177	J	0.56		36.5		1.1		13.1	J	22.8	J-	0.66		25		2240	
CC39B	Anglo Saxon Mine Upstream	9/28/2016	70500	J	626		4640	J	764	J	0.042	J	4.9		2.9	J	2.2	J	2.6		0.048	U	34.6		904	J
CC38C	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	40500	J	1480		4850	J	1150	J	0.031	J	1.8	J	1.9	J	2.6	J	3.5		0.048	U	16.7		546	J
CC38D	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	42700	J	890		3510	J	926	J	0.073	J	1.5	J	2	J	1.7	J	2.3		0.041	U	16.6		638	J
CC38	Anglo Saxon Mine In Porcupine Gulch	9/28/2016	40300	J	540		3930	J	585	J	0.047	J	1.8	J	2.3	J	1.3	J	1.5		0.083	U	17.3		285	J
CC39	Anglo Saxon Mine Downstream	9/27/2016	57400	J	414		4920	J	650	J	0.02	J	2.6		2.3	J	1.4	J	1.6		0.04	U	27.2		577	J
WR-CC43	Yukon Tunnel Waste Rock	7/27/2016	69800	J	3160		2700	J	711	J	0.26		45.8		3.5		13.4	J	16.3	J-	0.38		23.8		844	
CC41	Yukon Tunnel Upstream	9/27/2016	56600	J	621		5200	J	575	J	0.041	J	3.9		3	J	2.2	J	2.5		0.044	U	29.6		502	J
CC43E	Yukon Tunnel Downstream	9/27/2016	53100	J	343		4030	J	583	J	0.032	J	2.7		2.3	J	1.7	J	5.1		0.043	U	27.8		765	J
CC42	Yukon Tunnel in Illinois Gulch	9/27/2016	27200	J	422		3410	J	385	J	0.29		4.8		3.2	J	3.8	J	1.3		0.042	U	21.4		101	J
CC43D	Yukon Tunnel Pond	9/27/2016	65700	J	205		7660	J	960	J	0.028	J	3		6.5	J	2.1	J	0.99		0.044	U	20.9		177	J

Notes:
Waste rock samples are indicated by a "WR" in the sample location name
CC - Cement Creek
U - Indicates compound was analyzed for, but not detected in sample
UJ - The analyte was analyzed for, but was not detected. The reported value is appr
J - Indicates an estimated value. The associated numerical value is the approximate c
J- - Indicates an estimated value. The associated numerical value is the approximate

mg/kg - milligrams per kilogram
"--" - no data available
"U" samples are reported as the method detection limit

Sample Location	Waste Rock/Soil Sample Location	Sample Date	Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
			Animas River																							
A07E	Boston Mine Upstream	10/5/2016	106000	J	505	J	1340	J	7540	J	0.054	J	29.1		3.4	J	2.5	J	4.1		3.3		12.4		434	J
WR-BSN	Boston Mine Waste Rock	7/26/2016	25900		4660	J	2.2	U	122		1.7		118	J	0.68	J	0.99		22.4	J	2.3		4.5		4450	
A07D	Boston Mine Downstream	10/5/2016	23000	J	487	J	3800	J	2710	J	0.051	J	3.7		5.2	J	1.9	J	2		0.057	U	16.7		818	J
WR1-LND	London Mine Waste Rock 1	7/26/2016	28900		3300	J	2.2	U	161		0.6		16.2		1		2.9		16.9	J	0.63		5.7		2250	
WR2-LND	London Mine Waste Rock 2	7/26/2016	25000		5490	J	1570		713		0.53		48.9		1.3		1.4		35.4	J	2		12		7690	
AE18	London Mine Waste Rock 3	8/5/2015	14600	J	5660	J	277	J	107	J	0.66		--	--	1.2	J	2.2	J	47.4	J	2	J	4.5	J	9680	J
A07B	London Mine Downstream	9/30/2016	36800		561		1640	J	10700		0.056	J	7.4		3.8		2.4	J	1.9		0.1	U	4.6	J	546	J
WR-BB	Ben Butler Mine Waste Rock	7/26/2016	35500		24000	J	995		194		0.77		49.8	J	0.97	J	1.2		93.7	J	2.3		10		20200	
BB2	Ben Butler Mine Downstream	10/5/2016	22900	J	473	J	3030	J	910	J	0.028	J	2.2	J	4	J	0.92	J	1.2		0.048	U	19.5		328	J
AE1	Mountain Queen Upper Shaft	8/5/2015	32000	J	35700	J	30.2	J	54.3	J	1.5		--	--	0.35	J	32.3	J	16	J	0.003	UJ	5.4	J	12400	J
AE2	Mountain Queen Adit	8/5/2015	15700	J	1950	J	157	J	258	J	1.8		--	--	0.31	J	2.3	J	49.6	J	0.003	UJ	3.1	J	621	J
AE9A	Vermillion Mine Waste Rock	7/27/2016	25800		10400	J	2.1	U	60.4		1.1		41.2		0.42		2.9		45.1	J	1		5.1		8520	
CG6	Vermillion Mine Downstream	9/30/2016	40100	J	162		9250	J	7020	J	0.038	J	4.7		7.4	J	2.5	J	0.042	U	0.06	U	32.5		813	
AE44	Sunbank Group Mine Upper Adit	8/6/2015	47500	J	2040	J	847	J	3080	J	0.2		--	--	3.1	J	0.092	UJ	20.1	J	2.8	J	17.7	J	496	J
AE45	Sunbank Group Mine	8/6/2015	55100	J	2210	J	1310	J	8240	J	0.24		--	--	2.8	J	0.2	UJ	20.3	J	4.6	J	14.9	J	640	J
AE46	Sunbank Group Mine Waste Rock	8/6/2015	102000	J	631	J	1750	J	12800	J	0.26		--	--	2.6	J	0.12	UJ	8.7	J	6	J	24.7	J	295	J
A22	Sunbank Group Mine Upstream	9/30/2016	24000	J	1500		3270	J	19600	J	0.16		4.7		6.5	J	2.6	J	4.2		0.78		21.4		1600	
A21	Sunbank Group Mine Downstream	9/30/2016	37000		3390		3200	J	4270		0.86		7.8		3.6		3.4	J	10.4		0.11	U	13.8		1460	J
AE10	Bagley Tunnel Waste Rock - North	8/5/2015	33800	J	7040	J	1050	J	4040	J	1.2		--	--	2.4	J	0.17	UJ	27.1	J	1.4	J	8.1	J	1980	J
AE10A	Bagley Tunnel Waste Rock - South	8/5/2015	37600	J	3400	J	1760	J	2640	J	0.82		--	--	1.2	J	0.083	UJ	17.3	J	1.1	J	7.4	J	3200	J
A13	Bagley Tunnel Upstream	9/30/2016	28900	J	6000		4490	J	14800	J	2.6		12.9		4.6	J	2.1	J	21.8		0.063	U	14.9		2100	
CG9	Bagley Tunnel Downstream	9/30/2016	69700	J	1730		1550	J	55900	J	0.2	J	81.8		53.1	J	5.9	J	5.9		0.11	U	8.6		30200	
GC-OPP	Bagley Tunnel - North of Mine	7/27/2016	23700	J	151		4710		1700		0.0036	U	5.4		5.3		0.92		0.84		0.2		23.1		327	
AE13	Columbus Mine Waste Rock	8/4/2015	41700	J	6060	J	3570	J	1160	J	0.74		--	--	3.8	J	0.17	UJ	17.7	J	0.81	J	20.1	J	1750	J
CG11	Columbus Mine Upstream	9/30/2016	29300	J	1300		6190	J	6080	J	1.2		6.3		4.6	J	1.8	J	5.2		0.047	U	19.5		857	
A10	Columbus Mine Downstream	9/29/2016	40500	J	1870	J	6420	J	2350	J	0.64		16.3		3.6	J	1.2	J	5.9		0.041	U	20.3		404	J
CMP7	Campground 7	7/26/2016	23500	J	11800		4200		1560		0.29		6.4		5.1		2.9		26.7		0.43		24.4		5290	
AE32A	Silver Wing Mine	8/4/2015	43400	J	7010	J	886	J	357	J	0.17		--	--	1.9	J	4.3	J	16	J	0.003	UJ	12.4	J	1340	J
AE32B	Silver Wing Mine	8/4/2015	38600	J	4710	J	516	J	289	J	0.51		--	--	0.73	J	3	J	17.6	J	0.003	UJ	10.7	J	1970	J
WR-TM	Tom Moore Mine	7/27/2016	42400		8180		852	J	837	J	0.14		159	J	0.67	J	1.1		10.4	J	1.9		11.4		3080	
BE4	Ben Franklin Mine	8/4/2015	49100	J	6770	J	2300	J	1130	J	0.47		--	--	2.6	J	1.7	J	34.8	J	0.37	J	15.6	J	2870	J
EG3A	Ben Franklin Mine Upstream	9/29/2016	55600	J	605	J	9260	J	1620	J	0.23		2.1		10	J	2.2	J	4.9		0.041	U	39.2		282	J
EG5	Ben Franklin Mine Downstream	9/28/2016	65400		730	J	8550	J	5830	J	0.046	J	6.1		8.8	J	2.8		4.9	J	0.04	U	32.7		1050	
A39	Terry Tunnel Upstream	9/28/2016	60100		1010	J	10100	J	9450	J	0.055	J	9.5		11.5	J	3		7.6	J	0.042	U	25.9		3640	
EG6	Terry Tunnel Downstream	9/28/2016	67000		1770	J	8530	J	15100	J	0.11	J	5.2		9.2	J	2.3	J	5.8	J	0.044	U	27.8		3450	
WR-PWN	Pride of the West Mine North	7/27/2016	25200		13900		5290	J	5450	J	0.0033	U	101		4.5		3		12.9		0.23		9		9920	
WR-PWS	Pride of the West Mine South (10 sieve)	7/27/2016	42700		16300		5830	J	5860	J	0.27		82.4		5.5		1.2		50.4		0.29		14		12100	
WR-PWS	Pride of the West Mine South (60 sieve)	7/27/2016	50600		26700		5260	J	6580	J	0.55		91.7		7		2		49.3		0.38		16.6		13100	
CU4	Pride of the West Upstream	9/28/2016	21800	J	1760		4570	J	2210	J	0.015	J	7.1		2.3	J	1	J	2		0.045	U	9.3		665	J
CU4A	Pride of the West Downstream	9/28/2016	30200	J	820		5120	J	1260	J	0.012	J	4.4		3.9	J	1.9	J	2.4		0.046	U	32.1		458	J
CMP4	Campground 4	7/26/2016	37400	J	44200		3150		910		6		118	J	2.8		7.1		96.9		0.3		15.4		17300	

Notes:

Waste rock samples are indicated by a "WR" in the sample location name

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U - Indicates compound was analyzed for, but not detected in sample

UJ - The analyte was analyzed for, but was not detected. The reported value is appr

J - Indicates an estimated value. The associated numerical value is the approximate c

J- - Indicates an estimated value. The associated numerical value is the approximate

mg/kg - milligrams per kilogram

"--" - no data available

"U" samples are reported as the method detection limit

Appendix B

Risk Assessment Information

Part 1.1 – Interim Chronic Lead Risk Evaluation

Part 1.2 – Human Health Acute Arsenic Screening Levels

Part 2 – Ecological Risk Technical Memorandum

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Appendix B – Part 1.1

Interim Chronic Lead Risk Evaluation

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Appendix B – Part 1.1

Interim Chronic Lead Risk Evaluation

1.0 Introduction

This appendix describes an interim evaluation of potential lead risks from exposures to lead in soil/waste rock at the Bonita Peak Mining District Superfund Site (Site) located in southwestern Colorado. The Site consists of 48 historic mines or mining-related sources where ongoing releases of metal-laden water and sediments are occurring within the Mineral Creek, Cement Creek, and Upper Animas River drainages in San Juan County, Colorado. Drainages within the Site contain over 400 abandoned or inactive mines where large- to small-scale mining operations occurred. San Juan County is comprised of 10 historic mining districts (Colorado Geological Survey 2017). Historic mining districts within the Mineral Creek, Cement Creek, and Upper Animas River drainages (referred to as "the mining districts" in this appendix) include Animas, Animas Forks, Cement Creek, Eureka, Ice Lake Basin, and Mineral Point.

This interim lead risk evaluation was developed to support the identification of areas that may warrant interim remedial action in 2018. This evaluation is to be considered preliminary and subject to change pending completion of the Bonita Peak Mining District human health risk assessment (HHRA).

Lead was selected for evaluation because soil concentrations are notably elevated at several locations within the mining districts and lead is often an important human health risk driver for mining-related contamination. The camping scenario was selected for this evaluation because the camper receptor likely has the highest exposure to soil, due primarily to incidental ingestion of soil, compared to the other recreational receptors (e.g., hiker, hunter, recreational ATV rider) being considered in the HHRA. The camping scenario was also selected because this receptor includes exposures both as a young child and as an older child/adult. Children are often more vulnerable to pollutants than adults, particularly for lead exposures, because of differences in behavior and biology that can result in greater exposure and/or unique windows of susceptibility during development. Additionally, soil ingestion rates for young children are higher than adults due to increased frequency of contact through hand-to-mouth or object-to-mouth activity.

Potential risks to a variety of recreational and occupational receptor populations from all contaminants of interest (lead and nonlead) and all exposure media and pathways will be evaluated as part of the Bonita Peak Mining District HHRA.

2.0 Overview

Risks from lead are evaluated using a somewhat different approach than for most other chemicals. Because lead is widespread in the environment, exposure can occur from many sources. Thus, lead risks are usually based on consideration of total exposure (all sources) rather than just site-related sources. Additionally, because studies of lead exposures and resultant health effects in humans traditionally have been described in terms of blood lead level, lead exposures and risks typically are assessed by describing the levels of lead that may occur in the blood of exposed populations and comparing these to blood lead levels of potential health concern. For convenience, the concentration of lead in blood is usually abbreviated PbB, and is expressed in units of micrograms of lead per deciliter of blood (µg/dL).

Concern over health effects from elevated blood lead levels is greatest for young children or the fetuses of pregnant women. There are several reasons for this focus on young children or the fetus, including the following: (1) young children typically have higher exposures to lead-contaminated media per unit body weight than adults, (2) young children typically have higher lead absorption rates than adults, and (3) young children and fetuses are more susceptible to effects of lead than are adults. EPA has identified 10 µg/dL as the concentration level at which effects begin to occur that warrant avoidance and has set as a goal that there should be no more than a 5% chance that a child will have a blood lead value above 10 µg/dL (EPA 1994). The Centers for Disease Control (CDC) has identified 5 µg/dL as a "reference level" for blood lead in children[1] (CDC 2012). This concentration corresponds to the 97.5th percentile of blood lead levels in children in the U.S. The EPA is in the process of evaluating the CDC recommendations and implications for Superfund risk assessments. Until this assessment is complete, EPA recommends that lead risk assessments consider current scientific conclusions, which have shown adverse health effects at levels less than 10 µg/dL (EPA 2016). On this basis, this interim lead risk evaluation will employ a PbB threshold of 5 µg/dL. For convenience, the probability of a blood lead value exceeding 5 µg/dL is referred to as P5.

Although the PbB threshold is based on studies in young children, it is generally assumed that the same value is applicable to a fetus in utero. Available data suggest that the ratio of the blood lead level in a fetus to that of the mother is approximately 0.9 (Goyer 1990). Thus, the concentration of lead in blood in a pregnant female that would correspond to a PbB of 5 µg/dL in the fetus is:

$$PbB(mother) = 5\ \mu g/dL\ /\ 0.9 = 5.6\ \mu g/dL$$

3.0 Lead Exposure Models and Parameters

EPA recommends the use of toxicokinetic models to correlate blood lead concentrations with exposure and adverse health effects. EPA recommends the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate exposures from lead-contaminated media in children in a residential setting (EPA 1994) and the Adult Lead Methodology (ALM) to evaluate potential risks from lead exposure in adults (females of childbearing age) (EPA 2003a). Both the IEUBK model and the ALM can be used to predict blood lead concentrations in exposed individuals and estimate the probability of a blood lead concentration exceeding a level of concern as described below.

3.1 IEUBK Model

The IEUBK model developed by EPA predicts the likely range of blood lead levels in a population of young children (aged 0 to 84 months) exposed to a specified set of environmental lead levels (EPA 1994). This model requires as input data on the levels of lead in soil, dust, water, air, and diet at a location and on the amount of these media ingested or inhaled by a child living at that

[1] http://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm

location. For the purposes of this interim lead risk evaluation, soil is the site-specific source medium of primary interest for interim actions.

All inputs to the IEUBK model are central tendency point estimates. These point estimates are used to calculate an estimate of the central tendency (the geometric mean) of the distribution of blood lead values that might occur in a population of children exposed to the specified conditions. Assuming the distribution is lognormal, and given (as input) an estimate of the variability between different children (this is specified by the geometric standard deviation [GSD]), the model calculates the expected distribution of blood lead values and estimates the probability that any random child might have a blood lead value over the set target blood lead level (i.e., 5 µg/dL).

3.2 ALM

The ALM (EPA 2003a, 2009), based on the work of Bowers et al. (1994), predicts the blood lead level in a person with a site-related lead exposure by summing the baseline blood lead level (PbB0) (that which would occur in the absence of any site-related exposures) with the increment in blood lead that is expected as a result of increased exposure due to contact with a lead-contaminated exposure medium. The latter is estimated by multiplying the average daily absorbed dose of lead from site-related exposures by a biokinetic slope factor (BKSF). Thus, the basic equation for exposure to lead in soil is:

$$PbB = PbB0 + BKSF \cdot C_{soil,adj} \cdot IR_{soil} \cdot AF_{soil}$$

where:

PbB = Geometric mean blood lead concentration (µg/dL) in women of child-bearing age who are exposed to the site

PbB0 = Baseline geometric mean blood lead concentration (µg/dL) in women of child-bearing age in the absence of exposures to the site

BKSF = Biokinetic slope factor (µg/dL blood lead increase per microgram per day lead absorbed)

$C_{soil,adj}$ = Average lead concentration in soil expressed in units of micrograms per gram (µg/g), adjusted for the site-specific exposure frequency as described below in Section 3.3.2.

IR_{soil} = Intake rate of soil expressed in units of grams per day (g/day)

AF_{soil} = Absorption fraction of lead from soil (dimensionless)

As noted above, for the purposes of this interim lead risk evaluation, soil is the site-specific source medium of primary interest for interim actions; however, risks from all exposure media (soil, sediment, diet, water) will be evaluated as part of the Bonita Peak Mining District HHRA.

Once the geometric mean (GM) blood lead value in adult women who are exposed at the site is calculated, the full distribution of likely blood lead values in the population of exposed individuals can then be estimated by assuming the distribution is lognormal with a specified individual geometric standard deviation (GSD_i). The 95th percentile of the predicted distribution is given by the following equation (Aitchison and Brown 1957):

$$95^{th} = GM \cdot GSD_i^{1.645}$$

3.3 Evaluation of Intermittent Exposures

Both the IEUBK model and the ALM are designed to evaluate exposures that are approximately continuous (365 days per year). However, camper exposures are intermittent, occurring less than 365 days per year. When exposure is intermittent rather than continuous, the IEUBK model and ALM can still be used by adjusting the site-related exposure concentration that occurs during the exposure interval to a continuous exposure rate that yields the same total yearly exposure. However, this adjustment is reasonable only in cases where exposure occurs with a relatively constant frequency over a time interval long enough to establish an approximately steady-state response (EPA 2003b). Short-term exposures are not suitable for approximations as continuous exposures. To prevent applications of the lead models to exposure scenarios where an adjustment from intermittent to continuous exposure is not appropriate, EPA (2003b) recommends that these models only be applied to exposures that satisfy two criteria:

- The exposure frequency during the exposure interval is at least 1 day per week.
- The duration of the exposure interval is at least 3 consecutive months.

For the dispersed camper, the exposure frequency is based on the *Guidelines for the San Juan National Forest* (U.S. Forest Service [USFS] 2017). As stated in these guidelines, campers are permitted to camp in a National Forest for 14 days per month for 2 months. After they have been in the forest for 28 days, campers are to leave the National Forest. Thus, the maximum allowable camping time is 28 days per year. Lead risk assessments typically rely on central tendency exposure[2] (CTE) estimates. For the purposes of this interim lead risk evaluation, the exposure frequency was assumed to be one-half the maximum allowable time (14 days per year), with exposures occurring during consecutive summer months, for both the child camper and the older child/adult camper. Thus, this exposure frequency meets the minimum criteria specified in EPA (2003b).

Continuous exposures were determined such that they accounted for contributions from both impacted soil while on-site and unimpacted (background) media while off-site as described below.

3.3.1 IEUBK Model

For the IEUBK model, the average site soil lead concentration was adjusted by simulating a continuous exposure as follows:

$$C_{TWA} = [C_{site} \cdot EF_{site} + C_{bkg} \cdot (365\text{-}EF_{site})]/365$$

---

[2] CTE exposure estimates are intended to represent mean or median exposures for the population of interest (i.e., near the central portion of the range).

where:

C_{TWA} = Time-weighted average soil lead concentration (milligrams of lead per kilogram of soil [mg/kg])

C_{site} = Average soil lead concentration across the dispersed campsites (mg/kg)

EF_{site} = Exposure frequency at dispersed campsites (days/year)

C_{bkg} = Background soil lead concentration in uncontaminated medium (mg/kg)

3.3.2 ALM

The same general approach followed for the IEUBK model is followed for the ALM, excluding the contribution from background. This is because the PbB0 term used in the ALM is intended to represent background exposure to lead. Thus, the average site soil lead concentration was adjusted as follows:

$$C_{adj} = C_{site} \cdot (EF_{site}/365)$$

where:

C_{adj} = Adjusted average soil lead concentration (µg/g)

C_{site} = Average soil lead concentration across the dispersed campsites (µg/g)

EF_{site} = Exposure frequency at dispersed campsites (days/year)

3.4 IEUBK Model Inputs

Table B-1 presents the IEUBK input parameters used in this assessment. All model runs were performed using IEUBK Version 1.1, Build 11. All input parameters are set equal to EPA IEUBK defaults (EPA 1994), except as described below.

Soil Exposure Point Concentration

See Section 3.6 for a description of the exposure point concentration (EPC) for soil used in the IEUBK model.

Relative Bioavailability

The default value of relative bioavailability (RBA) for lead in soil and dust assumed by the IEUBK model is 0.60 (EPA 2007). Studies of lead RBA at a variety of mine sites suggests this is a typical value, but values at some sites may be higher or lower (EPA 2007). EPA measured the bioavailability of lead in several roadway and waste rock samples collected within the mining districts. The average site-specific RBA was 0.22, but RBA values were variable, ranging from 0 to 0.51, depending upon the sampling location (TechLaw, Inc. 2017). However, there are no measured RBA data for soils collected from camping areas within the mining districts. Therefore, the EPA default lead RBA value of 0.60 was assumed for this interim lead risk evaluation. This assumption is likely to be conservative as site-specific RBA measurements suggest that lead is in a form that is less readily absorbed. Based on a default absolute absorption fraction of 0.50 for lead in water and diet, this RBA corresponds to an absolute bioavailability of 0.30 (30%) to be used for soil and dust in the IEUBK model.

Target Blood Lead Level Threshold

As discussed previously in Section 2, this interim lead risk evaluation will employ a PbB threshold of 5 µg/dL. The goal is there should be no more than a 5% chance that a child will have a blood lead value above 5 µg/dL, which is referred to as P5.

Maternal Blood Lead

As recommended by EPA (2017a), the IEUBK default maternal blood lead concentration 1.0 µg/dL was changed to 0.8 µg/dL.

Intake Rates

The residential water intake rates, inhalation rates, dietary intake rates, and soil/dust intake rates were adjusted to be consistent with the values identified in the EPA Technical Review Workgroup (TRW) Lead Consultation for the Colorado Smelter Superfund Site (EPA 2017b). Because soil contact and intake during camping is higher than during typical residential exposures, camping-specific average soil intake rates were obtained from the *Exposure Factors Handbook* (EPA 2017c; Table 5-20). For the purposes of estimating exposures, a time-weighted soil intake rate, which included both the residential and camping-specific values, was calculated as follows:

$$IR_{TWA} = [IR_{camp} \cdot EF_{site} + IR_{res} \cdot (365\text{-}EF_{site})]/365$$

where:

IR_{TWA} = Time-weighted soil/dust intake rate

IR_{camp} = Camping-specific soil/dust intake rate[3]

EF_{site} = Exposure frequency at dispersed campsites (days/year)

IR_{bkgres} = Residential-specific soil/dust intake rate

Lead Drinking Water Concentration

As documented in the EPA TRW Lead Consultation for the Colorado Smelter Superfund Site (EPA 2017b), the default lead drinking water concentration was adjusted from 4 to 0.9 µg/L, based on the TRW re-analysis of the national drinking water system data reported to EPA.

Age Range

As recommended in EPA's *Recommendations for Default Age Range in the IEUBK Model* (EPA 2017d), the IEUBK default setting was adjusted to use an age range of 12 to 72 months rather than 0 to 84 months.

[3] Based on the average intake rate (as calculated from the geometric mean and standard deviation) across boys and girls. See also Table B-1 footnotes.

3.5 ALM Inputs

Lead risks for adult receptors (women of child-bearing age) were calculated using the ALM. **Table B-2** summarizes the ALM-specific input values used in this evaluation. Except for the absorption fraction, all values are EPA-recommended defaults. The EPA TRW recommendations for ALM (EPA 2003a) identify a default absorption fraction (AF) for soluble lead in soil of 0.20 but do not specify AF values for other media. As described above for the IEUBK model, the lead RBA for soil was assumed to be equal to the EPA default of 0.60. Based on this RBA, the AF for soil is:

$$AF(soil) = AF\ (soluble\ lead) \cdot RBA = 0.20 \cdot 0.60 = 0.12$$

See Section 3.6 for a description of the EPC for soil used in the ALM.

3.6 Concentration of Lead in Site Media

Camping area soil samples were collected using either a 30- or 5-point composite, depending on size of the area, from a depth of 0 to 2 inches with plastic scoops after breaking up the soil with a shovel. Samples were collected from 13 "dispersed" campsites[4] in designated backcountry areas located throughout the mining districts. **Table B-3** presents a summary of the lead soil concentrations for each dispersed campsite.

In accordance with EPA guidance (EPA 2000), when evaluating exposures from lead in soil, the soil size fraction of interest is the fine (250 micrometers [µm] or less) size fraction. However, most soil samples were not sieved prior to analysis; thus, sample results represent the bulk size fraction (2 millimeters [mm] or less). There were only three soil samples from camping areas that were sieved. These three samples indicate lead concentrations in the fine size fraction may be about 1.17 times higher than the bulk size fraction. Therefore, lead concentrations for the fine fraction were estimated based on measured bulk fraction concentrations using a camping area-specific fines enrichment factor of 1.17 as follows:

$$C_{soil,\ 250\ \mu m} = 1.17 \cdot C_{soil,\ 2\ mm}$$

where:

$C_{soil,\ 250\ \mu m}$ = Estimated lead concentration in soil for the fine (250 µm) fraction (mg/kg)

$C_{soil,\ 2\ mm}$ = Measured lead concentration in soil for the bulk (2 mm) fraction (mg/kg)

For the purposes of this lead evaluation, two exposure area scenarios were evaluated. The first scenario evaluated exposures based on the average concentration across all the dispersed campsites, which assumes a camper would frequent multiple dispersed campsites within the mining districts over the camping exposure time. Inspection of **Table B-3** shows there is considerable variability in soil lead concentrations across the 13 campsites, with fine fraction concentrations ranging from 86 to more than 51,000 mg/kg. Thus, the second scenario evaluated

[4] A "dispersed" campsite is an area that is suitable for camping or where camping is known to occur but may not be a formal campground. Soil from the USFS South Mineral Campground (CMP14) was not included in this evaluation because it will be evaluated as a different type of camping exposure area in the Bonita Peak Mining District HHRA.

exposures on a campsite-by-campsite basis, which assumes a camper spends all their camping exposure time at a single campsite location.

The basic time-weighted equations presented in Section 3.3 apply regardless of the scenario. For illustration, the time-weighted soil concentration (for the fine size fraction) used in the IEUBK model based on the mean concentration across all dispersed campsites is presented in **Table B-1** and was calculated as follows:

C_{TWA} = [6,399 mg/kg · 14 days/year + 100 mg/kg · 351 days/year] / 365 days/year = 342 mg/kg

Likewise, the adjusted soil concentration used in the ALM based on the mean concentration across all dispersed campsites is presented in **Table B-2** and was calculated as:

C_{adj} = [6,399 mg/kg · 14 days/year] / 365 days/year = 245 mg/kg

Upland reference areas, located upgradient of the contamination sources in the mining districts, were sampled using composite sampling (as 15-point composites). Only natural, undeveloped areas not likely to be impacted by roads and other anthropogenic features that could be sources of contamination were selected. A range of different upland vegetation communities, consisting of sub-alpine forests and meadows and alpine meadows, were sampled. In total, 17 samples were collected from four unique upland areas (two areas within the Upper Animas River watershed[5] and two areas within the Mineral Creek watershed[6]) (TechLaw, Inc. 2018). The background soil concentration of lead used in this evaluation was 100 mg/kg, which is approximately the 95% upper confidence limit on the mean concentration across all the upland reference soil samples.

As noted previously, the focus of this interim lead risk evaluation is on exposures from soil. The contribution of lead exposures from other media (e.g., diet, sediment, surface water) at the dispersed campsites is likely to be much lower than from soil. Risks from all exposure media will be evaluated as part of the Bonita Peak Mining District HHRA.

4.0 Results

4.1 Risk Estimates

Potential risks from lead exposures for campers in the dispersed camping areas in the mining districts are shown in **Table B-4** (Panel A) (for young children) and **Table B-5** (for fetuses of pregnant women).

There is a 20% probability that PbB levels in young children will exceed 5 µg/dL (see **Table B-4**, Panel A) based on the average across all dispersed campsites, which is above the selected health-based goal (P5 ≤ 5%). The campsite-specific evaluation shows there are four campsites where P5 is greater than 5%, including Campgrounds 2, 3, 4, and 7.

There is only 3% probability that PbB levels in fetuses will exceed 5 µg/dL (see **Table B-5**) based on the average across all dispersed campsites, which is below the health-based goal. However, the

[5] Collected near Clipper Mine and near Frisco/Bagley Tunnel
[6] Collected near Koehler Tunnel and near Bandora Mine

campsite-specific evaluation shows two campsites, Campgrounds 4 and 7, as having P5 greater than 5%.

4.2 Derivation of Interim Risk-Based Level

The primary risk driver for lead exposures is the child camper exposure scenario (as evidenced by the fact the predicted P5 values are higher based on IEUBK than ALM). Thus, an interim risk-based human health preliminary remediation goal (PRG) was calculated to ensure that post-remedial exposure conditions would result in a P5 ≤ 5% as determined based on IEUBK.

Recall the EPC used in the IEUBK model is a time-weighted soil lead concentration (C_{TWA}) that accounts for both site and background exposure. Using the IEUBK input parameters specified in Section 3.4, the C_{TWA} PRG must be 176 mg/kg or lower to achieve the target PbB of 5 µg/dL. The corresponding C_{site} concentration is calculated by re-arranging the equation shown in Section 3.3.1 to solve for C_{site} while setting C_{TWA} equal to 176 mg/kg and C_{bkg} equal to 100 mg/kg:

$$C_{site} = [(C_{TWA} * 365) – (C_{bkg} * (365 – EF_{site}))] / EF_{site}$$

where:

C_{site} = Average lead PRG across the dispersed campsites (mg/kg)

C_{TWA} = Time-weighted average soil lead PRG (176 mg/kg)

C_{bkg} = Background soil lead concentration (100 mg/kg)

EF_{site} = Exposure frequency at dispersed campsites (14 days/year)

Based on this calculation, to achieve the target PbB of 5 µg/dL, C_{site} must be 2,081 mg/kg or lower. As illustrated in Panel B of **Table B-4**, if C_{site} is 2,081 mg/kg, the time-weighted EPC (C_{TWA}) is 176 mg/kg and the resulting P5 is 5%. Therefore, the interim human health risk-based level for lead in soil at the dispersed campsites is 2,081 mg/kg. This risk-based level is based on the fine fraction (250 µm); the corresponding soil lead risk-based level based on the bulk fraction (2 mm) is 1,779 mg/kg. Inspection of **Table B-1** shows Campgrounds 2, 3, 4, and 7 have soil lead concentrations above this interim risk-based level.

However, this risk-based level is based on an assumed default lead RBA of 0.6. As discussed above, even though there are no data on site-specific RBA levels in the camping areas, EPA has measured the bioavailability of lead in several roadway and waste rock samples. The average site-specific RBA was 0.22, which suggests that lead in the mining districts is in a form that is less readily absorbed. As illustrated in Panel B of **Table B-4**, if the actual RBA in the camping areas is closer to 0.2, the risk-based level would be 11,598 mg/kg based on the fine fraction (250 µm). Inspection of **Table B-1** shows only Campgrounds 4 and 7 have soil lead concentrations above the risk-based level based on an RBA of 0.2.

Note these risk-based levels apply to the average soil lead concentration across an entire campsite exposure area; it is not to be applied to individual samples within the campsite as a not-to-exceed value.

5.0 Conclusion

Potential risks from lead exposures for campers in the dispersed camping areas in the mining districts are above the selected health-based goal (P5 ≤ 5%). Unacceptable lead exposures are primarily attributable to elevated soil lead concentrations at four dispersed campsites — Campgrounds 2, 3, 4, and 7.

For Campgrounds 2 and 3, the need for remedial action depends upon the site-specific RBA of lead in soil. If the lead RBA is near the default (0.6), remedial action would be needed; if the lead RBA is closer to the levels measured in roadway/waste rock samples (0.2), remedial action would not be needed. On this basis, it is recommended that any decisions regarding actions at these two campsites be delayed until site-specific measurements of RBA at the campsites can be completed.

For Campgrounds 4 and 7, the soil lead levels exceed the health-based goals for both children and fetuses. In addition, P5 is expected to be greater than 5% at these two campsites, even if RBA were assumed to be similar to levels measured in roadway/waste rock samples (0.2). On this basis, it is recommended these two campsites be included for interim actions in 2018.

The interim risk-based levels for lead presented in this appendix is to be considered preliminary for consideration in risk management decision-making in support of interim remedial actions within the mining districts in 2018. The need for additional remediation will be determined after the completion of the Bonita Peak Mining District HHRA.

6.0 References

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TABLE B-1
IEUBK INPUT PARAMETERS
Focused Feasibility Study, Bonita Peak Mining District

Panel A. Age-Independent Values

Parameter		Value	Basis
Soil concentration (mg/kg)	site	6,399	Mean across all dispersed campsites (see Table B-1)
	background	100	Assumed based on site-specific upland reference [a]
	time-weighted	342	Time-weight adjusted [b]
Drinking water concentration (µg/L)		0.9	EPA (2017d)
Indoor dust concentration		249.4	Cdust = (0.7 x Csoil) + (100 x Cair,out) (IEUBK default; EPA 1994)
Outdoor air concentration (µg/m^3)		0.1	IEUBK default (OSWER 9285.7-22; EPA 1994)
Indoor air concentration (µg/m^3)		30% of outdoor	IEUBK default (OSWER 9285.7-22; EPA 1994)
Exposure frequency [EF] (days/year)		14	USFS (2017); one-half maximum allowable time
Absorption fraction [AF] (water)		0.50	IEUBK default (OSWER 9285.7-22; EPA 1994)
Absorption fraction [AF] (diet)		0.50	IEUBK default (OSWER 9285.7-22; EPA 1994)
Relative bioavailability [RBA] (soil)		0.60	EPA default (OSWER 9285.7-80; EPA 2007)
Absorption fraction [AF] (soil,dust)		0.30	AF(soil) = AF(water) x RBA(soil)
Absorption fraction [AF] (air)		0.32	IEUBK default (OSWER 9285.7-22; EPA 1994)
Fraction of soil + dust that is soil		0.45	IEUBK default (OSWER 9285.7-22; EPA 1994)
Geometric standard deviation [GSD]		1.6	IEUBK default (OSWER 9285.7-22; EPA 1994)
Maternal PbB concentration (µg/dL)		0.8	EPA default (OLEM 9285.6-56; EPA 2017a)
Target PbB concentration (µg/dL)		5.0	CDC (2012); professional judgment

Panel B. Age-Dependent Values

Age	Air [c]		Diet [c]	Water [c]	Soil and Dust		
	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Dietary Intake (µg lead/day)	Water Intake (L/day)	Residential Intake Rate (g/day) [c]	Campground Intake Rate [d] (g/day)	Time-weighted Intake Rate [e] (g/day)
0-12 mo (0-1 yrs)	1.0	3.22	2.66	0.40	0.086	0.38 f	0.097
12-24 mos (1-2 yrs)	2.0	4.97	5.03	0.43	0.094	0.38	0.105
24-36 mos (2-3 yrs)	3.0	6.09	5.21	0.51	0.067	0.43	0.081
36-48 mos (3-4 yrs)	4.0	6.95	5.58	0.54	0.063	0.16	0.067
48-60 mos (4-5 yrs)	4.0	7.68	5.64	0.57	0.067	0.16	0.071
60-72 mos (5-6 yrs)	4.0	8.32	6.04	0.6	0.052	0.20 g	0.058
72-84 mo (6-7 yrs)	4.0	8.89	5.95	0.63	0.055	0.20 g	0.061

Notes:
[a] Based on 95% upper confidence limit on the mean concentration for the site-specific upland reference dataset.
[b] C(adjusted) = C(site) · (EF/365) + C(background) · ((365-EF)/365)
[c] Values are based on Colorado Smelter Lead Consultation letter (EPA 2017b)
[d] Values are based on campground-specific soil intake rates from *Exposure Factors Handbook* (EPA 2017c), Table 5-20 (averaged across girls and boys). Arithmetic mean calculated from geometric mean (GM) and geometric standard deviation (GSD) as: GM * EXP(0.5 * LN(GSD)^2).
[e] IR(adjusted) = IR(campground) · (EF/365) + IR(residential) · ((365-EF)/365)
[f] No values for 0-1 years provided; assumed to be equal to 1-2 years intake rate.
[g] No values for >5 years provided; assumed to be equal to intake rate across all age groups.

µg lead/day = micrograms of lead per day
µg/dL = micrograms of lead per deciliter of blood
µg/L = micrograms per liter of water
µg/m^3 = micrograms per cubic meter of air
CDC = Centers for Disease Control
Cdust = dust concentration
Csoil = soil concentration
EPA = U.S. Environmental Protection Agency
g/day = grams of soil per day
IEUBK = Integrated Exposure Uptake Biokinetic
L/day = liters of water per day
m^3/day = cubic meters of air per day
mg/kg = milligrams of lead per kilogram of soil (or dust)
OSWER = Office of Solid Waste and Emergency Response
PbB = blood lead
USFS = U.S. Forest Service

TABLE B-2
ADULT LEAD MODEL INPUT PARAMETERS
Focused Feasibility Study, Bonita Peak Mining District

Parameter	Units	Value	Source	Notes
Baseline geomean PbB [PbB0]	µg/dL	0.6	NHANES 2009-2014	
Biokinetic slope factor [BKSF]	µg/dL per µg/day	0.4	EPA (2003a)	EPA ALM default
Ratio	--	0.9	EPA (2003a)	EPA ALM default
Target PbB (fetus)	µg/dL	5.0	CDC (2012)	Professional judgement
Target PbB (mother)	µg/dL	5.6	Calculated	Target PbB (fetus) / Ratio
Geometric std. deviation [GSD]	--	1.8	NHANES 2009-2014	
Exposure Frequency [EF]	days/year	14	USFS (2017)	One-half maximum allowable time
Soil Concentration:				
site	µg/g	6,399	Site-specific (see Table B-1)	Mean across all dispersed campsites
adjusted	µg/g	245	Exposure frequency adjusted	Csite * EF / 365 days/year
Soil Ingestion Rate [IRsoil]	g/day	0.1	Professional judgment	CTE exposure parameter
Soil relative bioavailability [RBAsoil]	--	0.60	EPA (2007)	EPA ALM default
Soil absorption fraction [AFsoil]	--	0.12	Calculated; EPA (2003a)	0.2 (default) * 0.6 (RBAsoil)

Basic Equations:

PbB(mother) = PbB0 + BKSF * Csoil,adj * IRsoil *AFsoil

PbB(fetus) = PbB(mother) * Ratio

µg/d = micrograms of lead per day
µg/dL = micrograms of lead per deciliter of blood
µg/g = micrograms of lead per gram of soil
ALM = Adult Lead Methodology
C = concentration
CDC = Centers for Disease Control
CTE = central tendency exposure
days/year = days per year
EPA = U.S. Environmental Protection Agency
g/day = grams of soil per day
NHANES = National Health and Nutrition Examination Survey
PbB = blood lead
USFS = U.S. Forest Service

TABLE B-3

SOIL LEAD CONCENTRATIONS IN DISPERSED CAMPSITES

Focused Feasibility Study, Bonita Peak Mining District

Dispersed Campsite ID	Sample ID	Sample Date	Soil Lead Conc. (mg/kg)		
			2 mm	250 µm	
CMP2	MH1E13	7/26/2016	2,880	3,370	[a]
CMP3	A8M5-4732	9/27/2017	7,260	8,494	[a]
CMP4	MH1E14	7/26/2016	44,200	51,714	[a]
CMP5	MH1E15	7/26/2016	200	234	[a]
CMP7	MH1E16	7/26/2016	11,800	13,806	[a]
CMP8	A8M5-4733	9/27/2017	1,320	1,544	[a]
CMP9	MH1E17	7/27/2016	1,330	1,556	[a]
CMP10	MH1E18	7/27/2016	74	86	[a]
CMP11	MH1E19	7/28/2016	431	480	[b]
CMP12	MH1E21	7/27/2016	257	276	[b]
CMP13	MH1E23	7/28/2016	100	117	[a]
CMP15	MH1E26	7/28/2016	530	620	[a]
CMP15A	MH1L12	9/28/2016	761	890	[a]
			mean:	**6,399**	

[a] Estimated based on camping area-specific fines enrichment factor of 1.17:

$$C_{soil,\ 250\text{-}\mu m} = 1.17 \cdot C_{soil,\ 2\text{-}mm}$$

[b] Measured

µm = micrometers
Conc. = concentration
ID = identification
mg/kg = milligrams per kilogram soil
mm = millimeters

TABLE B-4

EVALUATION OF RISK FROM LEAD USING THE IEUBK MODEL

Focused Feasibility Study, Bonita Peak Mining District

Panel A. Exposure at Dispersed Campsites

Exposure Location	Soil Lead Concentration (mg/kg)			P5 (% Above Target Blood Lead of 5 µg/dL)
	Site	Bkg	Time-weighted EPC[a]	
Dispersed Campsites - all	6,399	100	342	20%
CMP2	3,370	100	225	9%
CMP3	8,494	100	422	29%
CMP4	51,714	100	2,080	97%
CMP5	234	100	105	2%
CMP7	13,806	100	626	52%
CMP8	1,544	100	155	4%
CMP9	1,556	100	156	4%
CMP10	86	100	99	1%
CMP11	480	100	115	2%
CMP12	276	100	107	2%
CMP13	117	100	101	1%
CMP15	620	100	120	2%
CMP15A	890	100	130	3%

(shaded) greater than 5%

Panel B. Derivation of Risk-based Cleanup Level

Exposure Location (RBA)	Soil Lead Concentration (mg/kg)			P5 (% Above Target Blood Lead of 5 µg/dL)
	Site	Bkg	Time-weighted EPC[a]	
Camping Area (RBA=0.6)	**2,081**	100	176	5.0%
Camping Area (RBA=0.2)	**11,598**	100	541	5.0%

↑ **risk-based level for site**

Notes:

[a] C(adjusted) = C(site) · (EF/365) + C(bkg) · ((365-EF)/365)

% = percent

µg/dL = micrograms per deciliter

C(bkg) = soil lead concentration for background

C(site) = soil lead concentration for the site

EF = exposure frequency (days per year)

EPC = exposure point concentration

IEUBK = Integrated Exposure Uptake Biokinetic

mg/kg = milligrams lead per kilogram soil

RBA = relative bioavailability

TABLE B-5
ADULT LEAD MODEL OUTPUT
Focused Feasibility Study, Bonita Peak Mining District

Exposure Location	Csoil, site	Absorbed dose from soil	GM PbB (mother)	mu [ln(GM PbB mother)]	sigma [ln(GSD)]	P5 (fetus)
	µg/g	µg/day	µg/dL			%
Dispersed Campsites - all	6,399	2.95	1.8	0.58	0.59	3%
CMP2	3,370	1.55	1.2	0.20	0.59	<0.01%
CMP3	8,494	3.91	2.2	0.77	0.59	5%
CMP4	51,714	23.80	10.1	2.31	0.59	85%
CMP5	234	0.11	0.6	-0.44	0.59	<0.01%
CMP7	13,806	6.35	3.1	1.14	0.59	17%
CMP8	1,544	0.71	0.9	-0.12	0.59	<0.01%
CMP9	1,556	0.72	0.9	-0.12	0.59	<0.01%
CMP10	86	0.04	0.6	-0.48	0.59	<0.01%
CMP11	480	0.22	0.7	-0.37	0.59	<0.01%
CMP12	276	0.13	0.7	-0.43	0.59	<0.01%
CMP13	117	0.05	0.6	-0.48	0.59	<0.01%
CMP15	620	0.29	0.7	-0.34	0.59	<0.01%
CMP15A	890	0.41	0.8	-0.27	0.59	<0.01%

greater than 5%

% = percent
µg/day = micrograms of lead per day
µg/dL = micrograms of lead per deciliter of blood
µg/g = micrograms of lead per gram of soil
Csoil, site = soil lead concentration for the site
GM = geometric mean
GSD = geometric standard deviation
PbB = blood lead

Appendix B – Part 1.2

Human Health Acute Arsenic Screening Levels

CDM Smith

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Appendix B – Part 1.2

Human Health Acute Arsenic Screening Levels

1.0 Introduction

This appendix describes an interim evaluation of potential arsenic risks from exposures to arsenic in soil/waste rock at the Bonita Peak Mining District Superfund Site (Site) located in southwestern Colorado. The Site consists of 48 historic mines or mining-related sources where ongoing releases of metal-laden water and sediments are occurring within the Mineral Creek, Cement Creek, and Upper Animas River drainages in San Juan County, Colorado. Drainages within the Site contain over 400 abandoned or inactive mines where large- to small-scale mining operations occurred. San Juan County is comprised of 10 historic mining districts (Colorado Geological Survey 2017). Historic mining districts within the Mineral Creek, Cement Creek, and Upper Animas River drainages (referred to as "the mining districts" in this appendix) include Animas, Animas Forks, Cement Creek, Eureka, Ice Lake Basin, and Mineral Point.

Acute screening levels have been developed for consideration in the identification of areas that may warrant interim remedial actions in 2018. These levels are to be considered preliminary and subject to change pending completion of the Bonita Peak Mining District human health risk assessment (HHRA).

Arsenic was selected for evaluation because soil concentrations are notably elevated at several locations within the mining districts and arsenic is often an important human health risk driver for mining-related contamination. The camping scenario was selected for the derivation of acute screening levels because the camper is anticipated to be the most sedentary of receptors (i.e., not moving about being exposed to a variety of soil/mine waste sources, in contrast with hiker, hunter, fisherman, all-terrain vehicle rider/guide, and road worker receptors). Derivation of screening levels for a sedentary receptor allows for the application of these screening levels to smaller exposure areas, such as individual campgrounds.

In addition, focus was placed on exposures to children because children are often more vulnerable to pollutants than adults due to differences in behavior and biology that can lead to greater exposure and/or unique windows of susceptibility during development. Additionally, soil ingestion rates for young children are higher than adults due to increased frequency of contact through hand-to-mouth or object-to-mouth activity. Thus, exposure parameters used in the derivation of the acute screening levels were tailored for children 1 to 3 years old depending on the exposure scenario. Three exposure scenarios for a child that may camp within the mining districts were evaluated:

- Scenario 1: Child, based on central tendency exposure (CTE) residential soil intake rates identified in the EPA Technical Review Workgroup (TRW) Lead Consultation for the Colorado Smelter Superfund Site (EPA 2017a)

- Scenario 2: Child, based on CTE soil intake rates specific to a camping exposure scenario (EPA 2017b)

- Scenario 3: Child, based on reasonable maximum exposure (RME) soil intake rates specific to a camping exposure scenario (EPA 2017b)

Potential risks to a variety of recreational and occupational receptor populations from all contaminants of interest and all exposure media and pathways will be evaluated as part of the Bonita Peak Mining District HHRA.

2.0 Derivation of Acute Screening Levels

As noted above, acute screening levels have been developed for multiple exposure scenarios resulting in a range of acute screening levels for consideration in risk management decision-making. The sections below present the approach and assumptions used in the derivation of the acute screening levels for arsenic for application to soil/waste rock.

Acute screening levels were developed based on exposure durations of 2 days and 14 days. An exposure duration of 2 days represents a camping duration of a weekend, while 14 days represents the maximum allowable time that may be spent camping in one location in the National Forest (U.S. Forest Service [USFS] 2017).

2.1 Toxicity Data

Acute toxicity information is generally lacking for arsenic, and acute arsenic screening levels specific to the type of receptors present within the mining districts (i.e., recreational visitors) are not available. A review of *Toxicological Profile for Arsenic* developed by the Agency for Toxic Substances and Disease Registry (ATSDR) reveals oral doses as low as 0.02 to 0.06 milligrams of arsenic per kilogram body weight per day (mg/kg BW/day) have been reported to cause toxic effects in some individuals (ATSDR 1989). Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6 mg/kg BW/day (ATSDR 1989).

Washington State Department of Health (WSDOH) provides a synopsis of published scientific information related to soil exposure and acute toxicity in *Hazards of Short-term Exposure to Arsenic Contaminated Soil* (WSDOH 1999). The most sensitive reported indicators of acute toxicity appear to be edema, conjunctivitis, liver enlargement, irritation of the mucous membranes, and gastrointestinal problems, such as vomiting, diarrhea, cramps, and pain. Transient adverse health effects commonly occur when doses between 0.035 and 0.071 milligrams of arsenic per kilogram of body weight (mg/kg BW) are ingested. The best estimate of an acute threshold for transient effects is 0.05 mg/kg BW.

Using the acute transient effect dose information, acute arsenic screening levels can be derived for each of the three exposure scenarios. The equation used to derive the acute screening levels is as follows:

$$ASL_{As} = (ATE / SF) / (IR / CF_{IR} / BW \cdot ED \cdot RBA)$$

where:

ASL_{As} = Acute screening level for arsenic (mg/kg soil)

ATE = Acute transient effect (mg/kg BW)

SF = Toxicity safety factor (unitless)

IR = Soil intake rate (g soil/day)

CF_{IR} = Conversion factor for intake rate, convert g to kg

BW = Body weight (kg BW)

ED = Exposure duration (days)

RBA = Relative bioavailability

2.2 Exposure Data

Table B-1 presents the general input parameters used to derive the acute screening levels for arsenic, recognizing that several of the assumptions may differ from those typically used in an evaluation of chronic exposures.

Table B-1. General Parameters Used to Calculate the Acute Arsenic Screening Levels

Parameter	Value	Source
Receptor gender	Female	EPA 2008 (Table 8-10)
Acute transient effect dose (mg arsenic/kg body weight)	0.05	WSDOH 1999
Toxicity safety factor (unitless)	10	WSDOH 1999
RBA	0.1	TechLaw (2017)

mg– milligrams
kg – kilograms
RBA – relative bioavailability

The rationale for the selection of each input provided in **Table B-1** is presented below:

- Receptor gender – A female receptor was selected because female children have a lower body weight than male children (EPA 2008). A receptor with a lower body weight is more sensitive to exposure compared to a receptor with a higher body weight.

- Acute transient effect dose – The best estimate acute transient effect dose was selected to represent the dose at which edema, conjunctivitis, liver enlargement, irritation of the mucous membranes, and/or gastrointestinal problems (vomiting, diarrhea, cramps, and pain) may occur (WSDOH 1999).

- Toxicity safety factor – A no-effect level is typically estimated by dividing the dose observed to cause health effects by a safety factor. There is little scientific information available to guide the selection of a safety factor for short-term exposure to arsenic in soil. The selection must be based on judgement of the margin of safety desired for protection from the potential adverse consequences of this type of event. For the three scenarios, a safety factor of 10, to derive a no-effect level from an acute effect level, was considered adequate to calculate soil arsenic concentrations protective of human health. This choice was based on consideration of documented variability in human sensitivity to the toxic effects of arsenic as well as consideration of likelihood of occurrence of the various scenarios (WSDOH 1999).

- RBA – Arsenic RBA was determined by measuring *in vitro* bioaccessability for roadway and waste rock samples collected within the mining districts. The mean estimate of RBA for arsenic was 0.06, with values ranging from 0.03 to 0.11 (TechLaw, Inc. 2017). There was little difference in mean RBA between these two media types (0.08 for roadway samples and 0.05 for waste rock samples). To simplify this evaluation and to be conservative, an RBA of 0.1 was selected for use in the calculations. The implications of this simplifying assumption are discussed further below.

Table B-2 presents the scenario-specific input parameters used to derive the acute screening level for arsenic.

Table B-2. Scenario-Specific Parameters Used to Calculate the Acute Arsenic Screening Levels

Parameter	Scenario 1 CTE Resident	Scenario 2 CTE Camping	Scenario 3 RME Camping	Source
Soil intake rate during exposure (g soil/day)	0.094	0.367	1.592	Scenario 1: EPA 2017a Scenario 2 & 3: EPA 2017b (Table 5-20)
Receptor age at exposure	1 year old	2 years old	2 years old	EPA 2017b (Table 5-20)
Receptor body weight (kg)	11.0	12.5	12.5	EPA 2008 (Table 8-10)

CTE – central tendency exposure
g – grams
kg – kilograms
RME – reasonable maximum exposure

The rationale for the selection of each input provided in **Table B-2** is presented below:

- Soil intake rate during exposure – Multiple soil intake rates were selected for use to present a range of acute screening levels. In each case, the most conservative soil intake rate available for each scenario was selected so that the most sensitive receptor was used in the model.

    - Scenario 1 – The soil intake rate selected for a CTE resident was 0.094 grams per day (g/day). This value was selected because it is the highest mean intake rate provided in the EPA TRW Lead Consultation for the Colorado Smelter Superfund Site (EPA 2017a) for children under the age of 6 years. This value corresponds to a 1-year-old to 2-year-old receptor.

    - Scenario 2 – The soil intake rate selected for a CTE child while camping was 0.367 g/day because this is the highest geometric mean intake rate provided in the *Exposure Factors Handbook* (EPA 2017b, Table 5-20). This value corresponds to a 2-year-old to 3-year-old girl. The study upon which this value is based evaluated soil intake using a tracer element methodology for 78 children aged 1 to 5 years old at campgrounds (Van Wijnen et al. 1990).

- Scenario 3 – The soil intake rate selected for an RME child while camping was 1.592 g/day because this is the 95th percentile (computed using the reported geomean and geometric standard deviation) for the intake rates provided for the 2-year-old to 3-year-old girl (EPA 2017, Table 5-20).

- Receptor age at exposure – The age at exposure was a 1 year old for Scenario 1, and 2 years old for Scenarios 2 and 3.

- Receptor body weight – The receptor body weight was selected to correlate to the age and gender of the receptor. The mean female body weights for a 1-year old and 2-year old were selected (EPA 2008, Table 8-10).

2.3 Screening Levels

Table B-3 presents the acute screening levels for arsenic based on a 2-day and 14-day exposure to soil/waste rock that were derived based on the inputs provided in the tables above and for the scenarios that have been described.

Table B-3. Acute Arsenic Screening Levels (mg/kg)

Scenario	2-Day Exposure	14-Day Exposure
Scenario 1	2,926	418
Scenario 2	851	122
Scenario 3	196	28

mg/kg – milligrams per kilogram

Table B-4 presents a comparison of the acute arsenic screening levels with varying RBA values (0.1 versus 0.06) to demonstrate the change in the screening level if a lower RBA value were used. As seen, the change in screening level is inversely proportional to the change in RBA; decreasing the RBA by a factor of 1.7 increases the screening level by 1.7.

Table B-4. Effect of Using a Different RBA Value on Acute Arsenic Screening Levels (mg/kg)

Scenario	2-Day Exposure		14-Day Exposure	
	RBA = 0.1	RBA = 0.06	RBA = 0.1	RBA = 0.06
Scenario 1	2,926	4,876	418	697
Scenario 2	851	1,419	122	203
Scenario 3	196	327	28	47

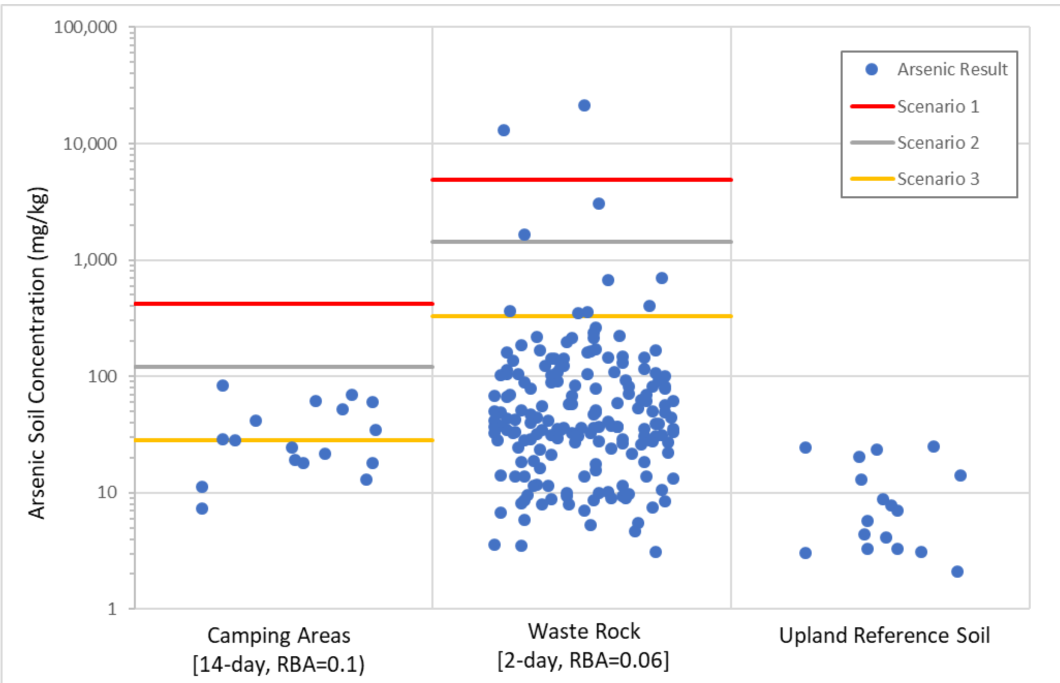
mg/kg – milligrams per kilogram
RBA – relative bioavailability

3.0 Conclusions

A range of screening levels have been provided based on the understanding there may be differences in the applicable exposure scenario depending upon the type of location being evaluated. When identifying potential locations where interim actions may be needed, the appropriate screening level (i.e., 14-day versus 2-day) will depend upon the type and duration of exposure that may reasonably be anticipated to occur at the location of interest. For example, the 14-day screening level should be used when evaluating established campgrounds and areas where extended camping may occur (e.g., the dispersed campsites), whereas the 2-day screening level should be used when evaluating other types of potential recreational use areas. When evaluating locations, such as the camping areas, where site-specific RBA data are not available, assuming a higher RBA of 0.1 is most appropriate; however, when evaluating locations where site-specific RBA data are applicable, such as the waste rock areas, use of the average RBA of 0.06 is most appropriate.

Figure B-1 illustrates a comparison of measured soil/waste rock arsenic concentrations to the acute screening levels for Scenarios 1, 2, and 3. For reference, measured concentrations from upland reference locations are also shown. The site-specific upland reference soil dataset includes 17 samples collected from natural, undeveloped areas within the mining districts not likely to be impacted by roads and other anthropogenic features that could be sources of contamination.

Figure B-1. Comparison of Soil/Waste Rock Arsenic Concentrations to Acute Screening Levels



Screening Levels:
Scenario 1 = Residential CTE soil intake rates
Scenario 2 = Camping-specific CTE soil intake rates
Scenario 3 = Camping-specific RME soil intake rates

CTE = central tendency exposure
mg/kg = milligrams per kilogram
RBA = relative bioavailability
RME = reasonable maximum exposure

Scenarios 2 and 3 employ camping-specific intake rates, which are likely to be more applicable to the recreational scenarios of interest within the mining districts. Thus, these scenarios were selected in preference to Scenario 1. For the purposes of this evaluation, Scenario 2 (based on CTE intake rates) was selected in preference to Scenario 3 (based on RME intake rates). This is because this focused evaluation is seeking to address those areas where exposures may be greatest, even for those individuals with "typical" intake rates. In addition, it appears the 14-day screening levels for Scenario 3 may be overly conservative in consideration of local background levels of arsenic. Inspection of the site-specific upland reference soil dataset shows background arsenic soil concentrations ranges from about 2 to 26 mg/kg (mean of 11 mg/kg) (TechLaw, Inc. 2018), whereas the 14-day Scenario 3 screening level is 28 mg/kg. It is not expected that naturally occurring levels of arsenic would approach an acutely toxic threshold based on a short-term exposure scenario. On this basis, it is recommended interim action determinations be based on the Scenario 2 screening levels.

When soil/waste rock arsenic concentrations are compared to Scenario 2 screening levels (see grey line series in **Figure B-1**), there are no camping area samples that are above the 14-day level (122 mg/kg at RBA of 0.1), but there are several samples from waste rock areas above the 2-day level (1,419 mg/kg at RBA of 0.06). Indeed, there are three locations – Koehler Tunnel, Junction Mine, and Longfellow Mine – where arsenic concentrations in waste rock are higher than 1,000 mg/kg.

The acute screening levels for arsenic presented in this appendix are to be considered preliminary for consideration in risk management decision-making in support of interim remedial actions within the mining districts in 2018. The need for additional remediation will be determined after the completion of the Bonita Peak Mining District HHRA.

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Appendix B – Part 2

Ecological Risk Technical Memorandum

CDM Smith

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05/11/18

To: Rebecca Thomas, Remedial Project Manager, USEPA Region 8
From: Andrew Todd, PhD, Aquatic Toxicologist, USEPA Region 8

Subject: Ecological Risk Technical Memorandum- Proposed Interim Remedial Actions in the Bonita Peak Mining District

Rebecca,

Per your request, this technical memorandum was drafted to summarize the potential for reduction of ecological risk associated with the Interim Remedial Action proposed to take place within the Bonita Peak Mining District ("Site") Superfund Site in San Juan County, Colorado. In the following analysis, I have considered these proposed actions through the lens of their role in contributing to ecological risk within the Site. Of note, because the terrestrial ecological risk assessment for the Site is currently in the early stages of development, this memorandum will focus on the potential for reduction of aquatic ecological risk through the proposed Interim Remedial Action.

<u>Background</u>

The Animas River and many of its tributaries have high concentrations of inorganic contamination in the surface water and sediment originating both from legacy mining-related sources as well as from natural sources not directly attributable to mining. Elevated metals concentrations in surface waters and sediments can pose significant risk to potentially resident aquatic organisms through a variety of mechanisms, including through both acute and chronic toxicity.

Past efforts to assess existing risk to aquatic ecosystems within the Animas River watershed are documented in the Draft Baseline Ecological Risk Assessment ("Draft BERA") for the Upper Animas Mining District (USEPA 2015). The spatial scope of that investigation considered the mainstems of the Animas River, Cement Creek, and Mineral Creek near their respective confluences in the town of Silverton, as well as the Animas River from Silverton downstream to Baker's Bridge north of Durango.

The Draft BERA evaluated several lines of evidence in quantifying ecological risk to the Animas River, including:

- Comparison of metal concentrations measured in site environmental media (surface water, sediment, pore water) to known toxicity thresholds
- Toxicity testing exposing aquatic organisms within a controlled laboratory environment to site environmental media
- Assessment of aquatic community characteristics in the field [e.g. quantifying fish and benthic macroinvertebrate (BMI) populations and locations]

The Draft BERA reached several conclusions regarding mining-related risk to the aquatic ecosystems in the Animas River watershed. Initially, all lines of evidence indicated that benthic macroinvertebrate communities are currently impaired in most of the reaches of the Animas River that were evaluated. Similarly, the Draft BERA concluded that fish communities in the evaluated reaches of the Animas River, Cement Creek, and Mineral Creek are either non-existent or highly stressed due to high metals concentrations.

For the sake of simplification, in considering how the proposed Interim Remedial Action will affect aquatic ecological risk within the Animas River and tributaries, this memorandum will focus primarily on fish. As noted above, BMI communities in most reaches of the Animas are currently at risk as well. However, because many of the factors limiting these BMI communities are similar to those limiting fish communities (e.g. acute and chronic toxicity of metals), it is expected that the instream BMI communities would respond in a similar fashion as fish to reductions in metal loading.

Known Fisheries in the upper Animas River and Tributaries

Routine fish sampling has been conducted by Colorado Parks and Wildlife ("CPW") within the Animas River below its confluence with Mineral Creek and downstream to the city of Durango. In the reach immediately below Silverton, CPW has three sampling locations (A-72, Elk Park, and Teft Spur), collectively referred to as Animas River #3. CPW has an additional long-term fishery sampling site on the Animas River at Howardsville (Animas River #4). **Figure 1** illustrates inter-annual trends of the brook trout fishery in the Animas River at Howardsville and the three sites immediately below Silverton.

At CPW's Howardsville site, densities of brook trout at this location have fluctuated over the years, but have remained relatively stable over the past two decades (1998, 2005, 2010, 2014, and 2015 sampling events) (**Figure 1**). The water quality at this site reflects metal loading from upper Animas sources, including proposed Interim Remedial Action locations in the Burrows Gulch, Animas Forks, and Eureka areas.

CPW's A-72 site is the closest to Silverton, and has been documented to be essentially devoid of fish (5 brook trout per mile were found in 2005) (**Figure 1**). The water quality at this site (and all sites within CPW's Animas River #3 section) reflects metal loading from the Animas River, Cement Creek, and Mineral Creek drainages, including all of the proposed Interim Remedial Action locations.

CPW's Elk Park Site is located approximately 5 miles downstream of A-72, and just upstream of Elk Creek. As opposed to A-72, this site sustained a brook trout fishery of between 70 – 90 fish per mile through sampling in 2005. After that point, brook trout populations have been significantly reduced (although 2 brook trout were captured in 2015) (**Figure 1**).

At CPW's Teft Spur site, fisheries surveys have revealed significant reductions in the density of the relatively metals-tolerant brook trout, as well as the elimination of populations of metals-sensitive salmonid species such as the cutthroat, rainbow and brown trout. For example, while brook trout densities at the Teft Spur site remained between 300 – 350 fish per mile in three surveys before 2006 (1992, 1998, and 2005), more recent surveys have documented brook trout densities near 100 fish per mile in the last three surveys (2010, 2014, 2015) (**Figure 1**). These dramatic fisheries impacts coincided with a period of increasing metals concentrations within this reach of the Animas River (i.e. between 2005 and 2010) (CPW 2010), in part attributable to the termination of operation of a key water treatment plant in the Cement Creek drainage in mid-2004.

Finally, fish have recently been documented in several other reaches of the Animas River and tributaries as a part of qualitative habitat surveys conducted by the USGS in 2016 as seen in **Figure 2**. These locations include trout populations in Cunningham Creek near its mouth, in the South Fork of Mineral Creek near its mouth, in Mineral Creek between Mill Creek and the Middle Fork of Mineral Creek, and in Mineral Creek below the South Fork of Mineral Creek.

Potential Risk Reduction Benefits from Proposed Interim Remedial Action

Each of the proposed Interim Remedial Action has as a potential benefit to the reduction of metals concentrations in surface waters downgradient of them by addressing potential mining related sources and/or the reduction of stormwater or mining-related discharges comingling with these sources. Importantly, many of the metals originating from the Interim Remedial Action mining-related sources are known to be toxic to aquatic life at elevated levels. **Table 1** presents hazard quotients (HQs) for samples collected from adit drainages and surface water found immediately downstream of proposed Interim Remedial Action mining-related sources until the next potential influence on the surface water body was encountered (e.g., another creek or mining-related source) in the Animas River, Cement Creek and Mineral Creek drainages. HQs were computed by comparing surface water concentrations with Colorado's hardness-based chronic aquatic life water quality criteria (concentration / criteria) for aluminum, cadmium, copper, and zinc for samples collected in 2015 to present. HQs greater than one indicate there is a potential unacceptable risk to aquatic life under CERCLA. **Figure 3** to **Figure 5** present the maximum individual HQs across the four metals for each sampling location to provide an overall impression of the magnitude of HQ at Interim Remedial Action locations. As seen, there are few locations where maximum individual metal HQ values are less than one, with many locations in both adit drainages and downstream surface waters demonstrating HQs greater than 100.

While aquatic life is unlikely to be directly exposed to mine-related surface water drainages (i.e., mine portal discharges), where they enter the receiving stream, they can significantly increase instream metals concentrations. Many toxic metals are conservatively transported in surface waters, and can remain in solution well downstream of where they were loaded. As such, actions that reduce toxic metal loading to surface waters containing aquatic ecosystems (or to surface waters that are tributary to waters containing aquatic ecosystems) are likely to reduce the metal-related ecological risk to resident or potentially-resident aquatic communities in the immediate receiving waters as well as hydrologically-connected downstream reaches.

Cement Creek

While Cement Creek has long been characterized as being unable to support aquatic life, the Animas River below Cement Creek contains fisheries that are sensitive to changes in instream metals concentration (**Figure 1**). Just as worsening of instream water quality between 2005 and 2010 surveys resulted in the reduction of brook trout density and overall fish species diversity at CPW's Teft Spur site, it is reasonable to predict that a sustained reduction of metal loading to this stream reach from Cement Creek is likely to reduce risk to resident or potentially-resident aquatic life. Further, improvements resulting from the reduction of dissolved metal-related risk would be expected in reaches of the Animas downstream of Teft Spur as well (e.g. Animas River in Durango).

Mineral Creek

Reduction of metal loading would be expected to reduce risk to the trout population that has been documented in the South Fork of Mineral Creek to its mouth. An Interim Remedial Action may improve conditions in the mainstem of Mineral Creek and beyond into the Animas River as described above.

Upper Animas River

Sustained reduction of metal loading through Interim Remedial Action (excluding the proposed action at the Pride of the West Mine) would be expected to reduce risk to the trout population present in the Animas River between Maggie Gulch and Cunningham Creek (**Figure 1**). The proposed Interim Remedial Action at the Pride of the West Mine would be expected to reduce risk to the trout population that has been documented in Cunningham Creek below the influence of the mine. All of these actions would be expected to improve water quality in the Animas River below Howardsville, including reaches of the Animas below Silverton described above.

Conclusions

The health of aquatic ecosystems within the Animas River and its tributaries are currently limited by high concentrations of toxic metals emanating from a wide range of mining-related and natural sources distributed throughout the greater Animas River watershed. In many locations, metals concentrations are currently so elevated that aquatic life is precluded. In other locations, metals-tolerant organisms (e.g. brook trout) are currently able to persist. Actions that result in sustained metal loading reduction function to reduce toxic metals exposure to resident organisms (or potentially resident) within these streams. If enough of these actions are taken, improved survival, abundance and diversity of aquatic life can reasonably be expected where aquatic ecosystems are currently marginal. Further, expansion of the spatial extent of aquatic communities may also be possible as instream water quality improves.

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USEPA. 2015. Final Draft Baseline Ecological Risk Assessment Upper Animas Mining District, San Juan County, Colorado. Prepared by: TechLaw, Inc. ESAT Region 8. Prepared for: U.S. Environmental Protection Agency, Region 8. April.

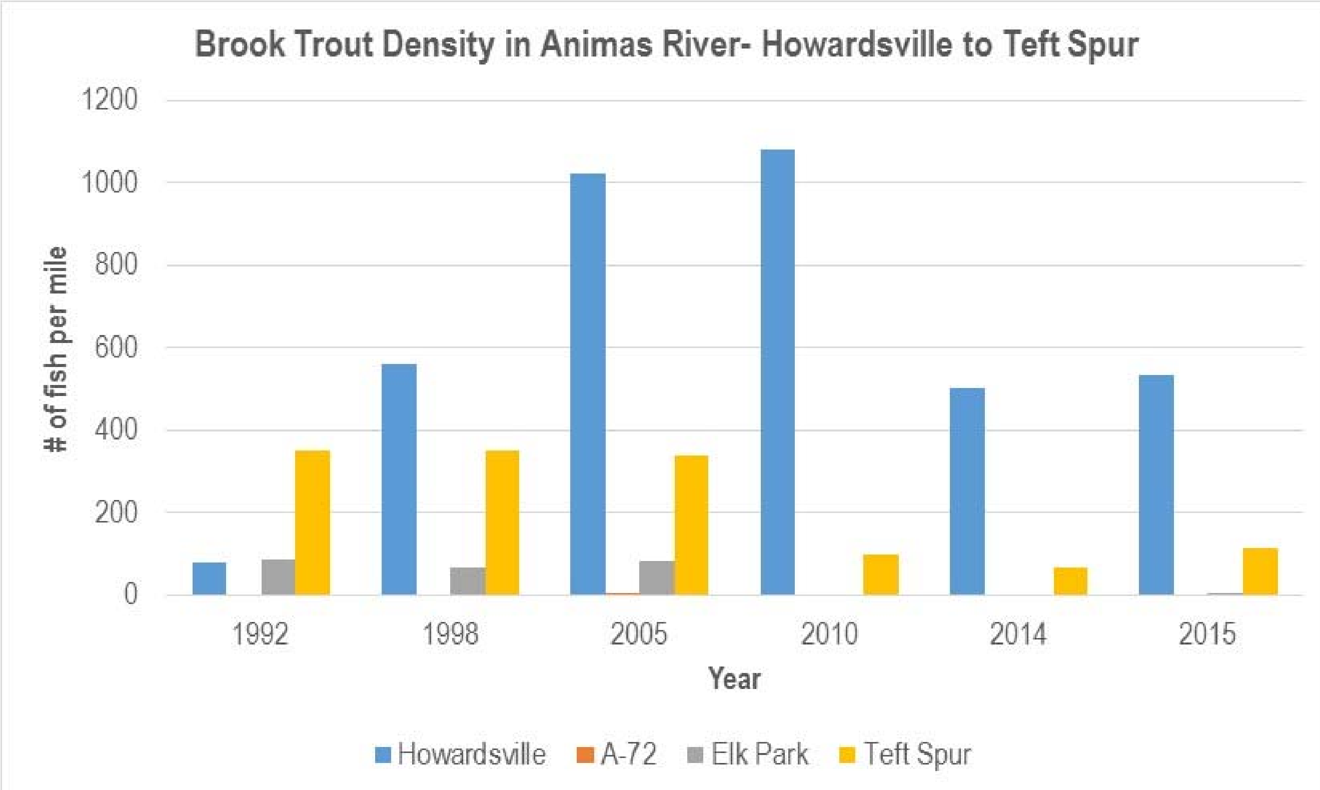


Figure 1. Fish densities in the Animas River at four sites. The Howardsville Site (CPW Animas Site #4) is located just above Cunningham Creek on the Animas. The remaining sites (A-72, Elk Park, Teft Spur) are in progressive order on the Animas River below Silverton. Data were collected and reported by Colorado Parks and Wildlife (CPW 2010; CPW 2014; CPW 2015).

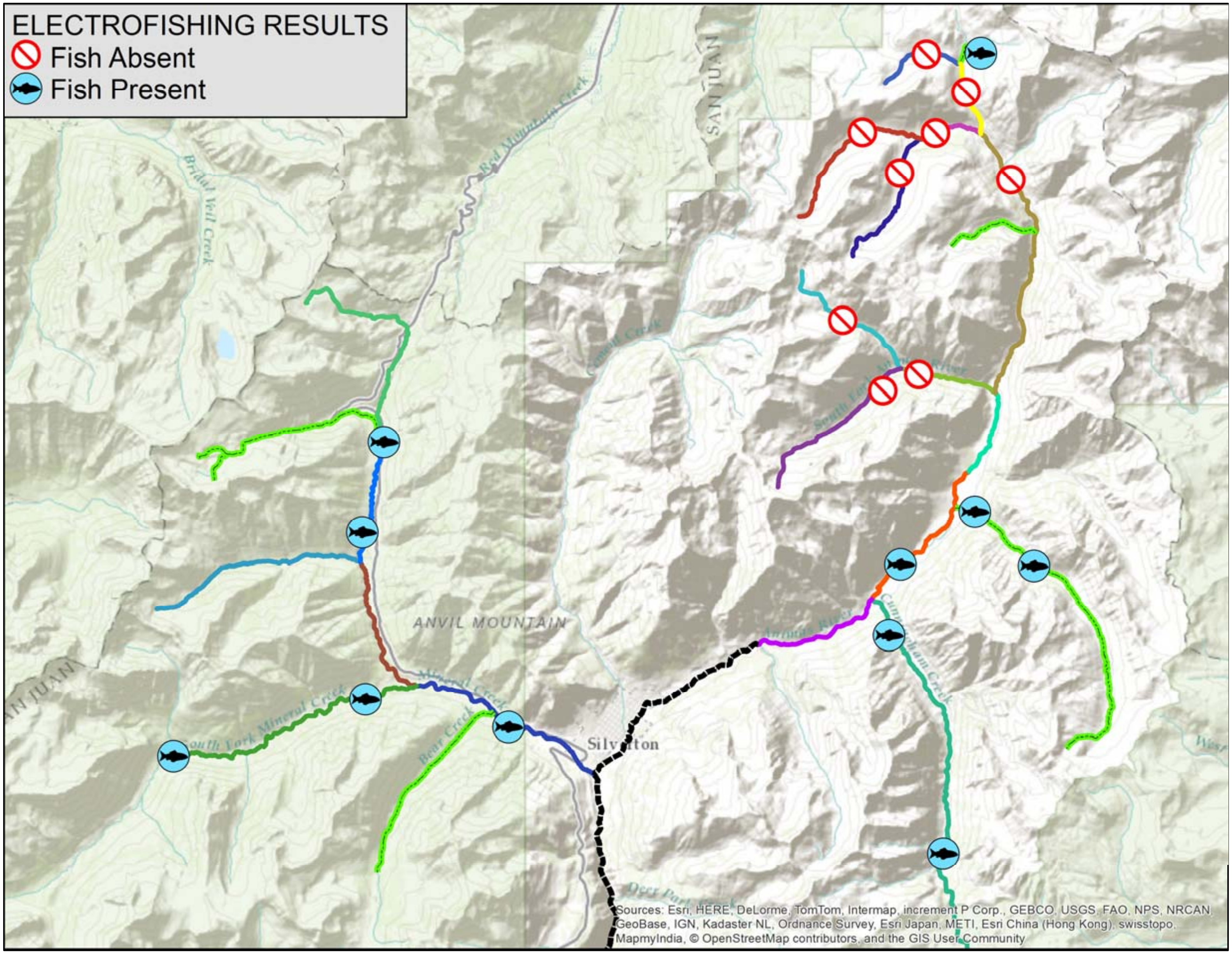
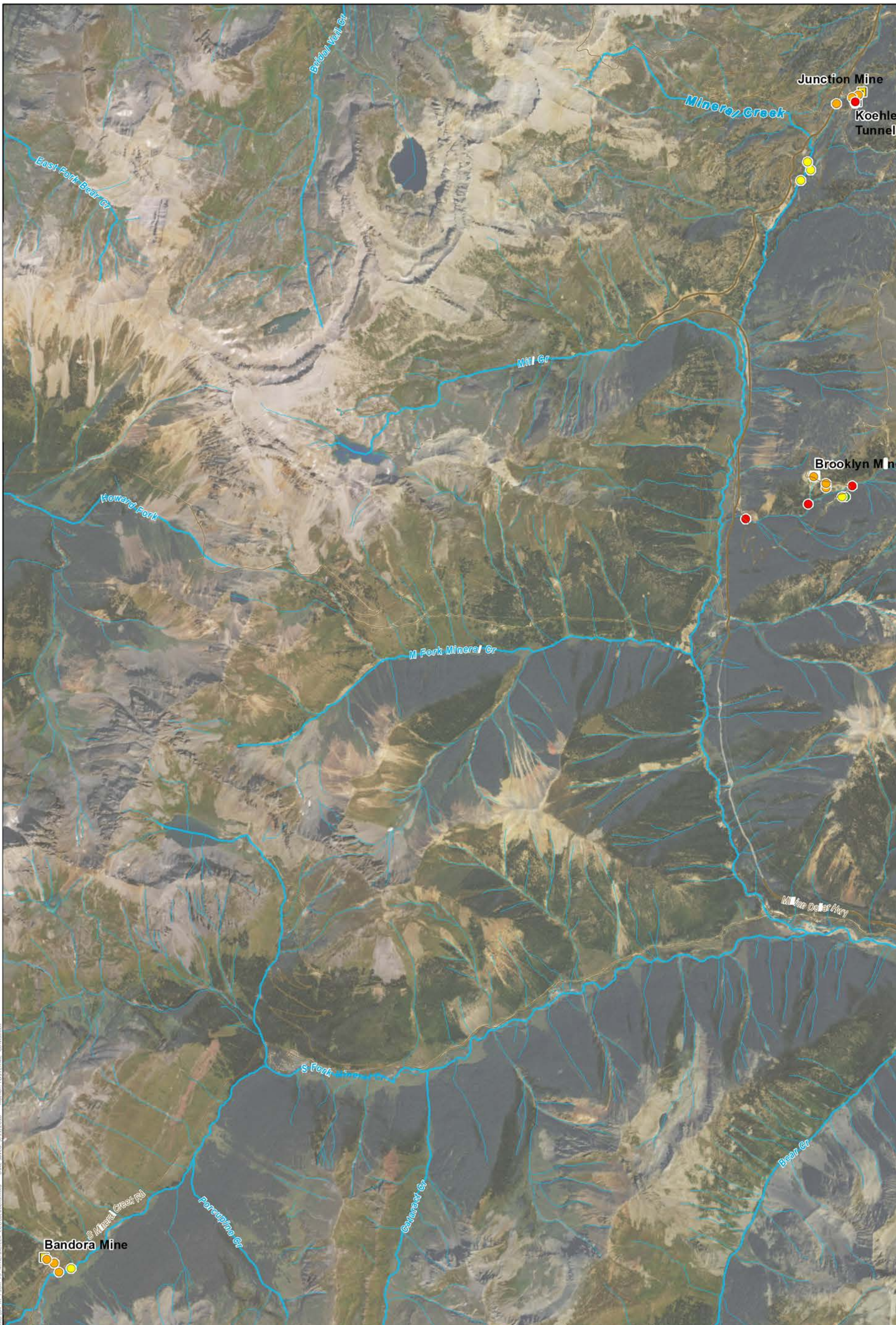
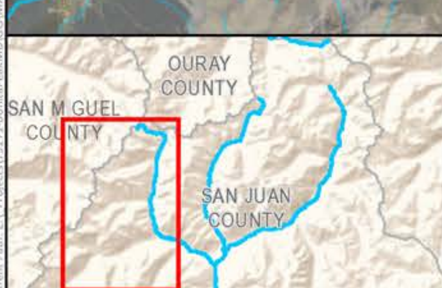


Figure 2. U.S. Geological Survey Electrofishing Results (2016)
Bonita Peak Mining District
San Juan County, CO





N

0 0.25 0.5

Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road and Railroad Source: US Census

Legend

- Proposed Interim Remedial Action Location
- Road

Hazard Quotient (HQ)

- HQ ≤ 1
- HQ >1 and ≤ 25
- HQ >25 and ≤ 100
- HQ >100

Figure 3

Maximum Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations - Mineral Creek

Bonita Peak Mining District | San Juan County, CO

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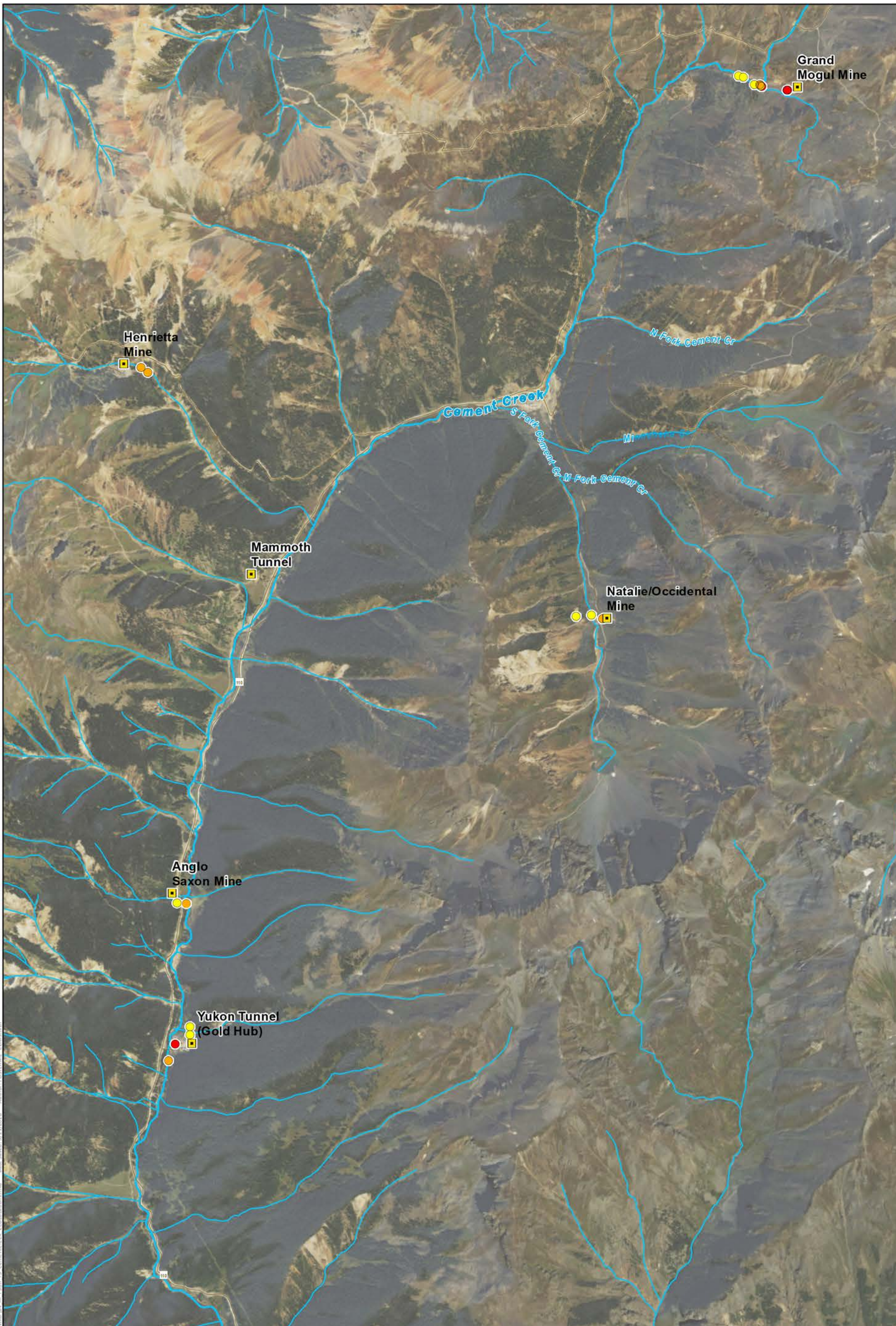

N

0 0.25 0.5

Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road and Railroad Source: US Census

Legend

- Proposed Interim Remedial Action Location

Hazard Quotient (HQ)

- HQ ≤ 1
- HQ >1 and ≤ 25
- HQ >25 and ≤ 100
- HQ >100
- Road

Figure 4

Maximum Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations - Cement Creek

Bonita Peak Mining District | San Juan County, CO

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Figure 5

Maximum Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations - Upper Animas Area

Bonita Peak Mining District | San Juan County, CO

TABLE 1

Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations

Bonita Peak Mining District

Drainage	Sub-Drainage	Location	Sample Date	Hazard Quotient (HQ)				Maximum HQ
				Aluminum	Cadmium	Copper	Zinc	
Mineral Creek	South Fork Mineral Creek	M24A	9/28/2016	11	44	0.2	33	**44**
		M24B	9/28/2016	2	59	1	42	**59**
		M24D	9/27/2016	2	43	0.1	35	**43**
		M25	6/29/2016	8	1	0.3	1	**21**
			9/27/2016	21	2	0.2	1	
	located in the mainstem of Mineral Creek	M02	6/29/2016	30	16	25	18	**78**
			10/7/2016	78	30	45	38	
		M02B	6/29/2016	20	17	20	14	**82**
			10/7/2016	82	40	54	32	
		M02C	10/7/2016	148	74	72	97	**148**
		M02E	6/29/2016	40	21	37	23	**93**
			10/7/2016	93	36	48	44	
		M02K	6/29/2016	77	45	73	50	**77**
		M02K1	6/29/2016	44	34	113	42	**113**
		M03	6/30/2016	22	5	18	5	**22**
			6/30/2016	20	5	17	5	
			10/8/2016	1	8	21	8	
		M04	10/8/2016	1	7	5	11	**11**
		M05	10/8/2016	0.9	7	5	11	**11**
		M12	6/7/2016	40	4	2	3	**105**
			6/29/2016	39	10	4	8	
			9/29/2016	105	10	4	7	
		M12A	6/29/2016	44	3	3	3	**117**
			9/30/2016	117	3	3	2	
		M12B	6/29/2016	45	0.9	2	0.7	**137**
			9/30/2016	137	0.6	2	0.6	
		M12C	6/29/2016	22	17	8	15	**42**
			9/30/2016	35	20	13	18	
			9/29/2016	42	19	13	18	
		M12D	9/30/2016	32	20	14	19	**32**
		M12E	10/7/2016	28	17	11	17	**28**
		M12F	10/7/2016	0.06	0.1	0.05	0.02	**0.1**
		M12G	10/7/2016	7	2	6	2	**7**
Cement Creek	Illinois Gulch	CC42	6/7/2016	0.3	0.1	0.1	0.1	**6**
			9/27/2016	6	0.2	0.04	0.2	
		CC43C	6/7/2016	6	0.2	0.1	0.2	**6**
			9/27/2016	6	0.2	0.1	0.3	
		CC43D	6/7/2016	355	18	115	16	**355**
		CC43E	6/7/2016	35	8	9	8	**65**
			9/27/2016	65	4	3	5	
	Prospect Gulch	CC24	6/8/2016	12	10	25	10	**40**
			9/29/2016	40	7	16	6	
		CC24B	6/8/2016	10	7	17	8	**32**
			9/29/2016	32	5	10	4	
Cement Creek	South Fork Cement Creek	CC14	6/10/2015	21	4	2	2	**28**
			9/29/2015	11	1	0.1	2	
			7/15/2015	18	0.5	0.1	2	
			6/9/2016	28	5	3	3	
			9/29/2016	11	2	0.1	2	
		CC15A	6/9/2016	9	2	1	1	**10**
			9/29/2016	10	1	0.2	1	
		CC16B	6/9/2016	12	2	2	1	**23**
			9/29/2016	23	1	0.5	1	
	located in the mainstem of Cement Creek	CC01C	7/15/2015	20	61	58	57	**326**
			6/29/2016	23	84	115	71	
			9/28/2016	118	252	326	233	
		CC01C1	6/29/2016	53	142	279	135	**557**
			9/28/2016	172	302	557	256	
		CC01C2	6/29/2016	34	99	169	87	**331**
			9/28/2016	93	198	331	172	
		CC01H	6/29/2016	8	16	19	12	**19**
			9/27/2016	8	14	13	11	
		CC01S	6/29/2016	32	14	6	8	**48**
			9/27/2016	48	25	5	12	
		CC01T	6/29/2016	20	12	6	7	**22**
			9/27/2016	22	20	9	11	
		CC01U	6/28/2016	13	11	6	7	**21**
			9/27/2016	21	20	9	11	
		CC02I	6/28/2016	11	14	3	14	**22**
			9/27/2016	22	20	9	11	

TABLE 1

Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations

Bonita Peak Mining District

Drainage	Sub-Drainage	Location	Sample Date	Hazard Quotient (HQ)				Maximum HQ
				Aluminum	Cadmium	Copper	Zinc	
Cement Creek	*located in the mainstem of Cement Creek*	CC38	6/7/2016	7	2	1	3	**7**
			9/28/2016	0.3	2	0.1	4	
		CC39	6/7/2016	25	6	7	6	**78**
			9/27/2016	78	5	3	5	
Animas River	Cunningham Creek	A50	6/7/2016	0.2	18	1	10	**18**
			9/28/2016	0.1	10	0.6	6	
		CU4A	6/7/2016	7	0.3	0.3	0.1	**7**
			9/28/2016	0.1	0.5	0.1	0.3	
	North Fork Animas River	A07	9/30/2015	129	51	9	30	**137**
			6/8/2016	49	46	9	35	
			9/30/2016	137	56	8	34	
		A07A	9/30/2015	161	55	10	32	**171**
			6/28/2016	75	67	16	40	
			9/30/2016	171	63	9	38	
		A07B	9/30/2015	161	55	6	37	**197**
			6/28/2016	81	70	14	48	
			9/30/2016	197	69	8	45	
		A07B1	6/28/2016	83	68	14	49	**83**
		A07B2	6/28/2016	4	0.5	0.1	0.6	**4**
		A07B3	6/28/2016	167	122	16	67	**167**
		A07C	9/30/2015	179	61	9	52	**182**
			6/28/2016	89	64	14	47	
			10/5/2016	182	73	10	54	
		A07D	6/28/2016	85	52	14	37	**184**
			6/28/2016	86	49	13	34	
			10/5/2016	184	80	19	46	
		A07D1	6/28/2016	222	147	12	107	**222**
		A07D2	6/28/2016	118	346	79	271	**346**
		A07E	6/28/2016	79	38	14	24	**159**
			10/5/2016	159	56	15	35	
		BB1	6/28/2016	15	110	113	101	**113**
	South Fork Animas River	A38	6/28/2016	0.05	0.1	0.04	3	**3**
			9/28/2016	0.1	0.2	0.04	3	
		A39	9/30/2015	0.3	3	2	4	**13**
			6/28/2016	0.5	10	2	13	
			9/28/2016	0.3	4	2	5	
		A39A	6/28/2016	0.5	11	2	13	**13**
		ARD1	9/29/2015	83	112	184	133	**254**
			6/28/2016	44	114	254	124	
			9/28/2016	115	135	205	150	
		DM32	9/29/2015	39	73	168	70	**245**
			6/28/2016	31	122	245	132	
			9/29/2016	0.7	0.6	0.2	0.2	
		EG3A	9/29/2015	0.1	1	1	2	**15**
			6/28/2016	2	11	2	15	
			9/29/2016	0.4	0.5	0.2	0.7	
		EG5	9/30/2015	0.1	1	0.6	2	**15**
			6/28/2016	0.5	11	2	15	
			9/28/2016	0.2	3	0.8	4	
		EG6	6/10/2015	1	11	4	17	**17**
			9/30/2015	0.02	2	0.4	3	
			6/28/2016	0.5	7	2	10	
			9/28/2016	0.3	3	1	4	
	West Fork Animas River	A10	6/9/2015	11	17	5	23	**72**
			9/29/2015	72	17	3	21	
			6/7/2016	17	14	3	19	
			9/29/2016	63	15	2	17	
		A11	6/9/2015	14	13	3	19	**76**
			9/29/2015	76	15	2	19	
			6/7/2016	19	11	2	17	
			9/30/2016	63	13	2	16	
		A11A	6/9/2015	79	1662	1213	2009	**2057**
			9/29/2015	356	1639	569	1835	
			6/7/2016	81	1555	1172	1782	
			9/30/2016	294	2057	648	1687	
		A12	6/9/2015	0.2	6	0.3	16	**17**
			10/1/2015	5	4	0.1	14	
			6/7/2016	7	7	0.2	17	
			9/28/2016	4	4	0.1	12	
			9/28/2016	4	4	0.1	12	

TABLE 1

Hazard Quotients in Mine Discharges and Surface Water for Aluminum, Cadmium, Cooper, and Zinc at Locations Downstream of Proposed Interim Remedial Action Locations

Bonita Peak Mining District

Drainage	Sub-Drainage	Location	Sample Date	Hazard Quotient (HQ)				Maximum HQ
				Aluminum	Cadmium	Copper	Zinc	
Animas River	West Fork Animas River	A15	6/10/2015	36	18	3	24	**138**
			9/29/2015	138	21	2	22	
			6/8/2016	34	16	2	21	
			9/30/2016	126	18	2	19	
		A16	9/30/2015	0.1	2	0.06	3	**3**
			6/28/2016	0.1	2	0.04	3	
			9/28/2016	0.8	2	0.1	3	
		A18	10/6/2016	0.4	2	1	1	**2**
		A18B	6/28/2016	47	9	2	8	**213**
			10/6/2016	213	20	3	17	
		A19A	9/30/2015	38	194	275	104	**275**
			9/28/2016	38	172	269	89	
		A20	6/10/2015	6	10	5	16	**16**
			9/29/2015	14	8	2	13	
			6/29/2016	10	9	3	14	
			9/30/2016	11	7	1	11	
		A21	9/29/2015	26	8	1	12	**26**
			6/29/2016	12	11	4	15	
			9/30/2016	17	8	1	12	
		A21A	9/29/2015	156	42	0.3	66	**174**
			6/29/2016	162	38	0.1	56	
			9/30/2016	174	46	0.2	62	
		CG11	6/9/2015	11	13	3	18	**76**
			9/29/2015	76	15	2	18	
			6/7/2016	17	12	3	17	
			9/30/2016	62	13	2	16	
		CG5	6/28/2016	26	96	45	117	**117**
			6/28/2016	26	97	44	116	
		CG5A	6/29/2016	26	95	44	120	**120**
		CG6	9/30/2015	157	22	2	22	**157**
			6/28/2016	42	14	2	14	
			9/30/2016	137	19	2	20	
		CG6A	6/29/2016	52	14	2	14	**52**
			6/29/2016	52	14	2	15	
		CG9	6/9/2015	12	12	3	18	**82**
			9/29/2015	82	15	2	18	
			6/7/2016	21	13	3	19	
			9/30/2016	64	13	2	16	
	located in the mainstem of the Animas River	A29	6/9/2015	16	13	91	11	**170**
			9/30/2015	21	15	170	13	
			6/7/2016	18	14	99	11	
			9/28/2016	18	13	106	10	
		A29A	6/9/2015	9	13	28	11	**28**
			6/7/2016	1	14	19	10	
		A30	6/9/2015	4	9	3	10	**16**
			9/30/2015	16	8	1	8	
			6/7/2016	6	9	2	10	
		A30B	6/8/2016	4	8	1	8	**21**
			9/29/2016	21	8	0.7	7	
		DM22	6/28/2016	0.03	2	0.03	3	**3**
			9/28/2016	0.3	1	0.04	3	

Maximum Hazard Quotient color legend:

- HQ ≤ 1
- HQ > 1 and ≤ 25
- HQ > 25 and ≤ 100
- HQ > 100

Appendix C

Potential Applicable or Relevant and Appropriate Requirements

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Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Bonita Peak Mining Site (Site)
Interim Remedial Actions (IRAs)

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical Specific	Location Specific	Action Specific
Federal ARARs							
1	National Historic Preservation Act (NHPA) and Implementing Regulations 16 United States Code (U.S.C.) 470 36 Code of Federal Regulations (CFR) Part 800	Potentially Applicable	This statute and implementing regulations require federal agencies to take into account the effect of this response action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally, 50 years old or older).	Cultural resource surveys have not been completed for all mining-related sources addressed by the IRAs. If cultural resources on or eligible for the national register are present, it will be necessary during remedial design and remedial action to determine if there will be an adverse effect and if so how the effect may be minimized or mitigated.		✓	
2	Archaeological and Historic Preservation Act and Implementing Regulations 16 U.S.C. 469 43 CFR 7	Potentially Applicable	This statute and implementing regulations establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit, and any not archaeological investigations at a site must be conducted by a professional archaeologist.	Cultural resource surveys have not been completed for all mining-related sources addressed by the IRAs. To date, no such resources have been found at the Site. If any are found, consultation with the State Historic Preservation Office (SHPO) and the NHPA will be addressed during remedial design and remedial action.		✓	
3	Historic Sites Act 16 USC §§ 461, et seq.	Potentially Applicable	The statute requires federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on such landmarks.	Cultural resource surveys have not been completed for all mining-related sources addressed by the IRA. To date, no National Natural Landmarks have been identified at the Site.		✓	
4	Fish and Wildlife Coordination Act and Implementing Regulations 16 U.S.C. 662, et seq., 50 CFR 83 33 CFR 320-330	Potentially Applicable	This statute and implementing regulations require coordination with federal and state agencies for federally funded projects to ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provides for adequate protection of fish and wildlife resources.	If the IRA involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources.		✓	

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
5	Bald and Golden Eagle Protection Act 16 U.S.C. §§ 668 et seq.	Potentially Applicable	This requirement makes it unlawful for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any bald or golden eagle, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. In addition to immediate impacts, this requirement also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment.	If bald or golden eagles are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat.		✓	
6	Endangered Species Act, 16 U.S.C. 1531 et seq. and Implementing Regulations, 50 CFR 17 and 402	Potentially Applicable	This statute and implementing regulations provide that federal activities not jeopardize the continued existence of any threatened or endangered species. 16 U.S.C. 1536(a) of the Endangered Species Act requires consultation with the U.S. Fish and Wildlife Service to identify the possible presence of protected species and mitigate potential impacts on such species. Substantive compliance with the ESA means that the lead agency must identify whether a threatened or endangered species, or its critical habitat, will be affected by a proposed response action. If so, the agency must avoid the action or take appropriate mitigation measures so that the action does not affect the species or its critical habitat. If, at any point, the conclusion is reached that endangered species are not present or will not be affected, no further action is required.	Canada Lynx (federally threatened mammal) and southwestern willow flycatcher (federally endangered bird) have been identified in San Juan County, but not necessarily found at the Site. Surveys to identify threatened and endangered species at the mining-related sources addressed by this IRA have not been completed. If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat.		✓	
7	Migratory Bird Treaty Act 16 U.S.C. 703 50 CFR 10.12	Potentially Applicable	This statute and implementing regulations makes it unlawful for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to these regulations.	If migratory birds are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat.		✓	

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
8	Identification and Listing of Hazardous Waste 40 CFR 261	Potentially Applicable	This regulation identifies solid wastes subject to regulation as hazardous wastes under the Resource Conservation and Recovery Act (RCRA). A solid waste is a hazardous waste if it meets the criteria and is not otherwise excluded from regulation as indicated in 40 CFR 261.3.	Mining-related sources identified for remediation during the IRA having been derived directly or indirectly from extraction of ore and thus meet the exclusion requirements for identification as a hazardous waste indicated in 40 CFR 261.4(b)(7), commonly known as the "Bevill" exclusion. These mining-related sources would instead be regulated as solid waste once they are generated for disposal. A similar regulation and exclusion exists for identification and listing of hazardous waste pursuant to the Colorado Hazardous Waste Regulations.	✓		
9	Criteria for Classification of Solid Waste Disposal Facilities and Practices 40 CFR 257	Potentially Applicable	This regulation establishes standards with which solid waste disposal must comply to avoid possible adverse effects on health or the environment. These criteria apply to both solid waste disposal facilities and practices that are not otherwise excepted in the regulation. Part 257.3-1 states that that facilities or practices in floodplains not restrict floods or result in washout of solid waste. Part 257.3-2 provides for the protection of threatened or endangered species. Part 257.3-3 provides that a facility must not cause the discharge of pollutants into waters of the United Sates in violation of the Clean Water Act. Part 257.3-4 states that a facility or practice must not contaminate underground drinking water. Part 257.3-5 regulates application of solid waste to land used for production of crops. Part 257.3-6 regulates facilities and practices to minimize diseases. Part 257.3-7 states that a facility or practice must not engage in open burning of solid waste. Part 257.3-8 states the explosive limits or other specifics regarding safety and prohibits uncontrolled public access as to expose the public to potential health and safety hazard at the disposal site.	RCRA Subtitle D specifically regulates nonhazardous solid waste. Because the State of Colorado has been delegated the authority to implement the solid waste program regulated under RCRA Subtitle D, the substantive requirements will be enforced through the Colorado Solid Waste Regulations.			✓

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
10	Clean Water Act 33 U.S.C. §§ 1342, et seq., Point Source Discharges Requirements, Section 402	Potentially Applicable	Section 402 of the Clean Water Act, 33 USC §§ 1342, *et seq.*, authorizes the issuance of permits for the discharge of any pollutant. This includes storm water discharges associated with industrial activity. *See*, 40 CFR 122.1(b)(2)(iv). Industrial activity includes inactive mining operations that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations, *see*, 40 CFR 122.26(b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA subtitle D, *see*, 40 CFR 122.26(b)(14)(v); and construction activity including clearing, grading, and excavation activities, *see*, 40 CFR 122.26(b)(14)(x).	Because the State of Colorado has been delegated the authority to implement the Clean Water Act, substantive requirements will be enforced through the Colorado Pollutant Discharge Elimination System (CPDES).			✓
11	Clean Water Act 404, 33 U.S.C. § 1344, et. seq., Dredge and Fill Provisions Section 404 (b)(1) 40 CFR 230	Potentially Applicable	Section 404 regulates the discharge of dredged or fill materials into waters of the United States including return flow from such activity. This program is implemented through regulations set forth in the 404 (b)(1) guidelines, 40 CFR 230. The guidelines specify: the restriction on discharge (40 CFR 230.10); the factual determinations that need to be made on short- and long-term effects of proposed discharge of dredge or fill material on the physical, chemical, and biological components of the aquatic environment (40 CFR 230.11) in light of Subpart C through F of the guidelines; and the findings of compliance on the restrictions (40 CFR 230.12). Subpart J of the guidelines provide the standards and criteria for the use of all types of compensatory mitigation when the response action will result in unavoidable impacts to the aquatic environment.	If the remediation of mining-related sources during the IRA involves the discharge of dredged or fill materials into waters of the United States identified at the Site, activities would be implemented in compliance with substantive requirements of these regulations.		✓	✓

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
12	National Forest Management Act (NFMA)	Potentially Applicable	The National Forest Management Act (NFMA) is the primary statute governing the administration of National Forest System (NFS) land. It was passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on NFS land. The NFMA requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the NFS. The NFMA is at 16 USC §§ 1601-1614.	This statute required the development of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan to govern activities performed on NFS land. Activities conducted during the IRA on NFS-managed land would need to comply with the substantive requirements of this Plan.		✓	
13	The San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan	Potentially Applicable	The purpose of this Land and Resource Management Plan (LRMP) is to provide strategic guidance for future management of all National Forest System (NFS) lands managed by the San Juan National Forest (SJNF) and lands within the Tres Rios Field Office (TRFO) administered by the Bureau of Land Management (BLM), except for those lands included in the BLM's Canyons of the Ancients National Monument. This LRMP guides the restoration or maintenance of the health of these lands to promote a sustainable flow of uses, benefits, products, services, and visitor opportunities. It provides a framework for informed decision making, while guiding resource management programs, practices, uses, and projects. It does not include specific project and activity decisions. Those decisions are made later, after more detailed analysis and further public involvement. The San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan is available at: https://www.fs.usda.gov/detail/sanjuan/landmanagement/planning/?cid=stelprdb5432707	The Plan contains standards and management direction for all actions to be taken on NFS land within the San Juan National Forest boundaries. Any remedial and removal action decisions made under CERCLA would be expected to follow the applicable standards and management direction (collectively, "plan components") set forth in the Plan. Standard and Guidelines from the Plan that may be applicable are: Abandoned Mine Lands and Hazardous Materials 2.21.1 through 2.21.9, Acid-Mine Runoff, 2.3.56, 2.5.26, Riparian Area and Wetland Ecosystems, 2.4.20, Aquatic Ecosystems and Fisheries, 2.5.18, 2.5.19, 2.5.25, Water Resources, 2.6.29, 2.6.30, 2.6.34, 2.6.39, Bats, 2.3.37, 2.3.38, 2.3.51-54, Fens, 2.4.7, Roads, 2.13.22, 2.13.23, 2.13.24.		✓	

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
14	FEMA Regulations to Implement EO 11990 44 CFR 9.11(b)(2), (b)(4), (c)(3)	Potentially Relevant and Appropriate	44 CFR 9 (Requirements for Flood Plain Management Regulations Areas) Requires measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains. The Executive Orders 11988 as amended by 13690 direct federal agencies to evaluate the potential effects of action that may be taken in a floodplain and to avoid, to the extent possible, long-term and short-term adverse effects associated with the occupancy and modification of floodplains, and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Executive Order 11990 directs that activities conducted by federal agencies avoid, to the extent possible, long-term and short-term adverse effects associated with the modification or destruction of wetlands and to avoid direct or indirect support of new construction in wetlands when there are partible alternatives.	If the IRA involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them.			
15	Floodplain Management Regulations Executive Order No. 11988	Potentially TBC	These require that actions be taken to avoid, to the extent possible, adverse effects associated with direct or indirect development of a floodplain, or to minimize adverse impacts if no practicable alternative exists.	If floodplains are delineated within areas designated for the IRA, activities actions will be carried out in a manner to avoid adversely affecting them.		✓	
16	Protection of Wetlands Regulations Executive Order No. 11990	Potentially TBC	This ARAR requires federal agencies to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	If jurisdictional wetlands are delineated within areas designated for the IRA, activities will be carried out in a manner to avoid adversely affecting them.		✓	✓

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
State ARARs							
1	Colorado Basic Standards for Groundwater, 5 Colorado Code of Regulations (CCR) 1002-41, pursuant to Colorado Revised Statutes (C.R.S.) §§ 25-8-101-703	Potentially Applicable	Establishes basic Statewide water quality standards for ground water, specific water quality standards for ground water, and an antidegradation rule.	Applicable if there is potential for groundwater infiltration from water management during pond draining and precipitate sludge dewatering, or from interim waste materials management at mining-related sources.			✓
2	Colorado Basic Standards and Methodologies for Surface Water, 5 CCR 1002-31, pursuant to CRS §§ 25-8-101-703	Potentially Applicable	Establishes Statewide water quality standards, specific surface water quality standards, and an antidegradation rule.	Applicable to stormwater discharges during construction and any other point source discharges during operations for run-on and adit discharge controls. Also, applicable if potential for surface or groundwater impacts from water management during pond draining and precipitate sludge dewatering, or from interim solid waste materials management at mine location.	✓		✓
3	Colorado Surface Water Quality Classifications and Numeric Standards, 5 CCR 1002-34, pursuant to CRS §§ 25-8-203 and 204	Potentially Applicable	Assigns Statewide water quality standards and classifications for State surface and ground waters.	Applicable to stormwater discharges during construction and any other point source discharges during operations for run-on and adit discharge controls. Also, applicable if potential for surface or groundwater impacts from water management during pond draining and precipitate sludge dewatering, or from interim solid waste materials management at mine location.	✓		

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
4	Colorado Discharge Permit System Regulations, 5 CCR 1002-61, Regulation No. 61, pursuant to CRS § 25-8-501 - 509	Potentially Applicable	Establishes program for permitting discharges of pollutants from a point source into waters of the United States within Colorado during remediation construction	Applicable to stormwater discharges during construction and any other point source discharges during operations for run-on and adit discharge controls. Also, applicable if potential for surface or groundwater impacts from water management during pond draining and precipitate sludge dewatering, or from interim solid waste materials management at mine location. Only substantive requirements apply.			✓
5	Colorado Effluent Limitations, 5 CCR 1002-62, pursuant to CRS § 25-8-205	Potentially applicable	Sets numeric limits for certain discharge permits except storm water discharge permits.	Applicable to stormwater discharges during construction and any other point source discharges during operations for run-on and adit discharge controls. Also, applicable if potential for surface or groundwater impacts from water management during pond draining and precipitate sludge dewatering, or from interim solid waste materials management at mine location.			✓
6	Colorado Solid Waste Disposal Sites and Facilities Regulations, 6 CCR 1007-2, pursuant to C.R.S. §§ 30-20-100.5 et seq. §§ 30-20-101-515	Potentially applicable	Establishes requirements and procedures for land disposal of solid wastes.	Pursuant to the Solid Wastes Disposal Sites and Facilities Act, C.R.S. § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under a Colorado Mined Land Reclamation Board (MLRB) permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. CDPHE interprets this provision to allow CERCLA response actions performed consistently with the MLRB regulation 2 C.C.R. 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal.		✓	✓
7	Colorado Hazardous Waste Regulations, 6 CCR 1007-3, pursuant to C.R.S. §§ 25-15-101 et. seq.	Relevant and Appropriate	Establishes provisions covering basic permitting requirements for hazardous waste.	Relevant and appropriate to pond draining, precipitate sludge dewatering, and interim waste materials management at mine locations.			✓

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
8	Colorado Fugitive Dust Control Plan/Opacity, Regulation No. 1., 5 CCR 1001-3, pursuant to Colorado Air Pollution Prevention and Control Act, C.R.S. §§ 25-7-101 et. seq.	Potentially Applicable	Establishes regulations concerning fugitive emissions from construction activities, storage and stockpiling activities, haul trucks, and tailings ponds.	Applicable to all activities generating dust.			✓
9	Colorado Mined Land Reclamation Act, C.R.S. §§ 34-32-101et. seq. and regulations 2 CCR 407-1 Rules 1.1 and 3	Relevant and Appropriate	Establishes performance standards for reclamation of permitted mined lands. Reclamation activities including grading, backfilling, or any other handling and disposal of acid-forming or toxic-producing mined materials, must minimize disturbances to the prevailing hydrologic balance of the mined land and surrounding area by complying with all laws pertaining to water rights, surface and ground water quality, and dredge and fill activities.	Substantive requirements are relevant and appropriate to mine reclamation activities including adit discharge control, reclamation of waste rock and other mine related materials, and revegetation.		✓	✓
10	Colorado Noxious Weed Act and the San Juan County Noxious Weed regulations, C.R.S. § 35-5.5-101-119; 8 CCR 1206-2	Potentially Applicable	Colorado and San Juan County regulations addressing management of noxious weeds.			✓	
11	Colorado Wildlife Enforcement and Penalties Act, C.R.S. §§ 33-6-101 to 130	Potentially Applicable	Prohibits actions detrimental to wildlife, and establishes provisions governing the taking, possession, hunting, and use of wildlife and migratory birds.	Applicable to all activities. Compliance achieved through coordination with the Colorado Division of Parks Wildlife.		✓	✓
12	Colorado Non-game, Endangered, or Threatened Species Act, C.R.S. §§ 33-2-101-108	Potentially Applicable	Protects endangered and threatened species and preserves their habitats. Requires coordination with the Division of Wildlife if remedial activities impact nongame wildlife deemed to be in need of management.	Applicable to all activities. Compliance achieved through coordination with the Colorado Division of Parks Wildlife.			✓

	Statute and Regulatory Citation	Preliminary ARAR Determination	Description	Comment	Chemical-Specific	Location-Specific	Action-Specific
13	Colorado Wildlife Commission Regulations, 2 CCR 406, pursuant to C.R.S. §§ 33-2-101-108	Potentially Applicable	Establishes specific requirements for protection of wildlife.	Applicable to all activities. Compliance achieved through coordination with the Colorado Division of Parks Wildlife.			✓
14	Colorado Noise Abatement Statute, C.R.S. §§ 25-12-101-110	Potentially Applicable	Establishes maximum permissible noise levels for particular time periods and land use zones.	Applicable to all construction, transport, and disposal activities.			✓
15	Colorado Environmental Covenants, C.R.S. §§ 25-15-317-327	Potentially Relevant and Appropriate	Required where remediation results in residual contamination levels determined by the regulatory agency not to be safe for all uses, or where remediation incorporates any engineered feature or structure or requires any monitoring, or maintenance, or operation, unless eligible for exemption as provided under § 25-15-320.	The Environmental Covenants statute does not apply to interim measures that are not intended as the final remedial action. Substantive requirements will be applicable to any final action where waste is left in place above levels safe for unrestricted use or where engineered features or structures are incorporated requiring monitoring, maintenance, or operation or that will not function as intended if disturbed. However, the Environmental Covenants Statute would be relevant and appropriate to interim actions that involve engineered features or structures or that require monitoring and/or maintenance.		✓	✓

Appendix D

Effectiveness Evaluation Considerations for FFS Remedial Alternatives

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Appendix D

Effectiveness Evaluation Considerations for FFS Remedial Alternatives

D.1 Introduction and Purpose

The focused feasibility study (FFS) includes remedial alternatives meant to mitigate contaminant migration issues that contribute to unacceptable human health and ecological risks from various contaminant-related issues during interim remedial actions (IRAs) for mining-related sources at the Bonita Peak Mining District (BPMD) Superfund Site (Site).

The purpose of this appendix is to provide an understanding of protectiveness and short- and long-term effectiveness considerations for remedial alternative components. This information can be used as the basis for alternatives analysis against National Oil and Hazardous Substances Pollution Contingency Plan (NCP) evaluation criteria of overall protection of human health and the environment, long-term effectiveness and permanence, and short-term effectiveness as described in Section 6 of the FFS.

D.2 Contaminant Migration Issues and PRAOs

The contaminant migration issues posed by the mining-related sources and addressed by the IRAs, as described in Section 3.2 of the FFS, include:

- mine portal mining-influenced water (MIW) discharges
- mining-related source/stormwater interactions
- mine portal pond sediments
- in-stream mine wastes
- mining-impacted recreation staging areas

The three preliminary remedial action objectives (PRAOs) identified in Section 3 of the FFS that remedial alternatives would need to achieve for the contaminant migration issues, as appropriate, include:

1. Reduce transport from mine waste, contaminated soil, and contaminated sediment into surface water of chemicals of potential concern (COPCs) that contribute to unacceptable ecological risks.
2. Reduce human exposure through ingestion and inhalation to mine waste and contaminated soils containing lead that results in greater than a 5 percent chance of exceeding a blood lead level of 5 micrograms per deciliter (μg/dL) during camping activities.

3. Reduce human exposure through ingestion to mine waste and contaminated soils containing arsenic that exceeds risk-based levels for acute exposures during camping activities.

D.3 Evaluation Information and Sources

This appendix includes background information on contaminant mass loading and formation and transport mechanisms for mining-related contamination. This information aids in understanding how these mechanisms are affected by remedial alternatives to address contaminant migration issues and achieve PRAOs. This appendix also discusses remedial approaches incorporated into the remedial alternatives for achieving the PRAOs to address the contaminant source migration issues.

The evaluation information presented in this appendix includes experience from other Comprehensive Environmental Response, Compensation, and Liability Act mining sites, and guidance including the U.S. Environmental Protection Agency (EPA) *Abandoned Mine Site Characterization and Cleanup Handbook* (EPA Handbook, EPA 2000). Other guidance considered originates from the Interstate Technology Regulatory Council (ITRC) and the International Network for Acid Prevention (INAP). The ITRC developed an online guidance document titled *Mining Waste Treatment Technology Selection* for treatment technologies applicable to mining wastes (ITRC 2010). The INAP developed *The International Network for Acid Prevention Global Acid Rock Drainage Guide* (GARD Guide) online guide in 2009.

D.4 Contaminant Mass Loading

The contaminant mass load is defined as the mass of the contaminant per unit of time, and is calculated as the product of the concentration and flow rate.

$$Load\ \left(\frac{mass}{time}\right) = Concentration\left(\frac{mass}{\cancel{volume}}\right) x\ Flow\ Rate\ \left(\frac{\cancel{volume}}{time}\right)$$

Loads are commonly reported in pounds per day (lbs/day) or kilograms per day (kg/day). It is a method to quantify or allocate sources of contaminants of potential concern (COPCs) in a watershed and can be used as a tool for decision makers to prioritize sources for remediation. Through the equation above, it is evident that to potentially improve water quality, by reducing the load of contaminants, contaminant concentrations and/or flow rate need to be decreased. Given a constant flow rate, the contaminant load will decrease in a receiving water such as a river or stream if the contaminant concentration is reduced. Alternatively, contaminant concentrations will decrease in a receiving water such as a river or stream if the input loads decrease and the flow rates remain the same.

It is important to realize that a mining-related source with a high flow rate and a low concentration can have a higher contaminant mass load than a source with a high concentration and low flow rate. In other words, MIWs with high contaminant concentrations are not necessarily the highest sources of contaminant loading, especially if the flows are insignificant. This is why it is important to understand *both* the concentration and flow rate to adequately characterize a mining-related source of MIW in a watershed.

The water quality in the streams is impacted by the varying MIW inputs from the mining-related sources. When considered on a watershed-scale, improving the water quality requires reducing contaminant loading from the different sources of MIW. The degree of contaminant loading from a given mining-related source depends on its particular setting (e.g., mine size, connection to bedrock groundwater, topography, proximity to surface water, mineralogy). Actions that reduce toxic metal loading to surface waters containing aquatic ecosystems are likely to reduce the metal-related ecological risks to resident or potentially resident aquatic communities in the immediate receiving waters and hydrologically connected downstream reaches (FFS Appendix B, Part 2).

D.5 Formation and Transport Mechanisms Resulting in Contaminant Migration Issues

The following subsections describe the geochemical and transport mechanisms for the mining-related sources that result in the contaminant migration issues addressed by remedial alternatives in the FFS.

D.5.1 Formation of MIW

MIW is water that is contaminated or influenced by mining-related activities. It is a broad term that does not specify the source of the contamination (other than a mining activity) or the pH of the water. MIW can include both acid mine drainage or acid rock drainage or water that is not acidic. MIW is formed by the oxidation of sulfide minerals, together with reactions of the base minerals in the rock, which are exposed to air and water. Activities that involve the excavation of rock with sulfide minerals, such as mining, accelerate the process because such activities increase the exposure of sulfide minerals to air, water, and microorganisms (INAP 2009).

MIW is metal-bearing, often acidic water discharged from underground mine workings through adits, tunnels, or shafts (collectively referred to as portals in the FFS), or through fractures in bedrock. MIW can also result from water seeping or flowing through and from acid-generating materials such as waste rock, tailings piles, or mineralized rock formations. MIW can also result from the physical erosion of mine waste materials into downstream receiving waters. The transported material can contaminate stream sediments, form secondary deposits of contaminated material, and potentially generate MIW in downstream areas.

The acid-generating source materials contain minerals, especially pyrite (FeS_2), that are unstable in the surface environment. When host rock, waste rock, or tailings bearing pyrite and other sulfide minerals are exposed to water and oxygen, the sulfide undergoes an oxidation reaction that produces sulfuric acid (H_2SO_4) and ferrous iron (Fe^{2+}). The rate of oxidation is difficult to predict, as it is strongly controlled by the size of the mineral particles, crystal morphology, crystal surface texture, porosity, and degree of aggregation with other minerals. Importantly, these oxidation reactions can also be catalyzed by microorganisms.

$$2FeS_2(s) + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO4^{-2} + 4H^{+}$$

In the presence of water with sufficient dissolved oxygen or when in contact with the atmosphere, the ferrous iron produced during pyrite oxidation will oxidize to ferric iron (Fe^{3+}).

$$4Fe^{2+} + O_2 + 4H^+ \rightarrow 4Fe^{3+} + 2H_2O$$

At pH values above approximately 3, the ferric iron may precipitate as iron hydroxide, which produces additional acidity. This reaction produces the common red to orange precipitates often observed at mine sites.

$$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3\,(s) + 3H^+$$

Mine workings often achieve solubility equilibrium with iron hydroxide because the kinetics of the precipitation reaction is rapid in relation to the retention time. Ferric iron that does not precipitate may oxidize additional pyrite. This is one factor involved in the rapid increase in the rate of acid generation once pH conditions decrease to approximately 3 and ferrous iron remains in solution. This reaction also provides for pyrite oxidation under saturated conditions in the presence of ferric iron.

$$FeS_2(s) + 14Fe^{3+} + 8H_2O \rightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+$$

In the process of pyrite oxidation, toxic metals and metalloids that were present as substitutions in the pyrite crystal structure are liberated from the solid form and become mobile and bioavailable. Oxidation of other metal sulfides in mine waste may not generate acid, but it does serve to liberate toxic metals associated with these phases into the environment.

D.5.2 Particulate Erosion and Transport

Particulate erosion and transport occurs when contaminated soil particles are detached, suspended, and transported from their original location, typically through precipitation runoff velocity, lack of vegetation cover, or through failure of unstable slopes (EPA 2000). The contaminants within the particles can be potentially transported to downstream surface waters far from their origin. Dissolved phase COPCs can also adsorb to sediments and be transported in effect as solid phase particulates. Draining adits with MIW often discharge onto or adjacent to mine waste piles. Increased erosion and transport of mine waste or contaminated soil into receiving water is likely from these MIW discharges (FFS Appendix A).

D.5.3 Uncontrolled Release of MIW

Uncontrolled releases of MIW may occur in a variety of scenarios where surface water flow in streams or subsurface water flows from underground mine workings is partially obstructed by mine waste or other mining-related materials. In the event mine waste material blocks a stream or is undercut by a stream, high contaminant loading events can occur if the blockage or waste pile suddenly destabilizes. Obstructions of draining mine portals may cause accumulation of MIW, sediments, and precipitates, which could result in uncontrolled releases to surface water. Ponds can fill with sediment, which reduces pond capacity for MIW and can lead to an uncontrolled release of a large amount of accumulated and mobile particulate sediment that has been impacted by MIW.

D.5.4 Reduced Residence Time

Settling ponds such as mine portal ponds can reduce contaminant concentrations in MIW by allowing suspended COPCs to settle out of the adit discharge water. The residence time for particle settling is dependent on the volume of the pond. The size (volume) is of a settling pond is typically designed using a targeted residence time, or average time that the water spends in the pond, along with extra capacity for storage of those sediments.

$$Flow\ rate\ (Q) = \frac{Volume\ (V)}{Time\ (t)}$$

Rearranged for volume:

$$V = Qt$$

Thus, for a constant flow rate, an increase in time in the settling pond requires an increase in pond volume. If flow rates increase, given the same pond volume, the time spent in the pond decreases.

When sediments and sludges accumulate, the residence time of adit discharge in the ponds is reduced and the water "short circuits" through the pond (i.e., water passes through the pond too quickly for effective particle settling or bypasses the pond altogether). Residence time can be similarly affected by the erosion of a separation berm between successive ponds. The ability for metals to settle out of the adit discharge water is reduced if the sludge accumulates such that water does not flow through the settling ponds as intended (FFS Appendix A), rendering the ponds ineffective for settling treatment, and potentially a creating a source for a future release of MIW, as discussed above.

D.5.5 Dissolved Phase Contaminants

Once COPCs are in the dissolved phase, treatment of the MIW becomes more difficult. Removal of dissolved COPCs in MIW requires a change the solubility or redox state to form relatively insoluble precipitates that can be removed from the water column (such as would happen in a water treatment plant or an engineered passive or semi-passive treatment system). Some dissolved COPCs in the MIW may form precipitates and/or adsorb to other precipitates and be removable as solids without an engineered treatment system, but effectiveness is less efficient and is more uncertain. In-stream and obstructive mine waste creates potential for additional metals leaching into nearby surface water bodies. It is therefore desirable to reduce the interactions between water and MIW-generating waste materials to lessen the formation of dissolved phased COPCs.

D.6 Mitigation Approaches for Contaminant Migration Issues Considered in Remedial Alternatives

When remediating sites, it is generally preferable to use a technology that provides a permanent solution (INAP 2009). However, interim responses can also be appropriate where there are opportunities "for conducting activities that, while not time critical or directed at eliminating the source of contamination, may temporarily decrease exposure from certain pathways" (EPA 2000). The IRAs contemplated in the FFS are not intended to be a permanent action, given the preliminary nature of remedial investigation at the Site. More permanent actions that could include waste relocation and isolation (e.g., removal to an engineered repository) require longer lead times, engineering design, agency coordination, and land use planning. The IRAs, as indicated in the FFS, are interim actions to reduce contributions to unacceptable risks from COPCs by reducing MIW generation, reducing transport of COPCs to other media (e.g., surrounding soils and surface water for contaminant migration issues related to unacceptable ecological risks, and reducing human health risks during camping from exposures to COPCs (e.g., via ingestion and inhalation (lead) and ingestion (arsenic)) prior to a final remedy determination.

The remedial alternatives in the FFS largely focus on addressing the contaminant migration issues through water management and its separation from contaminated solid phase mining-related sources (within the limited scope of the IRAs). This focus is to limit the formation of MIW and/or transport of contaminated solid media to receiving waters. These remedial approaches are consistent with control, diversion, and containment interim responses identified in the EPA Handbook (EPA 2000). The EPA Handbook states "These actions do not necessarily result in a facility being returned to ambient conditions; contamination may still be present and additional investigations or remediation may be required. As long as the containment measures are maintained, however, stabilized facilities commonly do not present unacceptable short-term risks to human health or the environment."

The GARD Guide (INAP 2009) provides perspective on the problem of preventing and mitigating MIW at mine sites:

> *The implementation of methods for prevention and mitigation* [of MIW] *depends on the mine development stage, deposit type, geochemistry, climatic regime, terrain (or topography), surface water, geology, groundwater, and aquatic and terrestrial ecosystems. Material availability, land management and land use requirements, receptors, risk, cost, maintenance, sustainability and regulatory requirements will also influence the approach selected.*

The GARD Guide also states: "Prevention and mitigation [of MIW] is an exercise in water quality management because water acts as a transport mechanism and as a reactant" (INAP 2009).

Because water and oxygen are required for oxidation of pyrite, limiting one or the other reactant should reduce the amount of acid produced, and thus limit the minerals dissolved. However, the amount of water required for sulfide oxidation is virtually always present in excess, except in extremely arid environments (INAP 2009). As is evident from the chemical reactions presented previously, cyclic wetting and drying that mine waste undergoes is conducive to the generation of MIW. It is difficult to limit oxygen and water infiltration in the open environment, such as is the case at the Site.

The best approaches to mitigating MIW formation are those that prevent clean (uncontaminated) water from turning into MIW in the first place, often termed "source control" (INAP 2009, ITRC 2010). If this is not possible, the primary role of water management is to route water away from waste to reduce infiltration through mine wastes and reduce the volume of MIW drainage.

Several of the remedial alternatives under evaluation in the FFS focus on managing water (whether uncontaminated stormwater or MIW) from contact with solid-phase mining-related sources. IRAs under evaluation in this FFS also have the purpose of improving the quality of the already-formed MIW through settling of solid-phase COPCs. However, this remedial benefit is limited to COPCs already in the total recoverable or solid phases. As previously discussed, treatment of MIW becomes more difficult once COPCs are in the dissolved phase.

D.7 Protectiveness and Effectiveness Considerations for Evaluation of Remedial Alternatives

The following subsections qualitatively discuss protectiveness and effectiveness considerations for remedial alternatives addressing the five contaminant migration issues identified in the FFS, using the information previously presented in this appendix.

D.7.1 Mine Portal MIW Discharges (Alternatives A1, A2)

Mine portal MIW is an issue because the discharge onto adjacent mine waste could increase the potential for erosion or mass wasting of contaminants in particulate form and/or cause leaching of COPCs from mine wastes to surface water, which contribute to unacceptable ecological risks. Furthermore, if discharge from the mine portal is partially obstructed, it has a potential to create an unstable impoundment of MIW, sediments, and metal precipitates of limited depth. While the minimal depth of that impoundment due to a partial obstruction would not result in flooded mine workings and buildup of significant hydraulic head that results in catastrophic releases, there could be enough MIW and sediment buildup after removing a partial obstruction in a temporary surge of flow to surface water with COPCs further contributing to unacceptable ecological risks.

By removing partial obstructions or rerouting discharges from flowing adits or other mine portals, the loading of COPCs is expected to decrease over the long term due to limited or no interaction of MIW with mine wastes. This lack of interaction with mine wastes reduces COPC concentrations in MIW contributing to contaminant mass loading, thus achieving PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). MIW is also diverted/isolated from mine wastes into a more stable channel, which should remain effective as long as the integrity of the diversion channel is maintained. This also reduces leaching from the mine waste pile and stabilizes the waste pile from erosion, which further reduces COPC concentrations contributing to contaminant mass loading. Removal of partial obstructions from mine portals also allows for inspection and observation of the conditions of the mine portal opening, preventing a future accumulation of MIW and sediment/precipitate material that can lead to an unstable blockage and a future release of MIW and particulate/precipitate material.

However, there may be short-term impacts as the partial obstruction of the mine portal is removed. The collapsed material in front of the portal may have been serving as a filter, retaining sludge and precipitates just inside the mine portal behind the blockage. This short-term impact should be considered in planning. There may also be a temporary surge of higher flows of MIW until the bedrock groundwater system within mine workings re-equilibrates.

D.7.2 Mining-Related Source/Stormwater Interactions (Alternatives B1, B2)

Mining-related source/stormwater interactions are an issue, because co-mingling of stormwater and mining-related sources could lead to transport of COPCs to surface water, which contribute to unacceptable ecological risks. This transport could occur due to erosion or mass wasting of contaminants in particulate form, and/or infiltration of the stormwater and generation of MIW.

By rerouting discharges of uncontaminated stormwater around mining-related sources, the loading of COPCs is expected to decrease over the long term due to limited or no interaction of stormwater with mine wastes. This lack of interaction with mine wastes reduces COPC concentrations in MIW contributing to contaminant mass loading, thus achieving PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). Stormwater is also diverted/isolated from mine wastes into a more stable channel, which should remain effective as long as the integrity of the diversion channel is maintained. This also reduces leaching from the mine waste pile and stabilizes the waste pile from erosion, which further reduces COPC concentrations contributing to contaminant mass loading. Since stormwater is uncontaminated, short-term impacts from diversion/isolation are limited to releases of particulates from uncontaminated upgradient soils that may pose turbidity and sedimentation issues if left unmanaged.

D.7.3 Mine Portal Pond Sediments (Alternatives C1, C2)

Mine portal pond sediments are a contaminant migration issue because they reduce storage space for settling of sediments and COPC-containing precipitates in ponds. Reduced capacity in the mine portal ponds increases the likelihood for short circuiting (water passes through the pond too quickly for effective particle settling or bypasses the pond altogether). The accumulated sediment has a potential to release COPCs (both particulates and MIW) during storm events to surface water, contributing to unacceptable ecological risks.

By removing sediments in the pond and repairing pond berms, storage space could be increased and mitigate short-circuiting, allowing more time for particulate settling at a given flow rate. The pond could also receive higher flow rates (e.g., during runoff events from precipitation or snowmelt) without scouring or re-entraining the retained sediments. These measures reduce the concentrations of COPCs and volume of MIW released over a given time from the ponds, resulting in a reduction of contaminant mass loading and thus achieving PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). The measures would continue to be effective as long as excessive sediment buildup is managed through monitoring and maintenance.

There may be temporary short-term impacts from mine portal pond sediment excavation, depending on MIW flow conditions to the ponds. A short-term increase in contaminant mass loading could result due to the disturbance of the sediments, exposing buried precipitates and reactive minerals from sediments to water and oxygen, temporarily increasing production of MIW.

D.7.4 In-Stream Mine Wastes (Alternatives D1, D2)

In-stream mine wastes are a contaminant migration issue because they impede the flow of surface water in streams, increasing the potential for erosion or mass wasting of contamination in particulate form and/or leaching of COPCs from mine wastes to surface water, which contribute to unacceptable ecological risks.

By removing mine wastes or rerouting stream channels around them, the loading of COPCs is expected to decrease over the long term due to limited or no interaction of surface water in streams with mine wastes. This lack of interaction with mine wastes reduces COPC concentrations in surface water contributing to contaminant mass loading, thus achieving PRAO 1

(PRAOs 2 and 3 are not pertinent to this contaminant migration issue). Surface water in streams is also rerouted from the impacted footprints of mine wastes, which also reduces leaching from the residual mine waste footprint which further reduces COPC concentrations contributing to contaminant mass loading.

Because the surface water often cuts through or undercuts the mine waste, removing it from the water helps lessen the likelihood of erosion and/or a sudden collapse of the material into surface water. Keeping the mine waste out of the water prevents MIW formation in the first place. However, depending on the stream conditions, a short-term increase in loading could result due to the disturbance of the mine waste exposing unreacted surfaces of reactive minerals to water and oxygen, temporarily increasing production of MIW.

D.7.5 Mining Impacted Recreation Staging Areas (Alternatives E1, E2)

Mining impacted recreation staging areas are a contaminant migration issue because camping at these staging areas causes repeated disturbances of mine wastes and contaminated soils that could result in exposure to arsenic through incidental ingestion or lead through inhalation and ingestion. Many of these areas are attractive to recreational visitors because they are often flat and unvegetated, perhaps indicating to the visitor that these barren areas are supposed to be used. Contributions to human health risks (from lead or arsenic under acute exposure scenarios) from mine wastes and contaminated soils at recreation staging areas could occur due to camping or other sedentary activities.

By covering recreation staging areas with uncontaminated soil or rock, a barrier to direct exposure from mine waste and contaminated soils containing lead would be present and would reduce exposures greater than a 5 percent chance of exceeding a blood lead level of 5 µg/dL during camping activities. Thus, PRAO 2 could be achieved. In addition, the covers would provide a barrier to direct exposure to mine waste and contaminated soil containing arsenic that exceed acute risk-based levels during camping. Thus, PRAO 3 could also be achieved. PRAO 1 is not pertinent to this contaminant migration issue.

While covering of mine wastes and contaminated soil can be effective at preventing direct exposure risk, the covers used for containment/isolation of mine wastes and contaminated soils could also be breached if disturbed, resulting in potential lead and arsenic exposures to campers.

D.8 References

EPA. 2000. *Abandoned Mine Site Characterization and Cleanup Handbook*. U.S. Environmental Protection Agency, EPA 910-B-00-001.

INAP. 2009. *The International Network for Acid Prevention Global Acid Rock Drainage Guide* (GARD Guide). Accessed February 2018 at http://www.gardguide.com/.

ITRC. 2010. *Mining Waste Treatment Technology Selection*. Accessed February 2018 at https://www.itrcweb.org/miningwaste-guidance/.

Appendix E

Detailed Evaluation of Alternatives

CDM Smith

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Detailed Evaluation of Mine Portal MIW Discharges Alternatives

Alternative A1
No Action

Table E-1a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative A1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	▪ This alternative would not be protective to human health and environment in the short term and would not provide adequate protection until a final remedy is selected. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation and would not meet preliminary remedial action objective 1 (PRAO 1) (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). ▪ Unaddressed mine portal mining-influenced water (MIW) discharges and partial obstructions to these discharges would not achieve PRAO 1 since no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable ecological risks. ▪ Unaddressed partial obstructions to MIW discharges would continue to impede MIW flow, increasing the potential for erosion or mass movement of contamination in particulate form and/or leaching of contaminants from mine wastes especially during periods of precipitation and snowmelt that contribute to unacceptable ecological risks.

Table E-1b. Evaluation Summary for Compliance with ARARs – Alternative A1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	▪ Chemical-, location-, and action-specific ARARs would not be triggered since no new remedial measures would be undertaken.

Table E-1c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative A1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges. ▪ Unaddressed obstructed MIW discharges have a potential to create an unstable impoundment of MIW, sediments, and metal precipitates that could be released to surface water in an uncontrolled manner. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ This alternative would not reduce generation and migration of MIW, and would not reduce releases to surface water from interaction with mining-related sources. ▪ Mine portal MIW discharges would migrate to surface water and could continue to contribute to unacceptable ecological risks.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ No controls are put in place under the no action alternative. Thus, mine portal MIW discharges would be left uncontrolled.

Table E-1d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative A1

<table>
<tr><th>Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment</th><th>Evaluation Summary</th></tr>
<tr><td>The treatment processes, the alternative uses, and materials they will treat</td><td rowspan="6">▪ No remedial action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment.
▪ The statutory preference for treatment as a principal element of the remedial action would not be met.</td></tr>
<tr><td>The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed</td></tr>
<tr><td>The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment</td></tr>
<tr><td>The degree to which the treatment is irreversible</td></tr>
<tr><td>The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents</td></tr>
<tr><td>Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action</td></tr>
</table>

Table E-1e. Short-Term Effectiveness Evaluation Summary – Alternative A1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges. Thus, there are no short-term risks posed on workers during implementation of the alternative.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	No action would be undertaken to address mine portal MIW discharges. Thus, there would be no potential adverse environmental impacts resulting from implementation of the alternative.
Time until protection is achieved	No action would be undertaken to address mine portal MIW discharges. Thus, protection would not be achieved under this alternative.

Table E-1f. Implementability Evaluation Summary – Alternative A1

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	No action would be to address mine portal MIW discharges and partial obstructions to these discharges. Since no action would be taken, there is no remedy to monitor.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
	Ease of undertaking additional remedial actions including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	
Administrative feasibility	Activities needed to coordinate with other offices and agencies	No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges; thus, there is no need to coordinate with other offices and agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	No offsite remedial activities would be conducted under this alternative.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges; thus, this criterion is not applicable.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	No action would be undertaken to address mine portal MIW discharges and partial obstructions to these discharges; thus, this criterion is not applicable.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	
	Availability of prospective technologies	

Table E-1g. Cost Evaluation Summary – Alternative A1

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	None
Total annual O&M cost	None
Total periodic O&M cost	None
Total cost (excluding present value discounting)	None
Total present value cost	None

Alternative A2
Diversion/Isolation

Table E-2a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative A2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would provide protection of human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. ▪ This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ PRAOs 2 and 3 are not pertinent to this contaminant migration issue. ▪ PRAO 1 would be achieved by construction and/or maintenance of diversion and isolation components to route mine portal MIW discharges around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. This would reduce the potential for mine portal MIW discharges to generate additional MIW and reduce transport of particulates containing chemicals of potential concern (COPCs) to surface water, which contribute to unacceptable ecological risks. ▪ Mine wastes or other materials at the entrance to mine portals that are partially obstructing free flow of MIW discharges would be excavated to reduce the potential for uncontrolled releases of particulates and MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. ▪ The excavation of mine wastes or other materials partially obstructing the entrance to mine portals could cause a minimal release of retained sludge and precipitates just inside the mine portals behind the partial blockages and temporary surges of higher flows of MIW until re-equilibration. ▪ Short-term increases in contaminant loading could result due to disturbances of the mine wastes during excavation, resulting in temporary increases in production of MIW. ▪ Local management of excavated mine wastes would include best management practices (BMPs) such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. ▪ Dust suppression would be maintained to eliminate contaminant migration during implementation of this alternative. ▪ Residual risks remain from untreated mine wastes managed locally at the mining-related source on an interim basis. Long-term effectiveness of interim waste management locations would be dependent on BMPs, inspection, and repair, as necessary, to maintain their integrity. ▪ Monitoring and maintenance of the diversion/isolation components and local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to institutional controls [ICs], storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection to assess maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of interim management location components and diversion/isolation components. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations and diversion/isolation components. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy. This data would provide information about the effectiveness of the alternative and is intended to help inform future remedial decisions at the Site.

Table E-2a. (continued)

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site (continued)	▪ While the Site-wide risk assessment is ongoing, it is assumed that the alternative would not result in unlimited use and unrestricted exposure land use scenarios. Thus, five-year reviews are assumed to be conducted for the mining-related sources included in this alternative in conjunction with sources addressed by other response actions as part of Site-

Table E-2b. Evaluation Summary for Compliance with ARARs – Alternative A2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	This alternative complies with or waives federal and state ARARs that are applicable or relevant and appropriate (presented in Appendix C) for this alternative. ***Chemical-Specific ARARs:*** ▪ State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. ▪ The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited remedial investigation (RI) information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative. ***Location- and Action-Specific ARARs:*** ***Remedial Activities:*** Excavation: ▪ The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. Dust Suppression: ▪ Dust suppression and emission-controlled equipment will be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements. Dewatering: ▪ All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. ▪ Because the groundwater, as defined in 5 Colorado Code of Regulations (CCR) 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado effluent limitations and Colorado Discharge Permit System (CDPS) regulations for groundwater. ▪ During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado effluent limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. ▪ The substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked.

Table E-2b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	<u>Interim Local Waste Management</u>: ▪ Mine wastes meet the exclusion requirements for identification as a hazardous waste indicated in 40 Code of Federal Regulations (CFR) 261.4(b)(7), commonly known as the "Bevill" exclusion and will be regulated as solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative. ▪ Mine wastes meet the exemptions from the extraction, beneficiation, and some processing of ores and minerals, in accordance with Colorado Hazardous Waste Identification and Listing: Exemption of Extraction, Beneficiation and Processing Mining Waste 6 CCR 1007-3, 261.4(b)(7), thus is assumed to be classified as a non-hazardous solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative. ▪ Pursuant to the Solid Wastes Disposal Sites and Facilities Act, Colorado Revised Statutes (C.R.S.) § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under a Colorado Mined Land Reclamation Board (MLRB) permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. The Colorado Department of Public Health and Environment (CDPHE) interprets this provision to allow CERCLA response actions performed consistently with MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal. ▪ All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards), which would allow the alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations. ▪ Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Surface Reclamation</u>: ▪ All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Institutional Controls</u> ▪ Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute. <u>Construction Activities:</u> ▪ Cultural resource surveys have not been completed for all mining-related sources addressed by the alternative. If any resources are found, it will be necessary to determine if there will be an adverse effect on the resource and if so, how the effect may be minimized or mitigated in accordance with National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act. ▪ If bald or golden eagles are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act. ▪ If the alternative involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and implementing regulations. ▪ If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Endangered Species Act.

Table E-2b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Migratory Bird Treaty Act. ▪ The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Wildlife Enforcement and Penalties Act and the Colorado Non-game, Endangered, or Threatened Species Act. ▪ It is not anticipated that nests or dens of wildlife exist at the mining-related sources. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission regulations. ▪ Activities conducted during remedial action on U.S. Forest Service (USFS)- managed land, such as borrow sources for berms and access roads and implementation of the alternative at the Brooklyn Mine, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan. ▪ If the alternative involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and Federal Emergency Management Agency (FEMA) floodplain management regulations. ▪ Maximum permissible noise levels would be established during remedial action and all construction activities would comply with Colorado Noise Abatement Statue 25-12-103.

Table E-2c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative A2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ As discussed in Appendix D, the loading of COPCs is expected to decrease under this alternative because diversion/isolation components addressing the interaction between mine portal MIW discharges and mine wastes it reduces the contact of the water with the waste, thereby reducing leaching and formation of MIW. However, the water quality in the streams irrespective of the removed mine wastes diversion/isolation components would still be impacted and contribute to unacceptable ecological risks. ▪ Residual risks would remain from untreated mine wastes excavated for diversion/isolation components and managed locally at the mining-related sources. Inspection and repair of the diversion/isolation components would be performed as necessary to maintain their integrity. Long-term effectiveness of interim local management locations would be dependent on BMPs, inspection, and repair as necessary to maintain their integrity.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	▪ Construction of diversion and isolation components to route mine portal MIW discharges around contaminated mine wastes are reliable controls if properly maintained. ▪ Long-term effectiveness of local waste management locations would be dependent on BMPs. ▪ Long-term effectiveness of diversion/isolation components would depend on their integrity. Inspection and repair of the diversion/isolation components and interim local waste management locations would be conducted as needed primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires, etc.). ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations and diversion/isolation components.

Table E-2d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative A2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ There is no treatment under this alternative; thus, there is no reduction of toxicity, mobility, or volume through treatment for MIW discharge. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-2e. Short-Term Effectiveness Evaluation Summary – Alternative A2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be impacts posed to the community (e.g., recreational users) due to increased safety hazards, as truck traffic would be required to transport borrow materials to mining-related categories for interim local waste management location berm construction and access road improvements. Safety measures, such as signage and flaggers, could be used in areas where truck traffic could pose increased safety hazards. ▪ Short-term risks posed to the community during implementation of the alternative also relate to human recreational users within the mining-related sources that ignore safety protocols, such as signage and work zones. ▪ Installation of temporary access roads to mining-related sources could attract recreational users to work areas, especially in unconventional access- subalpine and alpine categories. ▪ Implementation of this alternative could cause a short-term risk to the community due to dust creation after the excavation and berm construction. Safety measures, such as dust suppression, would protect community during implementation.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ Construction of diversion and isolation components and excavation and interim local management of mine wastes could pose some short-term risks to workers. ▪ Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures, such as signage and flaggers, would be implemented to protect workers from increased traffic. ▪ Safety measures, such as dust suppression, use of personal protection equipment (PPE) (e.g., steel-toe boots), and establishment of work zones, would protect workers during implementation.

Table E-2e. (continued)

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures (continued)	▪ Frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures could cause additional short-term risk to workers performing construction in alpine areas. Safety measures would be implemented to protect workers during implementation. ▪ Working in alpine areas could result in high altitude sickness, sunburns, and dehydration in workers. Safety measures, such as hydration and use of sunscreen, would protect workers during implementation. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as falls, electrical hazards, and mechanical hazards. Working at the entrance of mine portals could present additional hazard. ▪ These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ Short-term increases in contaminant loading could result due to disturbance of the mine wastes during excavation, resulting in temporary increases in production of MIW. ▪ The excavation of mine wastes or other materials partially obstructing the entrance to mine portals could cause a minimal release of retained sludge and precipitates just inside the mine portals behind the partial blockages and temporary surges of higher flows of MIW until re-equilibration. ▪ There could also be impacts to the environment during the implementation of the alternative due to the use of construction and hauling equipment and development of borrow for berm and access road construction, such as soil erosion, sedimentation, and stream crossing. There could also be damage to sensitive alpine meadow ecosystems. ▪ Use of fuel-efficient and low-emission equipment, use of LGP equipment in alpine areas, minimization of the area of soil disturbance, use of protective mats, implementation of erosion and sediment control measures, as well as careful selection and reclamation of access roads and borrow areas could reduce environmental impacts. ▪ The alternative would involve disturbance of mine waste which could pose potential adverse impacts through dispersion of dust after excavation and berm construction. Water- or chemical- based suppression would be used for controlling dust during construction. ▪ Development of borrow areas could adversely impact the environment. Mitigation measures could include selection of easily accessible borrow locations and reclamation of borrow areas after use. These activities, if conducted on USFS-managed land would follow BMPs identified within the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.
Time until protection is achieved	▪ The alternative at individual mine-related sources could be implemented in less than one year. Overall this alternative could be implemented at all identified mining-related sources within five years.

Table E-2f. Implementability Evaluation Summary – Alternative A2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Logistics for working with large numbers of construction equipment maybe difficult to manage in constrained mining-related categories. ▪ Mobilization and demobilization to mining-related sources located in unconventional access-subalpine and alpine categories would present difficulties in mobilizing and demobilizing of construction equipment for the implementation of this alternative. ▪ Implementation of this alternative at alpine locations could provide difficulties due to frequent changes in weather conditions, high-altitude lightning storms, rockslides, slope failure. ▪ Maintenance and monitoring of diversion/isolation components and interim local waste management areas could provide difficulties due to access and constrained mining-related categories, especially at nonconventional access-alpine and subalpine categories.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Construction of diversion and isolation components, excavation, dewatering, and interim local management of mine wastes is relatively straightforward and can be implemented using available equipment and labor resources. ▪ Implementation of alternative at alpine locations could be challenging, as machinery and systems often perform differently at higher elevations than they do at lower elevations. Vehicle performance can be compromised due to loss of horsepower at high elevations. These challenges would be considered prior to equipment selection. ▪ High water flow in a stream, caused by heavy rains, might cause a schedule delay. ▪ It is assumed that designated uncontaminated borrow outside of mining-related sources for the construction of remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not been identified yet. ▪ Construction of diversion and isolation components, excavation, dewatering, and interim local management of mine waste at nonconventional access -subalpine and alpine categories might require the use of smaller equipment.
	Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	▪ Future construction of diversion and isolation components, excavation, dewatering, and interim management of mine waste could be implemented. These actions are consistent and could be integrated with future actions. ▪ Implementation of additional remedial action at nonconventional access-subalpine and -alpine categories would incur similar challenges to original implementation (i.e., mobilization and demobilization, frequent weather changes, etc.).
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	▪ Periodic inspection and maintenance of diversion and isolation components and interim local waste management locations are relatively easy to implement. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy is relatively easy to implement. ▪ Modifications to the ICs can be implemented; monitoring of ICs is dependent on periodic reviews of the administrative and/or legal instruments used.

Table E-2f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure (continued)	▪ Maintenance of ICs may be more difficult due to various types of ownership and land use. Maintaining ICs would require agency coordination. ▪ Five-year site reviews conducted for the mining-related sources included in the alternative in conjunction with sources addressed by other response actions as part of Site-wide activities are relatively easy to implement.
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ Regulatory approval needed for excavation of mine waste in floodplains and wetlands require coordination with the U.S. Army Corps of Engineers (USACE) but should be obtainable. ▪ Regulatory approvals of ICs should be obtainable. ▪ ICs implementation to maintain the integrity of local waste management locations and diversion/isolation components would require coordination with CDPHE and San Juan County. ▪ Regulatory approvals for monitoring and maintenance of local waste management locations and diversion/isolation components should be obtainable. ▪ Development of borrow sources for berms and access roads, and implementation of this alternative at the Brooklyn Mine would require coordination and approval from the affected land agency, such as BLM and USFS. ▪ Private ownership is the predominant ownership form for the mining-related sources identified in this focused feasibility study. Additional considerations may be required for remedial actions for mining-related sources on public land including, but not limited to, coordination with other governmental agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite actions are conducted under this alternative.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ Offsite treatment, storage, and disposal services would not be required.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ Labor, equipment, and materials for construction of diversion and isolation components, excavation, dewatering, and local management of mine wastes should be available. Work outside mine portals could require the use of special equipment. ▪ Technical equipment and specialists are available for implementation of the remedy. ▪ Technical equipment and specialists are available for site inspections that would be required under five-year site reviews.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	▪ Suitable materials for berm and access road construction would be required from within the Site. ▪ Dewatering agents (assumed to be diatomaceous earth) should be readily available.
	Availability of prospective technologies	

Table E-2g. Cost Evaluation Summary – Alternative A2

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	$1,082,000
Total annual O&M cost	$1,890,000
Total periodic O&M cost	$301,000
Total cost (excluding present value discounting)	$3,273,000
Total present value cost	$2,411,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 15).

Detailed Evaluation of
Mining-Related Source/Stormwater Interactions Alternatives

Alternative B1
No Action

Table E-3a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative B1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	▪ This alternative would not be protective to human health and environment in the short term and would not provide adequate protection until a final remedy is selected. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation would not meet PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). ▪ Under this alternative, stormwater discharges interacting with mining-related sources would not be addressed and would be left in their current conditions. No action would be initiated to remediate them or otherwise reduce the potential for stormwater to generate MIW and release particulates containing COPCs to surface water from interaction with mining-related sources which contribute to unacceptable ecological risks. ▪ Unaddressed stormwater discharges interacting with mining-related sources could increase the potential for erosion and could leach contaminants to surface water, especially during periods of precipitation and snowmelt.

Table E-3b. Evaluation Summary for Compliance with ARARs – Alternative B1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	▪ Chemical, location-and action-specific ARARs would not be triggered since no new remedial measures would be undertaken.

Table E-3c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative B1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ This alternative would not reduce generation and migration of MIW, and would not reduce releases to surface water from interaction with mining-related sources. ▪ Left uncontrolled, stormwater discharges interacting with mining-related sources could migrate to surface water and could continue to contribute to unacceptable ecological risks.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ No controls are put in place under the no action alternative. Thus, stormwater discharges interacting with mining-related sources would be left uncontrolled.

Table E-3d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative B1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ No remedial action would be undertaken to address stormwater discharges interacting with mining-related sources. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-3e. Short-Term Effectiveness Evaluation Summary – Alternative B1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ No action would be undertaken to address stormwater discharges and partial obstructions to these discharges. Thus, there are no short-term risks posed on workers during implementation of the alternative
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources. Thus, there would be no potential adverse environmental impacts resulting from implementation of the alternative.
Time until protection is achieved	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources. Thus, protection would not be achieved under this alternative.

Table E-3f. Implementability Evaluation Summary – Alternative B1

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources. ▪ Since no action would be taken, there is no remedy to monitor.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
	Ease of undertaking additional remedial actions including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources; thus, there is no need to coordinate with other offices and agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources; thus, this criterion is not applicable.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources; thus, this criterion is not applicable.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ No action would be undertaken to address stormwater discharges interacting with mining-related sources; thus, this criterion is not applicable.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	
	Availability of prospective technologies	

Table E-3g. Cost Evaluation Summary – Alternative B1

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	None
Total annual O&M cost	None
Total periodic O&M cost	None
Total cost (excluding present value discounting)	None
Total present value cost	None

Alternative B2
Stormwater Diversion/Isolation

Table E-4a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative B2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would be protective to human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. ▪ PRAOs 2 and 3 are not pertinent to this contaminant migration issue. ▪ This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ PRAO 1 would be achieved by construction and/or maintenance of diversion and isolation components to route stormwater around mine portals and/or contaminated mine wastes with the potential for interaction and co-mingling at mining-related sources. This would reduce the potential for stormwater to generate additional MIW and reduce transport of particulates containing COPCs to surface water which contribute to unacceptable ecological risks. ▪ Wastes generated from the excavation of stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation. ▪ Dust suppression would be maintained to eliminate contaminant migration from mining-related sources adjacent to the stormwater diversion/isolation components during implementation of this alternative. ▪ Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection to assess maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of diversion/isolation components. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of diversion/isolation components. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy. This data would provide information about the effectiveness of the alternative and is intended to help inform future remedial decisions at the Site. ▪ While the Site-wide risk assessment is ongoing, it is assumed that the alternative would not result in unlimited use and unrestricted exposure land use scenarios. Thus, five-year reviews are assumed to be conducted for the mining-related sources included in this alternative in conjunction with sources addressed by other response actions as part of Site-wide activities.

Table E-4b. Evaluation Summary for Compliance with ARARs – Alternative B2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	This alternative complies with or waives federal and state ARARs that are applicable or relevant and appropriate (presented in Appendix C) for this alternative. ***Chemical Specific ARARs:*** ▪ State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. ▪ The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative. ***Location- and Action-Specific ARARs:*** ***<u>Remedial Activities</u>:*** <u>Excavation:</u> ▪ The excavation of mine wastes from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. <u>Dust Suppression:</u> ▪ Dust suppression and emission-controlled equipment will be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements. <u>Surface Reclamation</u>: ▪ All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Institutional Controls</u> ▪ Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute. <u>Construction Activities:</u> ▪ Cultural resource surveys have not been completed for all mining-related sources addressed by the alternative. If any cultural resources are found, it will be necessary to determine if there will be an adverse effect on the cultural resource and if so, how the effect may be minimized or mitigated in accordance with National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act. ▪ If bald or golden eagles are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act. ▪ If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Endangered Species Act. ▪ If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Migratory Bird Treaty Act.

Table E-4b. (continued)

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ This alternative would not be conducted within streams. However, activities may impact upland wildlife species. The alternative would be carried out in a manner to avoid adversely affecting wildlife. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and the Colorado Non-game, Endangered, or Threatened Species Act. ▪ It is not anticipated that nests or dens of wildlife exist at the mining-related sources. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Wildlife Commission Regulations. ▪ Activities conducted during remedial action on USFS-managed land, such as borrow sources for berms and access roads, and implementation the alternative at the Brooklyn Mine, would need to comply with the substantive requirements of The San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan. ▪ Stormwater diversion/isolation components may be constructed adjacent to floodplains or wetlands. If the alternative involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA floodplain management regulations. ▪ Maximum permissible noise levels would be established during remedial action and all construction activities would comply with Colorado Noise Abatement Statue 25-12-103.

Table E-4c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative B2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ As discussed in Appendix D, routing of stormwater around mine portals and/or contaminated mine wastes with the potential for interaction and co-mingling at mining-related sources would reduce the potential for stormwater to generate additional MIW and release particulates containing COPCs to surface water which contribute to unacceptable ecological risks. However, the water quality in the streams irrespective of diverted/isolated stormwater would still be impacted. ▪ Residual risks remain from mining-related sources unaddressed by this alternative.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	▪ Construction of diversion and isolation components to route stormwater around contaminated mine waste is a reliable control if properly maintained. ▪ Long-term effectiveness of diversion/isolation components would depend on their integrity. Inspection and repair of the diversion/isolation components would be conducted as needed primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires, etc.). ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of diversion/isolation components.

Table E-4d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative B2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ There is no treatment under this alternative; thus, there is no reduction of toxicity, mobility, or volume through treatment for stormwater diversion/isolation. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-4e. Short-Term Effectiveness Evaluation Summary – Alternative B2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be impacts posed to the community (e.g., recreational users), due to increased safety hazards, as truck traffic would be required to transport borrow materials to mine locations for diversion/isolation components, such as berms, and access road improvements due to increased safety hazards. Safety measures such as signage and flaggers could be used in areas where truck traffic could pose increased safety hazards. ▪ Short-term risks posed to the community during implementation of the alternative also relate to human recreational users within the mine locations, that ignore safety protocols such as signage and work zones. ▪ Installation of temporary access roads to mining-related sources could attract recreational users to work areas, especially in unconventional access- subalpine and alpine categories. ▪ Implementation of this alternative could cause a short-term risk to the community due to dust creation. Safety measures, such as dust suppression, would protect community during implementation.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ Construction of diversion and isolation components could pose some short-term risks to workers. ▪ Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures, such as signage and flaggers would be implemented to protect workers from increased traffic. ▪ Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during implementation. ▪ Frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures could cause additional short-term risk to workers performing construction in alpine areas. Safety measures would be implemented to protect workers during implementation. ▪ Working in alpine areas could result in high altitude sickness, sunburns, and dehydration in workers. Safety measures such as hydration and use of sunscreen would protect workers during implementation. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as falls, electrical hazards, and mechanical hazards. Working at the entrance of mine portals could present additional hazard. ▪ These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.

Table E-4e. (continued)

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ There could be impacts to the environment during the implementation of the alternative due to the use of construction and hauling equipment and development of borrow for berm and access road construction, such as soil erosion, sedimentation, and stream crossings. There could also be damage to sensitive alpine meadow ecosystems. ▪ Use of fuel-efficient and low-emission equipment, use of LGP equipment in alpine areas, minimization of the area of soil disturbance, use of protective mats, implementation of erosion and sediment control measures, as well as careful selection and reclamation of access roads and borrow areas could reduce environmental impacts. ▪ The alternative would involve construction of diversion/isolation components that could pose potential adverse impacts through dispersion of dust during construction activities. Water- or chemical- based suppression would be used for controlling dust during construction. ▪ Development of borrow areas could adversely impact the environment. Mitigation measures could include selection of easily accessible borrow locations and reclamation of borrow areas after use. These activities, if conducted on NFS-managed land would follow BMPs identified within the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.
Time until protection is achieved	▪ The alternative at individual mine-related sources could be implemented in less than one year. Overall this alternative could be implemented at all identified mining-related sources within five years.

Table E-4f. Implementability Evaluation Summary – Alternative B2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Logistics for working with large numbers of construction equipment maybe difficult to manage in constrained mine locations. ▪ Mobilization and demobilization to mine sites located in unconventional access-subalpine and alpine categories would present difficulties in mobilizing and demobilizing of construction equipment for the implementation of this alternative. ▪ Implementation of this alternative at alpine locations could provide difficulties due to frequent changes in weather conditions, high-altitude lightning storms, rockslides, slope failure. ▪ Maintenance and monitoring of diversion/isolation components could be difficult due to lack of access and constrained mine locations, especially at nonconventional access-alpine and subalpine categories.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Construction of diversion and isolation components, is relatively straightforward and can be implemented using available equipment and labor resources. ▪ Implementation of alternative at alpine location could be challenging, as machinery and systems often perform differently at higher elevation than they do at lower elevations. Vehicle performance can be compromised due to loss of horsepower at high elevations. These challenges would be considered prior to equipment selection. ▪ High water flow in a stream, caused by heavy rains, might cause a schedule delay.

Table E-4f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Reliability of the technology, focusing on technical problems that will lead to schedule delays (continued)	▪ It is assumed that designated uncontaminated borrow outside of mining-related sources for the construction of remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not been identified yet. ▪ Construction of diversion and isolation components at nonconventional access subalpine and alpine categories might require the use of smaller equipment.
	Ease of undertaking additional remedial actions, including g what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	▪ Future construction of diversion and isolation components could be implemented. These actions are consistent and could be integrated with future actions. ▪ Implementation of additional remedial action at nonconventional access -subalpine and alpine categories would incur similar challenges to original implementation (i.e., mobilization and demobilization, frequent weather changes, etc.).
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	▪ Periodic inspection and maintenance of diversion and isolation components are relatively easy to implement. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy is relatively easy to implement. ▪ Modifications to the ICs can be implemented; monitoring of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. ▪ Maintenance of ICs may be more difficult due to various types of ownership and land use. Maintaining ICs would require agency coordination. ▪ Five-year site reviews conducted for the mining-related sources included in the alternative in conjunction with sources addressed by other response actions as part of Site-wide activities. are relatively easy to implement.
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ Regulatory approvals of ICs should be obtainable. ▪ ICs implementation to maintain the integrity of diversion/isolation components would require coordination with CDPHE and San Juan County. ▪ Regulatory approvals for monitoring and maintenance of diversion/isolation components should be obtainable. ▪ Development of borrow sources for cover materials and access roads, and implementation of this alternative at the Brooklyn Mine would require coordination and approval from the affected land agency, such as BLM and USFS. ▪ Private ownership is the predominant ownership form for the mining-related sources identified in this FFS. Additional considerations may be required for remedial actions for mining-related sources on public land including coordination with other governmental agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite actions are conducted under this alternative.

Table E-4f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ Offsite treatment, storage, and disposal services would not be required.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ Labor, equipment, and materials for construction of diversion and isolation components should be available. ▪ Technical equipment and specialists are available for implementation of the remedy. ▪ Technical equipment and specialists are available for site inspections that would be required under five-year site reviews.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	▪ Suitable materials for berm and access road construction would be required from within the Site.
	Availability of prospective technologies	

Table E-4g. Cost Evaluation Summary – Alternative B2

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	$1,035,000
Total annual O&M cost	$1,260,000
Total periodic O&M cost	$147,000
Total cost (excluding present value discounting)	$2,442,000
Total present value cost	$1,889,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 15).

Detailed Evaluation of Mine Portal Pond Sediments Alternatives

Alternative C1
No Action

Table E-5a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative C1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	▪ This alternative would not be protective to human health and environment in the short term and would not provide adequate protection until a final remedy is selected. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation and would not meet PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). ▪ Unaddressed mine portal pond sediment would not achieve PRAO 1 since no action would be initiated to remediate them or otherwise mitigate the associated unacceptable risks to the environment caused by contaminant migration and transport from these sources of contamination. ▪ Unaddressed sediment would continue to reduce storage space and settling time for MIW in ponds increasing the likelihood for short circuiting and uncontrolled release of MIW and particulates containing COPCs. ▪ Unaddressed mine portal sediment could migrate to surface water, especially during periods of precipitation and snowmelt, which contribute to unacceptable ecological risks.

Table E-5b. Evaluation Summary for Compliance with ARARs – Alternative C1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	▪ Chemical, location-and action-specific ARARs would not be triggered since no new remedial measures would be undertaken.

Table E-5c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative C1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ No action would be undertaken to address mine portal pond sediments. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ Unaddressed sediments would continue to reduce storage space of MIW in in mine portal ponds and result in the potential for uncontrolled releases of particulates and/or MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. ▪ Unaddressed sediments in mine portal ponds have potential to remobilize COPCs in sediments and/or MIW during storm events.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ No controls are put in place under the no action alternative. Thus, sediments in mine portal ponds would be left uncontrolled.

Table E-5d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative C1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ No remedial action would be undertaken to address mine portal pond sediments. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-5e. Short-Term Effectiveness Evaluation Summary – Alternative C1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ No action would be undertaken to address sediments in mine portal ponds. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ No action would be undertaken to address sediments in mine portal ponds. Thus, there are no short-term risks posed to the workers during implementation of the alternative.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ No action would be undertaken to address sediment in mine portal ponds. Thus, there would be no potential adverse environmental impacts resulting from implementation of the alternative.
Time until protection is achieved	▪ No action would be undertaken to address sediments in mine portal ponds. Thus, protection would not be achieved under this alternative.

Table E-5f. Implementability Evaluation Summary – Alternative C1

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ No action would be undertaken for sediments in mine portal ponds. ▪ Since no action would be taken, there is no remedy to monitor.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
	Ease of undertaking additional remedial actions including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ No action would be undertaken to address sediments in mine portal ponds; thus, no need to coordinate with other offices and agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite remedial activities would be conducted under this alternative.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ No action would be undertaken to address sediments in mine portal ponds; thus, this criterion is not applicable.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ No action would be undertaken to address sediments in mine portal ponds; thus, this criterion is not applicable.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	
	Availability of prospective technologies	

Table E-5g. Cost Evaluation Summary – Alternative C1

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	None
Total annual O&M cost	None
Total periodic O&M cost	None
Total cost (excluding present value discounting)	None
Total present value cost	None

Alternative C2
Excavation and Interim Local Waste Management

Table E-6a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative C2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would be protective to human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. ▪ PRAOs 2 and 3 are not pertinent to this contaminant migration issue. ▪ This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ PRAO 1 would be achieved by excavation and interim local waste management of sediment that would reduce the potential for uncontrolled releases, and transport of particulates and MIW containing COPCs to surface water from mine portal ponds, which contribute to unacceptable ecological risks. ▪ Excavated sediments would increase storage space for MIW in ponds and prevent short-circuiting. ▪ Excavation and interim local waste management would reduce migration to surface water, especially during periods of precipitation and snowmelt. ▪ Short-term increases in contaminant loading could result due to disturbance of the mine portal pond sediments during excavation, resulting in temporary increases in production of MIW. ▪ Dust suppression would be performed to eliminate contaminant migration during implementation of this alternative. ▪ Residual risks remain from untreated sediments managed locally at the mining-related source on an interim basis. ▪ Long-term effectiveness of interim waste management locations would be dependent on BMPs, inspection and repair as necessary to maintain their integrity. ▪ Monitoring and maintenance of the local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection to assess maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of interim management location components. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy. This data would provide information about the effectiveness of the alternative and is intended to help inform future remedial decisions at the Site. ▪ While the Site-wide risk assessment is ongoing, it is assumed that the alternative would not result in unlimited use and unrestricted exposure land use scenarios. Thus, five-year reviews are assumed to be conducted for the mining-related sources included in this alternative in conjunction with sources addressed by other response actions as part of Site-wide activities.

Table E-6b. Evaluation Summary for Compliance with ARARs – Alternative C2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	This alternative complies with or waives federal and state ARARs that are applicable or relevant and appropriate (presented in Appendix C) for this alternative. ***Chemical Specific ARARs:*** ▪ State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. ▪ The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative. ***Location- and Action- Specific ARARs:*** ***<u>Remedial Activities</u>:*** <u>Excavation:</u> ▪ The excavation of mine portal pond sediments from waters of the U.S. is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. <u>Dust Suppression:</u> ▪ Dust suppression and emission-controlled equipment will be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements. <u>Dewatering:</u> ▪ All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. ▪ Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado effluent limitations and CDPS regulations for groundwater. ▪ During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado effluent limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. ▪ The substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked. <u>Interim Local Waste Management</u>: ▪ Mine portal pond sediments meet the exclusion requirements for identification as a hazardous waste indicated in 40 CFR 261.4(b)(7), commonly known as the “Bevill” exclusion, and will be regulated as solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative. Mine portal pond sediments meet the exemptions from the extraction, beneficiation, and some processing of ores and minerals, in accordance with Colorado Hazardous Waste Identification and Listing: Exemption of Extraction, Beneficiation and Processing Mining Waste 6 CCR 1007-3, 261.4(b)(7), thus is assumed to be classified as a non-hazardous solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative.

Table E-6b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ Pursuant to the Solid Wastes Disposal Sites and Facilities Act, C.R.S. § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under an MLRB permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. CDPHE interprets this provision to allow CERCLA response actions performed consistently with the MLRB regulation 2 C.C.R. 407-1 Rule 3 (Reclamation Performance Standards) to be compliant with Colorado's regulations pertaining to solid waste disposal. ▪ All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 C.C.R. 407-1 Rule 3 (Reclamation Performance Standards), which would allow the alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations. ▪ Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3 <u>Surface Reclamation:</u> ▪ All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Institutional Controls</u> ▪ Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute. <u>Construction Activities:</u> ▪ Cultural resource surveys have not been completed for all mining-related sources addressed by the alternative. If any cultural resources are found, it will be necessary to determine if there will be an adverse effect to the cultural resource and if so, how the effect may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act. ▪ If bald or golden eagles are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act. ▪ If the alternative involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and Implementing Regulations. ▪ If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Endangered Species Act. ▪ If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Migratory Bird Treaty Act. ▪ If activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act.

Table E-6b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ It is not anticipated that nests or dens of wildlife exist at the mine locations. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the substantive requirements of Colorado Wildlife Commission Regulations. ▪ Activities conducted during the IRA on USFS-managed land, such as borrow sources for berms and access roads and the remedial action at the Brooklyn Mine, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan. ▪ Mine portal ponds may exist in or adjacent to floodplains or wetlands. If the remedial action involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management Regulations. ▪ Maximum permissible noise levels would be established during remedial action and all construction activities would comply with Colorado Noise Abatement Statue 25-12-103.

Table E-6c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative C2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ As discussed in Appendix D, excavating pond sediments improves the effectiveness of the pond and reduces the potential for an uncontrolled release of MIW. However, the water quality in the streams irrespective of the removed mine portal pond sediments would still be impacted. ▪ Residual risks remain from untreated mine portal pond sediments managed locally at the mining-related source on an interim basis Long-term effectiveness of interim local management locations would be dependent on BMPs, inspection and repair as necessary to maintain their integrity. ▪ Residual risks remain from mining-related sources unaddressed by this alternative.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	▪ Local waste management of excavated mine portal pond sediments is a reliable control if the interim local waste management locations are properly maintained. ▪ Long-term effectiveness of local waste management locations would be dependent on BMPs. ▪ Long-term effectiveness of diversion/isolation components would depend on their integrity. Inspection and repair of the diversion/isolation components and interim local waste management locations would be conducted as needed primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires, etc.). ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations

Table E-6d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative C2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ There is no treatment under this alternative; thus, there is no reduction of toxicity, mobility, or volume through treatment for mine portal pond sediments. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-6e. Short-Term Effectiveness Evaluation Summary – Alternative C2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be impact posed to the community (e.g., recreational users), due to increased safety hazards, as truck traffic would be required to transport borrow materials to mine locations for interim local waste management location berm construction and access road improvements due to increased safety hazards. Safety measures, such as signage and flaggers, could be used in areas where truck traffic could pose increased safety hazards. ▪ Short-term risks posed to the community during implementation of the alternative also relate to human recreational users within the mine locations that ignore safety protocols, such as signage and work zones. ▪ Installation of temporary access roads to mining-related sources could attract recreational users to work areas, especially in unconventional access- subalpine and alpine categories. ▪ Implementation of this alternative could cause a short-term risk to the community due to dust creation after excavation and pond berm construction. Safety measures, such as dust suppression, would protect the community during implementation.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ Excavation and local management of mine portal pond sediment at the mining-related sources on an interim basis could pose some short-term risks to workers. ▪ Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures, such as signage and flaggers, would be implemented to protect workers from increased traffic. ▪ Safety measures, such as dust suppression, use of PPE, and establishment of work zones, would protect workers during implementation. ▪ Frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures could cause additional short-term risk to workers performing construction in alpine areas. Safety measures would be implemented to protect workers during implementation. ▪ Working in alpine areas could result in high altitude sickness, sunburns, and dehydration in workers. Safety measures, such as hydration and use of sunscreen, would protect workers during implementation.

Table E-6e. (continued)

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures (continued)	▪ Other potential impacts could be from safety hazards during remedial implementation, such as falls, electrical hazards, and mechanical hazards. These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ Short-term increases in contaminant loading could result due to disturbance of the mine portal pond sediments during excavation, resulting in temporary increases in production of MIW. ▪ There could also be impacts to the environment during the implementation of the alternative due to the use of construction and hauling equipment and development of borrow for berm and access road construction, such as soil erosion, sedimentation, and stream crossings. There could also be damage to sensitive alpine meadow ecosystems. ▪ Use of fuel-efficient and low-emission equipment, use of LGP equipment in alpine areas, minimization of the area of soil disturbance, use of protective mats, implementation of erosion and sediment control measures, as well as careful selection and reclamation of access roads and borrow areas could reduce environmental impacts. ▪ The alternative would involve disturbance of mine portal pond sediment, which could pose potential adverse impacts through dispersion of dust after excavation and berm construction. Water- or chemical-based suppression would be used for controlling dust during construction. ▪ Development of borrow areas could adversely impact the environment. Mitigation measures could include selection of easily accessible borrow locations and reclamation of borrow areas after use. These activities, if conducted on USFS-managed land, would follow BMPs identified within the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.
Time until protection is achieved	▪ The alternative at individual mine-related sources could be implemented in less than one year. Overall this alternative could be implemented at all identified mining-related sources within five years.

Table E-6f. Implementability Evaluation Summary – Alternative C2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Logistics for working with large numbers of construction equipment may be difficult to manage in constrained mine locations. ▪ Mobilization and demobilization to mining-related sources located in unconventional access-subalpine and alpine categories would present difficulties in mobilizing and demobilizing of construction equipment for the implementation of this alternative. ▪ Implementation of this alternative at alpine locations could provide difficulties due to frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures. ▪ Maintenance and monitoring of local waste management locations may be difficult due to lack of access and constrained mine locations, especially at nonconventional access-alpine and subalpine categories.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Excavation, dewatering, and interim local waste management of mine portal pond sediments is relatively straightforward and can be implemented using available equipment and labor resources.

Table E-6f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Reliability of the technology, focusing on technical problems that will lead to schedule delays (continued)	▪ Implementation of alternative at alpine locations could be challenging, as machinery and systems often perform differently at higher elevations than they do at lower elevations. Vehicle performance can be compromised due to loss of horsepower at high elevations. These challenges would be considered prior to equipment selection. ▪ High water flow in a stream caused by heavy rains might cause a schedule delay. ▪ It is assumed that designated uncontaminated borrow outside of mining-related sources for the construction of remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not yet been identified. ▪ Excavation, dewatering, and interim local management of mine portal pond sediments at nonconventional access-subalpine and -alpine categories might require the use of smaller equipment.
	Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	▪ Future excavation, dewatering, and interim local management of mine portal pond sediments could be implemented. These actions are consistent and could be integrated with future actions. ▪ Implementation of additional remedial action at nonconventional access-subalpine and -alpine categories would incur similar challenges to original implementation (i.e., mobilization and demobilization, frequent weather changes, etc.).
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	▪ Periodic inspection of interim local waste management locations is relatively easy to implement. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy is relatively easy to implement. ▪ Modifications to the ICs can be implemented; monitoring of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. ▪ Maintenance of ICs may be more difficult due to various types of ownership and land use. Maintaining ICs would require agency coordination. ▪ Five-year site conducted for the mining-related sources included in the alternative in conjunction with sources addressed by other response actions as part of Site-wide activities are relatively easy to implement.
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ Regulatory approval needed for excavation and interim management of mine portal pond sediment in floodplains and wetlands would require coordination with USACE but should be obtainable. ▪ Regulatory approvals of ICs should be obtainable. ▪ ICs implementation to maintain the integrity of local waste management location would require coordination with CDPHE and San Juan County. ▪ Regulatory approvals for monitoring and maintenance of local waste management locations should be obtainable. ▪ Development of borrow sources for berms and access roads, and implementation of this alternative at Brooklyn Mine would require coordination and approval from the affected land agency, such as BLM and USFS.

Table E-6f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Administrative feasibility (continued)	Activities needed to coordinate with other offices and agencies (continued)	▪ Private ownership is the predominant ownership form for the mining-related sources identified in this FFS. Additional considerations may be required for remedial actions for mining-related sources on public land including coordination with other governmental agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite actions are conducted under this alternative.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ Offsite treatment, storage, and disposal services would not be required.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ Labor, equipment, and materials for excavation, dewatering, and local management of in-stream mine wastes should be available. ▪ Technical equipment and specialists are available for implementation of the remedy. ▪ Technical equipment and specialists are available for site inspections that would be required under five-year site reviews.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	▪ Suitable materials for berm and access road construction would be required from within the Site. ▪ Dewatering agent (assumed to be diatomaceous earth) should be readily available.
	Availability of prospective technologies	

Table E-6g. Cost Evaluation Summary – Alternative C2

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	$1,355,000
Total annual O&M cost	$1,110,000
Total periodic O&M cost	$2,387,000
Total cost (excluding present value discounting)	$4,852,000
Total present value cost	$3,384,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 15).

Detailed Evaluation of In-Stream Mine Wastes Alternatives

Alternative D1
No Action

Table E-7a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative D1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	▪ This alternative would not be protective to human health and environment in the short term and would not provide adequate protection until a final remedy is selected. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation and would not meet PRAO 1 (PRAOs 2 and 3 are not pertinent to this contaminant migration issue). ▪ Under this alternative, in-stream mine wastes would not be addressed and would be left in their current conditions, and no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment. ▪ Unaddressed in-stream mine wastes would continue to impede stream flow, increasing the potential for erosion or mass movement of contamination in particulate form and/or leaching of contaminants from the mine wastes. ▪ Unaddressed in-stream mine wastes could result in migration of particulates and/or MIW containing COPCs to surface water, especially during periods of precipitation and snowmelt.

Table E-7b. Evaluation Summary for Compliance with ARARs – Alternative D1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	▪ Chemical, location-, and action-specific ARARs would not be triggered since no new remedial measures would be undertaken.

Table E-7c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative D1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ No action would be undertaken to address in-stream mine wastes. ▪ Unaddressed in-stream mine wastes would continue to impede stream flow. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ Unaddressed in-stream mine wastes would continue to have the potential for erosion and result in the potential for releases of particulates and/or MIW containing COPCs to surface water, which contribute to unacceptable ecological risks. ▪ Unaddressed in-stream mine wastes have potential to remobilize COPCs in particulate form and/or MIW during storm events.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ No controls are put in place under the no action alternative. Thus, in-stream mine wastes would be left uncontrolled.

Table E-7d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative D1

<table>
<tr><th>Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment</th><th>Evaluation Summary</th></tr>
<tr><td>The treatment processes, the alternative uses, and materials they will treat</td><td rowspan="6">▪ No remedial action would be undertaken to address in-stream mine wastes. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment.
▪ The statutory preference for treatment as a principal element of the remedial action would not be met.</td></tr>
<tr><td>The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed</td></tr>
<tr><td>The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment</td></tr>
<tr><td>The degree to which the treatment is irreversible</td></tr>
<tr><td>The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents</td></tr>
<tr><td>Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action</td></tr>
</table>

Table E-7e. Short-Term Effectiveness Evaluation Summary – Alternative D1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ No action would be undertaken to address in-stream mine wastes. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ No action would be undertaken to address in-stream mine wastes. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ No action would be undertaken to address in-stream mine wastes. Thus, there would be no potential adverse environmental impacts resulting from implementation of the alternative.
Time until protection is achieved	▪ No action would be undertaken to address in-stream mine wastes. Thus, protection would not be achieved under this alternative.

Table E-7f. Implementability Evaluation Summary – Alternative D1

<table>
<tr><th colspan="2">Evaluation Factors for Implementability</th><th>Evaluation Summary</th></tr>
<tr><td rowspan="4">Technical feasibility</td><td>Technical difficulties and unknowns associated with the construction and operation of a technology</td><td rowspan="4">▪ No action would be undertaken to address in-stream mine wastes.
▪ Since no action would be taken, there is no remedy to monitor.</td></tr>
<tr><td>Reliability of the technology, focusing on technical problems that will lead to schedule delays</td></tr>
<tr><td>Ease of undertaking additional remedial actions including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions</td></tr>
<tr><td>Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure</td></tr>
<tr><td rowspan="2">Administrative feasibility</td><td>Activities needed to coordinate with other offices and agencies</td><td>▪ No action would be undertaken to address in-stream mine wastes; thus, no need to coordinate with other offices and agencies.</td></tr>
<tr><td>The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)</td><td>▪ No offsite remedial activities would be conducted under this alternative.</td></tr>
<tr><td rowspan="4">Availability of services and materials</td><td>Availability of adequate offsite treatment, storage capacity, and disposal capacity and services</td><td>▪ No action would be undertaken to address in-stream mine wastes; thus, this criterion is not applicable.</td></tr>
<tr><td>Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources</td><td rowspan="3">▪ No action would be undertaken to address in-stream mine wastes; thus, this criterion is not applicable.</td></tr>
<tr><td>Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies</td></tr>
<tr><td>Availability of prospective technologies</td></tr>
</table>

Table E-7g. Cost Evaluation Summary – Alternative D1

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	None
Total annual O&M cost	None
Total periodic O&M cost	None
Total cost (excluding present value discounting)	None
Total present value cost	None

Alternative D2
Excavation and Interim Local Waste Management

Table E-8a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative D2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would be protective to human health and environment in the short term and is intended to provide adequate protection until a final remedy is selected. ▪ PRAOs 2 and 3 are not pertinent to this contaminant migration issue. ▪ This alternative would provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ PRAO 1 would be achieved by excavation of in-stream mine wastes that impede flow or is susceptible to erosion or leaching of contaminants and formation of MIW and transport of particulates containing COPCs to surface water which contribute to unacceptable ecological risks. ▪ Excavation and interim local waste management would reduce migration to surface water, especially during periods of precipitation and snowmelt. ▪ Short-term increases in contaminants loading could result due to disturbance of the mine wastes during excavation, resulting in temporary increase in production of MIW. ▪ Local waste management of excavated mine wastes would include BMPs such as berming, as necessary, to address fugitive dust and potential erosion and sedimentation issues. ▪ Dust suppression would be maintained to eliminate contaminant migration during implementation of this alternative. ▪ Residual risks remain from untreated mine waste managed locally at the mining-related source on an interim basis. ▪ Long-term effectiveness of interim waste management locations would be dependent on BMPs, inspection, and repair as necessary to maintain their integrity. ▪ Monitoring and maintenance of the local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection to assess maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of interim management location components. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations and diversion/isolation components. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy. This data would provide information about the effectiveness of the alternative and is intended to help inform future remedial decisions at the Site. ▪ While the Site-wide risk assessment is ongoing, it is assumed that the alternative would not result in unlimited use and unrestricted exposure land use scenarios. Thus, five-year reviews are assumed to be conducted for the mining-related sources included in this alternative in conjunction with sources addressed by other response actions as part of Site-wide activities.

Table E-8b. Evaluation Summary for Compliance with ARARs – Alternative D2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	This alternative complies with or waives federal and state ARARs that are applicable or relevant and appropriate (presented in Appendix C) for this alternative. ***Chemical Specific ARARs:*** ▪ State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. ▪ The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative. ***Location- and Action- Specific ARARs:*** ***<u>Remedial Activities</u>:*** <u>Excavation:</u> ▪ The excavation of in-stream mine wastes from waters of the U.S is assumed to be performed with neat excavation only involving incidental fallback. Thus, the substantive requirements of Section 404 would not be triggered. If grading or excavation activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. <u>Dust Suppression:</u> ▪ Dust suppression and emission-controlled equipment will be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements. <u>Dewatering:</u> ▪ All dewatering activities would be conducted in a way to discharge to surface water and minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. ▪ Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado effluent limitations and CDPS regulations for groundwater. ▪ During effluent discharge to surface water from dewatering after excavating mine wastes, the discharge limit requirements of Colorado effluent limitations would be met without treatment at the dewatering locations; otherwise an interim measures CERCLA ARAR waiver would be invoked. ▪ The substantive provisions of the CDPS regulations would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked. <u>Interim Local Waste Management</u>: ▪ In-stream mine wastes meet the exclusion requirements for identification as a hazardous waste indicated in 40 CFR 261.4(b)(7), commonly known as the "Bevill" exclusion, and will be regulated as solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative. ▪ In-stream mine wastes meet the exemptions from the extraction, beneficiation, and some processing of ores and minerals, in accordance with Colorado Hazardous Waste Identification and Listing: Exemption of Extraction, Beneficiation and Processing Mining Waste 6 CCR 1007-3, 261.4(b)(7), thus is assumed to be classified as a non-hazardous solid waste. No other solid waste that could be identified as hazardous waste are anticipated to be generated during implementation of the alternative.

Table E-8b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ Pursuant to the Solid Wastes Disposal Sites and Facilities Act, C.R.S. § 30-20-102(4), mining operations including reclamation activities with approved reclamation plans under an MLRB permit may dispose of solid wastes generated by such operations within the permitted area without obtaining a Certificate of Designation. CDPHE interprets this provision to allow CERCLA response actions performed consistently with MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards) to be compliant Colorado's regulations pertaining to solid waste disposal. ▪ All waste handling and disposal activities under this alternative would be performed in accordance with substantive requirements of the relevant and appropriate subparts of MLRB regulation 2 CCR 407-1 Rule 3 (Reclamation Performance Standards), which would allow the alternative to be compliant with substantive requirements of the Colorado Solid Waste Disposal Sites and Facilities Regulations. ▪ Placement, grading, and backfilling of wastes for interim local management would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Surface Reclamation and Stream Rehabilitation:</u> ▪ All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. <u>Institutional Controls</u> ▪ Environmental Covenants would be implemented to protect diversion/isolation components and interim local waste management locations and meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute. <u>Construction Activities</u>: ▪ Cultural resource surveys have not been completed for all mining-related sources addressed by the alternative. If any are found, it will be necessary to determine if there will be an adverse effect and if so how the effect may be minimized or mitigated in accordance with National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act. ▪ If bald or golden eagles are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act. ▪ If the alternative involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources in accordance with Fish and Wildlife Coordination Act and Implementing Regulations. ▪ If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Endangered Species Act. ▪ If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with Migratory Bird Treaty Act. ▪ If activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act. ▪ It is not anticipated that nests or dens of wildlife exist at the mining-impacted categories. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with substantive requirements of Colorado Wildlife Commission Regulations.

Table E-8b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	▪ Activities conducted during remedial action on USFS-managed land, such as borrow sources for berms and access roads, and implementation of this alternative at Brooklyn Mine, would need to comply with the substantive requirements of The San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan. ▪ If the remedial action involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA Floodplain Management Regulations. ▪ Maximum permissible noise levels would be established during remedial action and all construction activities would comply with Colorado Noise Abatement Statue 25-12-103.

Table E-8c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative D2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ As discussed in Appendix D, through removal of in-stream mine wastes the loading of COPCs is expected to decrease because it reduces the contact of the water with the waste, thereby reducing leaching and formation of MIW. However, the water quality in the streams irrespective of the removed mine wastes would still be impacted. ▪ Residual risks would remain from untreated wastes managed locally at the mining-related source on an interim basis Long-term effectiveness of interim local management locations would be dependent on BMPs, inspection and repair as necessary to maintain their integrity. ▪ Residual risks remain from mining-related sources unaddressed by this alternative
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	▪ Local waste management of excavated in-stream mine wastes is a reliable control if the interim local waste management locations are properly maintained. ▪ Long-term effectiveness of interim local waste management locations would be dependent on BMPs, inspection and repair as necessary to maintain their integrity. Periodic monitoring and maintenance of interim local waste management locations would be performed until final disposition of managed wastes that would be addressed as part of a future response action. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of local waste management locations and prevent uses inconsistent with current and reasonably anticipated future land uses.

Table E-8d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative D2

<table>
<tr><th>Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment</th><th>Evaluation Summary</th></tr>
<tr><td>The treatment processes, the alternative uses, and materials they will treat</td><td rowspan="6">▪ There is no treatment under this alternative; thus, there is no reduction of toxicity, mobility, or volume through treatment for in-stream mine wastes.
▪ The statutory preference for treatment as a principal element of the remedial action would not be met.</td></tr>
<tr><td>The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed</td></tr>
<tr><td>The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment</td></tr>
<tr><td>The degree to which the treatment is irreversible</td></tr>
<tr><td>The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents</td></tr>
<tr><td>Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action</td></tr>
</table>

Table E-8e. Short-Term Effectiveness Evaluation Summary – Alternative D2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be impacts posed to the community (e.g. recreational users), due to increased safety hazards, as truck traffic would be required to transport borrow materials to mining-impacted categories for interim local waste management location berm construction and access road improvements due to increased safety hazards. Safety measures, such as signage and flaggers, could be used in areas where truck traffic could pose increased safety hazards. ▪ Short-term risks posed to the community during implementation of the alternative also relate to human recreational users within the mining-impacted categories that ignore safety protocols, such as signage and work zones. ▪ Installation of temporary access roads to mining-related sources could attract recreational users to work areas, especially in unconventional access- subalpine and alpine categories. ▪ Implementation of this alternative could cause a short-term risk to the community due to dust creation after excavation. Safety measures, such as dust suppression, would protect community during implementation.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ Excavation and local management of in-stream mine wastes at the mining-related sources on an interim basis could pose some short-term risks to workers. ▪ Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures, such as signage and flaggers, would be implemented to protect workers from increased traffic. ▪ Safety measures, such as dust suppression, use of PPE, and establishment of work zones, would protect workers during implementation. ▪ Frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures could cause additional short-term risk to workers performing construction in alpine areas. Safety measures would be implemented to protect workers during implementation. ▪ Working in alpine areas could result in high altitude sickness, sunburns, and dehydration in workers. Safety measures, such as hydration and use of sunscreen, would protect workers during implementation. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as falls, electrical hazards, and mechanical hazards. These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.

Table E-8e. (continued)

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ Short-term increases in contaminants loading could result due to disturbance of the mine waste exposing unreacted surfaces of minerals to water and oxygen, temporarily increasing production of MIW. ▪ There could also be impacts to the environment during the implementation of the alternative due to the use of construction and hauling equipment and development of borrow for berm and access road construction, such as soil erosion, sedimentation, stream crossing. There could also be damage to sensitive alpine meadow ecosystems. ▪ Use of fuel-efficient and low-emission equipment, use of LGP equipment in alpine areas, minimization of the area of soil disturbance, use of protective mats, implementation of erosion and sediment control measures, as well as careful selection and reclamation of access roads and borrow areas could reduce environmental impacts. ▪ The alternative would involve disturbance of in-stream mine wastes which could pose potential adverse impacts through dispersion of dust after excavation. Water- or chemical-based suppression would be used for controlling dust during construction. ▪ Development of borrow areas could adversely impact the environment. Mitigation measures could include selection of easily accessible borrow locations and reclamation of borrow areas after use. These activities, if conducted on USFS-managed land would follow BMPs identified within The San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.
Time until protection is achieved	▪ The alternative at individual mine-related sources could be implemented in less than one year. Overall this alternative could be implemented at all identified mining-related sources within five years.

Table E-8f. Implementability Evaluation Summary – Alternative D2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Logistics for working with large numbers of construction equipment may be difficult to manage in constrained mining-impacted categories. ▪ Mobilization and demobilization to mining-related sources located in unconventional access-subalpine and alpine categories would present difficulties in mobilizing and demobilizing of construction equipment for the implementation of this alternative. ▪ Implementation of this alternative at alpine locations could provide difficulties due to frequent changes in weather conditions, high-altitude, lightning storms, rockslides, slope failure. ▪ Maintenance and monitoring of local waste management location may be difficult due to lack of access and constrained mining-impacted categories, especially at nonconventional access-alpine and -subalpine categories.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Excavation, dewatering, and interim local waste management of in-stream mine wastes are relatively straightforward and can be implemented using available equipment and labor resources. ▪ Implementation of alternative at alpine location could be challenging, as machinery and systems often perform differently at higher elevations than they do at lower elevations. Vehicle performance can be compromised due to loss of horsepower at high elevations. These challenges would be considered prior to equipment selection. ▪ High water flow in a stream caused by heavy rains might cause a schedule delay.

Table E-8f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility (continued)	Reliability of the technology, focusing on technical problems that will lead to schedule delays (continued)	▪ It is assumed that designated uncontaminated borrow outside of mining-related sources for the construction of remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not been identified yet. ▪ Excavation, dewatering, and interim local management of in-stream mine wastes at nonconventional access-subalpine and -alpine categories might require the use of smaller equipment.
	Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	▪ Future excavation, dewatering, and interim local waste management of in-stream mine wastes could be implemented. These actions are consistent and could be integrated with future actions. ▪ Implementation of additional remedial action at nonconventional access-subalpine and -alpine categories would incur similar challenges (e.g., mobilization and demobilization, frequent weather changes, etc.) to original implementation.
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	▪ Periodic inspection of interim local waste management locations is relatively easy to implement. ▪ Intrusive monitoring, consisting of surface water measurements and/or sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy is relatively easy to implement. ▪ Modifications to the ICs can be implemented; monitoring of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. ▪ Maintenance of ICs may be more difficult due to various types of ownership and land use. Maintaining ICs would require agency coordination. ▪ Five-year site reviews conducted for the mining-related sources included in the alternative in conjunction with sources addressed by other response actions as part of Site-wide activities. are relatively easy to implement.
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ Regulatory approval needed for excavation and local waste management of in-stream mine wastes would require coordination with USACE but should be obtainable. ▪ Regulatory approvals of ICs should be obtainable. ▪ ICs implementation to maintain the integrity of local waste management location would require coordination with CDPHE and San Juan County. ▪ Regulatory approvals for monitoring and maintenance of local waste management locations should be obtainable. ▪ Development of borrow sources for cover materials and access roads, would require coordination and approval from the affected land agency, such as BLM and USFS. ▪ Private ownership is the predominant ownership form for the mining-related sources identified in this FFS. Additional considerations may be required for remedial actions for mining-related sources on public land including, but not limited to, coordination with other governmental agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite actions are conducted under this alternative.

Table E-8f. (continued)

<table>
<tr><th colspan="2">Evaluation Factors for Implementability</th><th>Evaluation Summary</th></tr>
<tr><td rowspan="4">Availability of services and materials</td><td>Availability of adequate offsite treatment, storage capacity, and disposal capacity and services</td><td>▪ Offsite treatment, storage, and disposal services would not be required.</td></tr>
<tr><td>Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources</td><td>▪ Labor, equipment, and materials for excavation, dewatering, and local management of in-stream mine wastes should be available.
▪ Technical equipment and specialists are available for implementation of the remedy.
▪ Technical equipment and specialists are available for site inspections that would be required under five-year site reviews.</td></tr>
<tr><td>Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies</td><td rowspan="2">▪ Suitable materials for berm and access road construction would be required from within the Site.
▪ Dewatering agent (assumed to be diatomaceous earth) should be readily available.</td></tr>
<tr><td>Availability of prospective technologies</td></tr>
</table>

Table E-8g. Cost Evaluation Summary – Alternative D2

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	$340,000
Total annual O&M cost	$405,000
Total periodic O&M cost	$63,000
Total cost (excluding present value discounting)	$808,000
Total present value cost	$624,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 15).

Detailed Evaluation of Mining-Impacted Recreation Staging Areas Alternatives

Alternative E1
No Action

Table E-9a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative E1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	▪ This alternative would fail to provide protection to human health and the environment in the short term until a final remedy is selected. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation. ▪ Unaddressed mining-impacted recreation staging areas would not achieve PRAOs 2 and 3 (PRAO 1 is not pertinent to this contaminant migration issue) since no action would be taken to prevent human exposure to mine wastes and contaminated soils containing lead and arsenic that exceed risk-based levels during camping at recreation staging activities. Under this alternative, mining-impacted recreation staging areas would not be addressed and would be left in their current condition. ▪ Disturbance of these areas by campers could result in human exposure to mine wastes and contaminated soils containing lead and arsenic that exceed risk-based levels during camping.

Table E-9b. Evaluation Summary for Compliance with ARARs – Alternative E1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	▪ Chemical-, location-, and action-specific ARARs would not be triggered since no remedial measures would be undertaken.

Table E-9c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative E1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ No action would be undertaken to address mining-impacted recreation staging areas. ▪ Repeated disturbances of unaddressed mining-impacted recreation staging areas could result in potential adverse lead and arsenic exposures to campers, assuming current or reasonably anticipated future recreational use. ▪ This alternative would not provide stabilization of the mining-related sources and prevent further environmental degradation.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ No controls are put in place under the no action alternative. Thus, mine waste at mining-impacted camping and recreation staging areas would be left uncontrolled.

Table E-9d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative E1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ No remedial action would be undertaken to address mining-impacted recreation staging areas. Thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-9e. Short-Term Effectiveness Evaluation Summary – Alternative E1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ No action would be undertaken to address mining-impacted recreation staging areas. Thus, there are no short-term risks posed to the community during implementation of the alternative.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ No action would be undertaken to address mining-impacted recreation staging areas. Thus, there are no short-term risks posed to the workers during implementation of the alternative.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ No action would be undertaken to address mining-impacted recreation staging areas. Thus, there would be no potential adverse environmental impacts resulting from implementation of the alternative.
Time until protection is achieved	▪ No action would be undertaken to address mining-impacted recreation staging areas. Thus, protection would not be achieved under this alternative.

Table E-9f. Implementability Evaluation Summary – Alternative E1

<table>
<tr><th colspan="2">Evaluation Factors for Implementability</th><th>Evaluation Summary</th></tr>
<tr><td rowspan="4">Technical feasibility</td><td>Technical difficulties and unknowns associated with the construction and operation of a technology</td><td rowspan="4">▪ No action would be undertaken for mining-impacted recreation staging areas.
▪ Since no action would be taken, there is no remedy to monitor.</td></tr>
<tr><td>Reliability of the technology, focusing on technical problems that will lead to schedule delays</td></tr>
<tr><td>Ease of undertaking additional remedial actions including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions</td></tr>
<tr><td>Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure</td></tr>
<tr><td rowspan="2">Administrative feasibility</td><td>Activities needed to coordinate with other offices and agencies</td><td>▪ No action would be undertaken to address mining-impacted recreation staging areas; thus, there is no need to coordinate with other offices and agencies.</td></tr>
<tr><td>The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)</td><td>▪ No offsite remedial activities would be conducted under this alternative.</td></tr>
<tr><td rowspan="4">Availability of services and materials</td><td>Availability of adequate offsite treatment, storage capacity, and disposal capacity and services</td><td>▪ No action would be undertaken to address mining-impacted recreation staging areas; thus, this criterion is not applicable.</td></tr>
<tr><td>Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources</td><td rowspan="3">▪ No action would be undertaken to address mining-impacted recreation staging areas; thus, this criterion is not applicable.</td></tr>
<tr><td>Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies</td></tr>
<tr><td>Availability of prospective technologies</td></tr>
</table>

Table E-9g. Cost Evaluation Summary – Alternative E1

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	None
Total annual O&M cost	None
Total periodic O&M cost	None
Total cost (excluding present value discounting)	None
Total present value cost	None

Alternative E2
Containment/Isolation

Table E-10a. Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative E2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would provide protection to human health and the environment in the short term until a final remedy is implemented. ▪ PRAO 1 is not pertinent to this contaminant migration issue. ▪ PRAOs 2 and 3 would be achieved by containment/isolation of mine wastes and contaminated soils within mining-impacted recreation staging areas. Combinations of aggregate and soil covers would be implemented to reduce disturbances of mine wastes and contaminated soils, and exposure to contaminants to meet the established PRAOs. ▪ Dust suppression would be performed to eliminate contaminant migration during implementation of this alternative. ▪ The covers would provide an exposure barrier and eliminate surface exposure to mine waste and contaminated soils. The covers would be sloped to promote positive drainage to minimize erosion and to reduce infiltration that could saturate the subsurface and compromise the integrity of the covers. ▪ The covers used for containment/isolation of mine wastes and contaminated soils could be breached if disturbed, resulting in potential COPC exposures to campers. ▪ Monitoring and maintenance of the covers would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). ▪ Monitoring would consist of non-intrusive (surface) visual inspection to assess maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of covers. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented, as needed, based on land ownership or management, to maintain the integrity of local waste management locations and diversion/isolation components. ▪ While the Site-wide risk assessment is ongoing, it is assumed that the alternative would not result in unlimited use and unrestricted exposure land use scenarios. Thus, five-year reviews are assumed to be conducted for the mining-related sources included in this alternative in conjunction with sources addressed by other response actions as part of Site-wide activities.

Table E-10b. Evaluation Summary for Compliance with ARARs – Alternative E2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs	This alternative complies with or waives federal and state ARARs that are applicable or relevant and appropriate (presented in Appendix C) for this alternative. ***Chemical Specific ARARs:*** ▪ State water quality standards for COPCs would likely not be met for the streams receiving mine portal MIW discharges after the alternative is constructed due to other contributing mining-related sources, thus the interim measures CERCLA ARAR waiver would be invoked for the Colorado Basic Standards and Methodologies for Surface Water. ▪ The Colorado Basic Standards for Groundwater would also be waived using an interim measures CERCLA ARAR waiver because the limited RI information available does not indicate that groundwater meeting the regulatory definition exists beneath the mining-related sources addressed by this alternative. ***Location- and Action- Specific ARARs:*** ***<u>Remedial Activities</u>:*** <u>Cover Placement</u>: ▪ The placement and grading of covers is assumed to be performed without the discharge of dredged or fill materials into the waters of the U.S. Thus, the substantive requirements of Section 404 would not be triggered. If grading activities result in a discharge of dredge material, the substantive requirements of Nationwide Permit 20 (Response Operations for Oil or Hazardous Substances) would be met. ▪ All cover placement activities would be conducted in a way minimize infiltration, if present, into the ground surface that could cause additional degradation of groundwater. ▪ Because the groundwater, as defined in 5 CCR 1002-41, is not known to be present below the mining-related sources, an interim measures CERCLA ARAR waiver would be invoked. An interim measures CERCLA ARAR waiver would also be invoked to waive the substantive provisions of Colorado Effluent Limitations and CDPS regulations for groundwater. ▪ For channelized stormwater discharges from covers, the substantive provisions of the CDPS program would be met; otherwise an interim measures CERCLA ARAR waiver would be invoked. ▪ During construction of the covers, the discharge limit requirements of Colorado effluent limitations would be met without treatment; otherwise an interim measures CERCLA ARAR waiver would be invoked. <u>Surface Reclamation</u>: ▪ All surface reclamation activities under this alternative, including placement, grading, and backfilling, would be performed to meet relevant and appropriate substantive requirements of 2 CCR 407-1 Rule 3. During construction and seeding of covers, compliance would be achieved through completion of noxious weed surveys and coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Noxious Weed Act and the San Juan County Noxious Weed regulations. <u>Dust Suppression</u>: ▪ Dust suppression and emission-controlled equipment will be used during construction activities for the alternative to achieve compliance with Colorado emission control requirements. <u>Institutional Controls</u>: ▪ Environmental covenants would be implemented for the covered portions of mining-impacted recreation staging areas to meet the substantive relevant and appropriate requirements of the Colorado Environmental Covenants Statute.

Table E-10b. (continued)

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with chemical-specific, location-specific, and action-specific ARARs (continued)	<u>Construction Activities:</u> ▪ State water quality standards would likely not be met for the streams after the action is complete due to other contributing mining-related sources; thus, the interim measures CERCLA ARAR waiver would be invoked. ▪ Cultural resource surveys have not been completed for all mining-related sources addressed by the alternative. If any cultural resources are found, it will be necessary to determine if there will be an adverse effect to the cultural resource and if so, how the effect may be minimized or mitigated in accordance with the National Historic Preservation Act, Archaeological and Historic Preservation Act, and Historic Sites Act. ▪ If bald or golden eagles are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat to comply with the substantive requirements of the Bald and Golden Eagle Protection Act. ▪ If the remedial action involves activities modifying streams or water bodies that affect wildlife and/or non-game fish, federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources in accordance with the Fish and Wildlife Coordination Act and implementing regulations. ▪ If threatened or endangered species are identified at these mining-related sources during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Endangered Species Act. ▪ If migratory birds are identified during remedial design and remedial action, activities must be modified and conducted to conserve the species and their habitat in accordance with the Migratory Bird Treaty Act. ▪ The alternative would not be conducted within streams. However, if activities were to impact streams, they would be carried out in a manner to avoid adversely affecting wildlife and/or non-game fish within streams. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with the Colorado Wildlife Enforcement and Penalties Act and Colorado Non-game, Endangered, or Threatened Species Act. ▪ It is not anticipated that nests or dens of wildlife exist at the mining-related sources. If they were to be encountered, the alternative would be implemented to avoid disturbing or destroying nests or dens. Compliance would be achieved through coordination with the Colorado Division of Parks Wildlife and in accordance with Colorado Wildlife Commission regulations. ▪ Activities conducted during remedial action on USFS-managed land, such as obtaining of borrow materials, would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan. ▪ If the alternative involves activities that affect identified floodplains or wetlands, activities will be carried out in a manner to avoid adversely affecting them and thus meet the substantive requirements of the Clean Water Act, Section 404 regulations and FEMA floodplain management regulations. ▪ Maximum permissible noise levels would be established during remedial action and all construction activities would comply with Colorado Noise Abatement Statute 25-12-103.

Table E-10c. Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative E2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	▪ As discussed in Appendix D, exposures to mine wastes and contaminated soils containing lead or arsenic that exceed risk-based levels are reduced through covers installed over recreation staging areas. However, the mine wastes and contaminated soils posing unacceptable human health risks would be left in place under the covers. The covers used for containing/isolating mine wastes and contaminated soils could be breached resulting in potential lead and arsenic exposures to campers if disturbed.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	▪ Containment/isolation of mine wastes and contaminated soils within mining-impacted recreation staging areas using a combination of aggregate and soil covers is a reliable control if the covers are properly maintained. ▪ The covers would be sloped to promote positive drainage that minimizes erosion and to reduces infiltration that could saturate the subsurface and compromise the integrity of the covers. ▪ ICs, in the form of Environmental Covenants at a minimum, would be implemented to prevent activities which would disturb the integrity of the covers and prevent uses inconsistent with current and reasonably anticipated future land uses. ▪ Long-term effectiveness of covers would be dependent on BMPs, inspection, and repair as necessary to maintain their integrity.

Table E-10d. Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative E2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment processes, the alternative uses, and materials they will treat	▪ There is no treatment under this alternative; thus, there is no reduction of toxicity, mobility, or volume through treatment for mine wastes and contaminated soils at mining-impacted recreation areas. ▪ The statutory preference for treatment as a principal element of the remedial action would not be met.
The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed	
The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment	
The degree to which the treatment is irreversible	
The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	

Table E-10e. Short-Term Effectiveness Evaluation Summary – Alternative E2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	▪ There would be impacts to the community (e.g., recreational users) due to increased safety hazards, as truck traffic would be required to transport borrow materials to mining-related sources cover construction and access road improvements. Safety measures, such as signage and flaggers, could be used in areas where truck traffic could pose increased safety hazards. ▪ Short-term risks posed to the community during implementation of the alternative also relate to human recreational users within the mining-related sources that ignore safety protocols, such as signage and work zones. ▪ Installation of temporary access roads to mining-related sources could attract recreational users to work areas, especially in unconventional access-subalpine and -alpine categories. ▪ Implementation of this alternative could cause a short-term risk to the community due to dust creation during cover placement. Safety measures, such as dust suppression, would protect community during implementation.
Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures	▪ Construction of covers within mining-impacted recreation staging areas could pose some short-term risks to workers. ▪ Driving on access roads that have high centers, rock outcroppings, steep slopes, and lack sufficient width for transporting construction equipment could cause accidents. Safety measures, such as signage and flaggers, would be implemented to protect workers from increased traffic. ▪ Safety measures, such as dust suppression, use of PPE (e.g., steel-toe boots), and establishment of work zones, would protect workers during implementation. ▪ Frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures could cause additional short-term risk to workers performing construction in alpine areas. Safety measures would be implemented to protect workers during implementation. ▪ Working in alpine areas could result in high altitude sickness, sunburns, and dehydration in workers. Safety measures such as hydration and use of sunscreen would protect workers during implementation. ▪ Other potential impacts could be from safety hazards during remedial implementation, such as falls, electrical hazards, and mechanical hazards. These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts	▪ There could also be impacts to the environment during the implementation of the alternative due to the use of construction and hauling equipment and development of borrow for covers, such as soil erosion, sedimentation, and stream crossing. There could also be damage to sensitive alpine meadow ecosystems. ▪ Use of fuel-efficient and low-emission equipment, use of LGP equipment in alpine areas, minimization of the area of soil disturbance, use of protective mats, implementation of erosion and sediment control measures, as well as careful selection and reclamation of access roads and borrow areas could reduce environmental impacts. ▪ The alternative would involve disturbance of mine wastes and contaminated soils, which could pose potential adverse impacts through dispersion of dust. Water- or chemical-based suppression would be used for controlling dust during construction. ▪ Development of borrow areas could adversely impact the environment. Mitigation measures could include selection of easily accessible borrow locations and reclamation of borrow areas after use. These activities, if conducted on USFS-managed land would need to comply with the substantive requirements of the San Juan National Forest and Tres Rios Field Office Land and Resource Management Plan.
Time until protection is achieved	▪ The alternative at individual mine-related sources could be implemented in less than one year. Overall this alternative could be implemented in five years.

Table E-10f. Implementability Evaluation Summary – Alternative E2

Evaluation Factors for Implementability		Evaluation Summary
Technical feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Logistics for working with large numbers of construction equipment maybe difficult to manage in constrained mine locations. ▪ Mobilization and demobilization to mining-related sources located in unconventional access-subalpine and alpine categories would present difficulties in mobilizing and demobilizing of construction equipment for the implementation of this alternative. ▪ Implementation of this alternative at alpine locations could provide difficulties due to frequent changes in weather conditions, high-altitudes, lightning storms, rockslides, and slope failures. ▪ Maintenance and monitoring of covers may be difficult due to lack of access and constrained mine locations, especially at nonconventional access-alpine and -subalpine categories.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ Cover placement is relatively straightforward and can be implemented using available equipment and labor resources. ▪ Implementation of alternative at alpine locations could be challenging, as machinery and systems often perform differently at higher elevations than they do at lower elevations. Vehicle performance can be compromised due to loss of horsepower at high elevations. These challenges would be considered prior to equipment selection. ▪ High water flow in a stream, caused by heavy rains, might cause a schedule delay. ▪ It is assumed that designated uncontaminated borrow outside of mining-related sources for the construction of remedial components and access roads would be generated and transported from within the Site, however borrow location(s) of suitable quantity and quality have not been identified yet. ▪ Cover placement at nonconventional access-subalpine and -alpine categories might require the use of smaller equipment.
	Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions	▪ Future cover placement and vegetation of covers could be implemented. If covers were determined not to be effective, excavation and disposal of mine wastes and contaminated soils could be conducted. These actions are consistent and could be integrated with future actions. ▪ Implementation of additional remedial action at nonconventional access-subalpine and -alpine categories would incur similar challenges to original implementation (i.e., mobilization and demobilization, frequent weather changes, etc.).
	Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure	▪ Periodic inspection of covers is relatively easy to implement. ▪ Intrusive monitoring, consisting of sample collection and analysis, would be conducted to monitor effectiveness of the implemented remedy is relatively easy to implement. ▪ Modifications to the ICs can be implemented; monitoring of ICs is dependent on periodic reviews of the administrative and/or legal instruments used. ▪ Maintenance of ICs may be more difficult due to various types of ownership and land use. Maintaining ICs would require agency coordination. ▪ If inspection and monitoring fail to detect cover failure, it could result in potential COPC exposures to campers. ▪ Five-year site conducted for the mining-related sources included in the alternative in conjunction with sources addressed by other response actions as part of Site-wide activities. are relatively easy to implement.

Table E-10f. (continued)

Evaluation Factors for Implementability		Evaluation Summary
Administrative feasibility	Activities needed to coordinate with other offices and agencies	▪ Regulatory approval needed for placement of the covers over mine wastes and contaminated soils on streambanks would require coordination with USACE, but should be obtainable. ▪ Regulatory approvals of ICs should be obtainable. ▪ ICs implementation to maintain the integrity of the covers would require coordination with CDPHE and San Juan County. ▪ Regulatory approvals for monitoring and maintenance of covers should be obtainable. ▪ Development of borrow sources for cover materials and access roads would require coordination and approval from the affected land agency, such as BLM and USFS. ▪ Private ownership is the predominant ownership form for the mining-related sources identified in this FFS. Additional considerations may be required for remedial actions for mining-related sources on public land including, but not limited to, coordination with other governmental agencies.
	The ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)	▪ No offsite actions are conducted under this alternative.
Availability of services and materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services	▪ Offsite treatment, storage, and disposal services would not be required.
	Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources	▪ Labor, equipment, and materials for cover placement should be available. ▪ Technical equipment and specialists are available for implementation of the remedy. ▪ Technical equipment and specialists are available for site inspections that would be required under five-year site reviews.
	Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies	▪ Suitable materials for covers and access road construction would be required from within the Site.
	Availability of prospective technologies	

Table E-10g. Cost Evaluation Summary – Alternative E2

Evaluation Factors for Cost	Estimated Cost (Dollars)
Total capital cost	$1,210,000
Total annual O&M cost	$135,000
Total periodic O&M cost	$623,000
Total cost (excluding present value discounting)	$1,968,000
Total present value cost	$1,668,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 15).

Appendix F

Cost Estimate

CDM Smith

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The cost spreadsheets included in this appendix were developed in accordance with EPA 540-R-00-002 (OSWER 9355.0-75) July 2000.

These costs should be used to compare alternative relative costs. Costs for project management, remedial design, and construction management were determined as percentages of capital cost per the guidance. Costs for these work items may not reflect costs for implementation. These costs are determined based on specific client requirements during implementation.

TABLE CS-ALT

ALTERNATIVE COST SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

		Total Capital Cost	Total Annual O&M Cost	Total Periodic O&M Cost	Total Non-Discounted Cost	Present Value Cost
Mine Portal MIW Discharges Alternatives						
A1	No Action	$0	$0	$0	$0	$0
A2	Diversion/Isolation	$1,082,000	$1,890,000	$301,000	$3,273,000	$2,411,000
Mining-Related Source/Stormwater Interactions Alternatives						
B1	No Action	$0	$0	$0	$0	$0
B2	Diversion/Isolation	$1,035,000	$1,260,000	$147,000	$2,442,000	$1,889,000
Mine Portal Pond Sediments Alternatives						
C1	No Action	$0	$0	$0	$0	$0
C2	Excavation and Interim Local Waste Management	$1,355,000	$1,110,000	$2,387,000	$4,852,000	$3,384,000
In-Stream Mine Wastes Alternatives						
D1	No Action	$0	$0	$0	$0	$0
D2	Excavation and Interim Local Waste Management	$340,000	$405,000	$63,000	$808,000	$624,000
Mining-Impacted Recreation Staging Areas Alternatives						
E1	No Action	$0	$0	$0	$0	$0
E2	Containment/Isolation	$1,210,000	$135,000	$623,000	$1,968,000	$1,668,000

Notes:

1 - Capital, Annual O&M, and Periodic O&M costs are presented on tables CS-A1 through CS-E2.

2 - Estimated remedial timeframes and associated present value analysis for each remedial alternative are provided on tables PV-A1 through PV-E2.

3 - The non-discounted total cost demonstrates the impact of a discount rate on the total present value cost and the relative amount of future annual expenditures. Non-discounted costs are presented for comparison purposes only and should not be used in place of present value costs in the CERCLA remedy selection process.

4 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for feasibility study level evaluation purposes.

Alternative-specific costs include all anticipated activities for implementation at the mining-related sources identified for evaluation to address the specific contaminant migration issue identified in the alternative. The alternative-specific costs exclude consideration of other remedial alternatives that address other contaminant migration issues at the same mining related sources and locations due to uncertainties such as phasing and funding of the IRA over the period of implementation. Thus some common cost elements, such as but not limited to road improvements for accessing mining-related sources, may be duplicative between alternatives and may result in conservative estimates when considering concurrent implementation of alternatives during remedial action.

Present Value and Cost Estimate Summary

Alternative A1
No Action

TABLE PV-A1

PRESENT VALUE ANALYSIS

Alternative **A1** **Mine Portal MIW Discharges**
No Action

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$0	$0	$0	$0	1.0000	$0
1	$0	$0	$0	$0	0.9346	$0
2	$0	$0	$0	$0	0.8734	$0
3	$0	$0	$0	$0	0.8163	$0
4	$0	$0	$0	$0	0.7629	$0
5	$0	$0	$0	$0	0.7130	$0
6	$0	$0	$0	$0	0.6663	$0
7	$0	$0	$0	$0	0.6227	$0
8	$0	$0	$0	$0	0.5820	$0
9	$0	$0	$0	$0	0.5439	$0
10	$0	$0	$0	$0	0.5083	$0
11	$0	$0	$0	$0	0.4751	$0
12	$0	$0	$0	$0	0.4440	$0
13	$0	$0	$0	$0	0.4150	$0
14	$0	$0	$0	$0	0.3878	$0
15	$0	$0	$0	$0	0.3624	$0
TOTALS:	$0	$0	$0	$0		$0
TOTAL PRESENT VALUE OF ALTERNATIVE A1 [5]						**$0**

Notes:

[1] The period of analysis for Alternative A1 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-A1.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS A1						
Alternative A1 **No Action**	**Mine Portal MIW Discharges**					**COST ESTIMATE SUMMARY**

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative A1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mine portal MIW discharges and partial obstructions to these discharges in their current state, and no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport with the associated contributions to unacceptable risks to the environment.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SUBTOTAL						
Contingency (Scope and Bid)		30%			$0	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL						
Project Management		10%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		20%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		15%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL				$0	$0	
TOTAL CAPITAL COST					**$0**	No capital costs are assumed.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations: $0

BCY	Bank Cubic Yard
LF	Linear Feet
LS	Lump Sum
QTY	Quantity

Present Value and Cost Estimate Summary

Alternative A2
Diversion/Isolation

TABLE PV-A2

PRESENT VALUE ANALYSIS

Alternative A2 Mine Portal MIW Discharges Diversion/Isolation

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,082,000	$0	$0	$1,082,000	1.0000	$1,082,000
1	$0	$126,000	$0	$126,000	0.9346	$117,760
2	$0	$126,000	$43,000	$169,000	0.8734	$147,605
3	$0	$126,000	$0	$126,000	0.8163	$102,854
4	$0	$126,000	$43,000	$169,000	0.7629	$128,930
5	$0	$126,000	$0	$126,000	0.7130	$89,838
6	$0	$126,000	$43,000	$169,000	0.6663	$112,605
7	$0	$126,000	$0	$126,000	0.6227	$78,460
8	$0	$126,000	$43,000	$169,000	0.5820	$98,358
9	$0	$126,000	$0	$126,000	0.5439	$68,531
10	$0	$126,000	$43,000	$169,000	0.5083	$85,903
11	$0	$126,000	$0	$126,000	0.4751	$59,863
12	$0	$126,000	$43,000	$169,000	0.4440	$75,036
13	$0	$126,000	$0	$126,000	0.4150	$52,290
14	$0	$126,000	$43,000	$169,000	0.3878	$65,538
15	$0	$126,000	$0	$126,000	0.3624	$45,662
TOTALS:	$1,082,000	$1,890,000	$301,000	$3,273,000		$2,411,233
TOTAL PRESENT VALUE OF ALTERNATIVE A2 [5]						**$2,411,000**

Notes:
[1] The period of analysis for Alternative A2 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-A2.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS A2

Alternative A2 Diversion/Isolation | **Mine Portal MIW Discharges**

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative A2 would involve construction and/or maintenance of diversion and isolation components to route mine portal MIW discharge around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative A2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect mine portal MIW discharge and divert it around the existing mine waste. The construction of berms immediately upgradient of mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing MIW diversion or isolation components, repairs would be conducted to improve the conditions of those components. Mine wastes or other materials at the entrance to a mine portal that are partially obstructing free flow of mine portal MIW discharge in addition to mine wastes excavated for open channel diversion would be excavated. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated materials through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization such as analysis of geotechnical parameters would be conducted, as needed, on excavated and dewatered mine waste to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include best management practices (BMPs), such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the diversion/isolation components and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	CW-A2-1	1	LS	$8,599	$8,599	
Mobilization/Demobilization	CW-A2-2	1	LS	$38,639	$38,639	
Installation of Diversion/Isolation Components						
Nonconventional Access-Alpine Locations	CW-A2-3A	1	LS	$17,329	$17,329	Includes components at 6 nonconventional access-alpine mining related sources
Nonconventional Access-Subalpine Locations	CW-A2-3B	1	LS	$35,936	$35,936	Includes components at 9 nonconventional access-subalpine mining related sources
Conventional Access-Subalpine Locations	CW-A2-3C	1	LS	$7,397	$7,397	Includes components at 5 conventional access-subalpine mining related sources
Repairs of Existing Diversion/Isolation Components	CW-A2-4	1	LS	$33,052	$33,052	
Excavation, Dewatering, and Management of Mine Waste at Local Interim Management Areas	CW-A2-5	433	BCY	$19	$8,108	
Access Road Improvements	CW-A2-6	5,300	LF	$46	$243,812	
Development of Borrow Materials	CW-A2-7	6,280	BCY	$16	$101,250	
Transportation of Borrow Materials	CW-A2-8	3,700	LCY	$28	$101,798	
Dust Control	CW-A2-9	1	LS	$48,065	$48,065	
Erosion Control and Reclamation of Areas Disturbed during Construction	CW-A2-10	1	LS	$16,712	$16,712	
SUBTOTAL					$660,697	
Contingency (Scope and Bid)		30%			$198,209	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$858,906	
Project Management		6%			$51,534	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		12%			$103,069	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		8%			$68,712	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$1,082,221	
TOTAL CAPITAL COST					**$1,082,000**	Total capital cost is rounded to the nearest $1,000.

Table CS A2

Alternative Diversion/Isolation	**A2**	**Mine Portal MIW Discharges**	**COST ESTIMATE SUMMARY**

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative A2 would involve construction and/or maintenance of diversion and isolation components to route mine portal MIW discharge around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative A2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect mine portal MIW discharge and divert it around the existing mine waste. The construction of berms immediately upgradient of mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing MIW diversion or isolation components, repairs would be conducted to improve the conditions of those components. Mine wastes or other materials at the entrance to a mine portal that are partially obstructing free flow of mine portal MIW discharge in addition to mine wastes excavated for open channel diversion would be excavated. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated materials through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization such as analysis of geotechnical parameters would be conducted, as needed, on excavated and dewatered mine waste to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include best management practices (BMPs), such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the diversion/isolation components and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

ANNUAL O&M COSTS (Assumed to be Incurred Annually During Year 1 through 15)

DESCRIPTION		QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Inspection of Remedial Components	CW-A2-11	1	LS	$8,209	$8,209	
Surface Water Monitoring	CW-A2-12	2	EA	$44,551	$89,102	Includes two surface water monitoring events. Assumes monitoring at 20 mining-related sources to evaluate effectiveness of interim remedy.
				SUBTOTAL	$97,311	
Contingency (Scope and Bid)		20%			$19,462	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$116,773	
Project Management		8%			$9,342	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$126,115	
TOTAL ANNUAL O&M COST					**$126,000**	Total annual O&M cost is rounded to the nearest $1,000.

PERIODIC O&M COSTS (Assumed to be Incurred Once Every 2 Years During Year 1 through 15)

DESCRIPTION		QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Post-Construction Maintenance	CW-A2-13	1	LS	$32,626	$32,626	
				SUBTOTAL	$32,626	
Contingency (Scope and Bid)		20%			$6,525	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$39,151	
Project Management		10%			$3,915	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$43,066	
TOTAL PERIODIC O&M COST					**$43,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Table CS A2			
Alternative **Diversion/Isolation**	**A2**	**Mine Portal MIW Discharges**	**COST ESTIMATE SUMMARY**
Site:	Bonita Peak Mining District Superfund Site	Description:	Alternative A2 would involve construction and/or maintenance of diversion and isolation components to route mine portal MIW discharge around contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative A2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect mine portal MIW discharge and divert it around the existing mine waste. The construction of berms immediately upgradient of mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing MIW diversion or isolation components, repairs would be conducted to improve the conditions of those components. Mine wastes or other materials at the entrance to a mine portal that are partially obstructing free flow of mine portal MIW discharge in addition to mine wastes excavated for open channel diversion would be excavated. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated materials through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization such as analysis of geotechnical parameters would be conducted, as needed, on excavated and dewatered mine waste to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include best management practices (BMPs), such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the diversion/isolation components and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study		
Base Year:	2018		
Date:	May 2018		

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.

Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

BCY	Bank Cubic Yard
EA	Each
LF	Linear Feet
LCY	Loose Cubic Yard
LS	Lump Sum

Present Value and Cost Estimate Summary

Alternative B1
No Action

TABLE PV-B1

PRESENT VALUE ANALYSIS

Alternative **B1** **Mining-Related Source / Stormwater Interactions**
No Action

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$0	$0	$0	$0	1.0000	$0
1	$0	$0	$0	$0	0.9346	$0
2	$0	$0	$0	$0	0.8734	$0
3	$0	$0	$0	$0	0.8163	$0
4	$0	$0	$0	$0	0.7629	$0
5	$0	$0	$0	$0	0.7130	$0
6	$0	$0	$0	$0	0.6663	$0
7	$0	$0	$0	$0	0.6227	$0
8	$0	$0	$0	$0	0.5820	$0
9	$0	$0	$0	$0	0.5439	$0
10	$0	$0	$0	$0	0.5083	$0
11	$0	$0	$0	$0	0.4751	$0
12	$0	$0	$0	$0	0.4440	$0
13	$0	$0	$0	$0	0.4150	$0
14	$0	$0	$0	$0	0.3878	$0
15	$0	$0	$0	$0	0.3624	$0
TOTALS:	$0	$0	$0	$0		$0
TOTAL PRESENT VALUE OF ALTERNATIVE B1 [5]						**$0**

Notes:
[1] The period of analysis for Alternative B1 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-B1.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS B1

Alternative No Action	B1	Mining-Related Source / Stormwater Interactions	COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative B1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave stormwater discharges to mining-related sources in their current state, and no action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SUBTOTAL					$0	
Contingency (Scope and Bid)		30%			$0	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$0	
Project Management		10%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		20%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		15%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$0	
TOTAL CAPITAL COST					**$0**	No capital costs are assumed.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

BCY	Bank Cubic Yard
LF	Linear Feet
LS	Lump Sum
QTY	Quantity

Present Value and Cost Estimate Summary

Alternative B2
Stormwater Diversion/Isolation

TABLE PV-B2

PRESENT VALUE ANALYSIS

Alternative **B2** **Mining-Related Source / Stormwater Interactions**

Stormwater Diversion/Isolation

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,035,000	$0	$0	$1,035,000	1.0000	$1,035,000
1	$0	$84,000	$0	$84,000	0.9346	$78,506
2	$0	$84,000	$21,000	$105,000	0.8734	$91,707
3	$0	$84,000	$0	$84,000	0.8163	$68,569
4	$0	$84,000	$21,000	$105,000	0.7629	$80,105
5	$0	$84,000	$0	$84,000	0.7130	$59,892
6	$0	$84,000	$21,000	$105,000	0.6663	$69,962
7	$0	$84,000	$0	$84,000	0.6227	$52,307
8	$0	$84,000	$21,000	$105,000	0.5820	$61,110
9	$0	$84,000	$0	$84,000	0.5439	$45,688
10	$0	$84,000	$21,000	$105,000	0.5083	$53,372
11	$0	$84,000	$0	$84,000	0.4751	$39,908
12	$0	$84,000	$21,000	$105,000	0.4440	$46,620
13	$0	$84,000	$0	$84,000	0.4150	$34,860
14	$0	$84,000	$21,000	$105,000	0.3878	$40,719
15	$0	$84,000	$0	$84,000	0.3624	$30,442
TOTALS:	$1,035,000	$1,260,000	$147,000	$2,442,000		$1,888,767
TOTAL PRESENT VALUE OF ALTERNATIVE B2 [5]						**$1,889,000**

Notes:
1 The period of analysis for Alternative B2 is assumed to be 15 years post construction.
2 Capital costs are assumed to be capital costs distributed as indicated on Table CS-B2.
3 Total annual expenditure is the total cost per year with no discounting.
4 Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
5 Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS B2

Alternative **B2** **Mining-Related Source / Stormwater Interactions**
Stormwater Diversion/Isolation

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative B2 would involve construction and/or maintenance of diversion and isolation components to route stormwater around mine portals and/or contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative B2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect stormwater and divert it around the existing mine portals or mine waste. The construction of berms immediately upgradient of mine portals or mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing stormwater diversion or isolation components, repairs would be conducted to improve the conditions of those components. Wastes generated from excavation stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation. Where amenable, this alternative could include subsurface components, in conjunction with surface components previously described. Subsurface components, such as interception trenches or french drains, could be constructed to intercept stormwater that has infiltrated into the shallow subsurface and divert it around mine portals or mine waste. Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	CW-B2-1	1	LS	$8,599	$8,599	
Mobilization/Demobilization	CW-B2-2	1	LS	$27,134	$27,134	
Installation of Surface Stormwater Diversion/Isolation Components						
Nonconventional Access-Alpine Locations	CW-B2-3A	1	LS	$34,389	$34,389	Includes components at 5 nonconventional access-alpine mining related sources
Nonconventional Access-Subalpine Locations	CW-B2-3B	1	LS	$30,599	$30,599	Includes components at 4 nonconventional access-subalpine mining related sources
Conventional Access-Subalpine Locations	CW-B2-3C	1	LS	$4,639	$4,639	Includes components at 2 conventional access-subalpine mining related sources
Installation of Subsurface Stormwater Diversion/Isolation Components						
Nonconventional Access-Alpine Locations	CW-B2-4A	200	LF	$43	$8,654	Includes components at 5 nonconventional access-alpine mining related sources
Nonconventional Access-Subalpine Locations	CW-B2-4B	190	LF	$30	$5,772	Includes components at 4 nonconventional access-subalpine mining related sources
Conventional Access-Subalpine Locations	CW-B2-4C	50	LF	$29	$1,427	Includes components at 2 conventional access-subalpine mining related sources
Access Road Improvements	CW-B2-5	5,000	LF	$48	$239,369	
Development of Borrow Materials	CW-B2-6	3,440	BCY	$27	$92,416	
Transportation of Borrow Materials	CW-B2-7	3,800	LCY	$31	$117,594	
Dust Control	CW-B2-8	1	LS	$48,390	$48,390	
Erosion Control and Reclamation of Areas	CW-B2-9	1	LS	$13,056	$13,056	
SUBTOTAL					$632,038	
Contingency (Scope and Bid)		30%			$189,611	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$821,649	
Project Management		6%			$49,299	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		12%			$98,598	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		8%			$65,732	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$1,035,278	
TOTAL CAPITAL COST					**$1,035,000**	Total capital cost is rounded to the nearest $1,000.

Table CS B2

Alternative B2 — **Mining-Related Source / Stormwater Interactions**

Stormwater Diversion/Isolation

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative B2 would involve construction and/or maintenance of diversion and isolation components to route stormwater around mine portals and/or contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative B2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect stormwater and divert it around the existing mine portals or mine waste. The construction of berms immediately upgradient of mine portals or mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing stormwater diversion or isolation components, repairs would be conducted to improve the conditions of those components. Wastes generated from excavation stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation. Where amenable, this alternative could include subsurface components, in conjunction with surface components previously described. Subsurface components, such as interception trenches or french drains, could be constructed to intercept stormwater that has infiltrated into the shallow subsurface and divert it around mine portals or mine waste. Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.

ANNUAL O&M COSTS (Assumed to be Incurred Annually During Year 1 through 15)

DESCRIPTION		QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Inspection of Remedial Components	CW-B2-10	1	LS	$6,567	$6,567	
Surface Water Monitoring	CW-B2-11	2	EA	$28,578	$57,155	Includes two surface water monitoring events. Assumes monitoring at 11 mining-related sources to evaluate effectiveness of interim remedy.
				SUBTOTAL	$63,722	
Contingency (Scope and Bid)		20%			$12,744	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$76,466	
Project Management		10%			$7,647	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$84,113	
TOTAL ANNUAL O&M COST					**$84,000**	Total annual O&M cost is rounded to the nearest $1,000.

PERIODIC O&M COSTS (Assumed to be Incurred Once Every 2 Years During Year 1 through 15)

DESCRIPTION		QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Post-Construction Maintenance	CW-B2-12	1	LS	$15,834	$15,834	
				SUBTOTAL	$15,834	
Contingency (Scope and Bid)		20%			$3,167	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$19,001	
Project Management		10%			$1,900	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$20,901	
TOTAL PERIODIC O&M COST					**$21,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Table CS B2			
Alternative B2 **Stormwater Diversion/Isolation**	**Mining-Related Source / Stormwater Interactions**		**COST ESTIMATE SUMMARY**

Site:	Bonita Peak Mining District Superfund Site	Description:	Alternative B2 would involve construction and/or maintenance of diversion and isolation components to route stormwater around mine portals and/or contaminated mine waste with the potential for interaction and co-mingling at mining-related sources. Alternative B2 would also include maintenance of previously existing and newly constructed diversion and isolation components. Diversion or isolation components implemented at each mining-related source would be chosen on a location-by-location basis. Open channels typically would be constructed to collect stormwater and divert it around the existing mine portals or mine waste. The construction of berms immediately upgradient of mine portals or mine waste, collection/diversion piping or liners, or a combination of multiple types of components are also viable for locations that are not conducive to open channel diversion. It is assumed that berms would be considered at locations with underlying rock surfaces while collection/diversion piping or liners would be considered at locations with steep slopes or other features that would pose challenges, such as roads directly adjacent to proposed diversion/isolation components. These assumptions would be refined at the time of remedial design using location-specific information. At mining-related sources with existing stormwater diversion or isolation components, repairs would be conducted to improve the conditions of those components. Wastes generated from excavation stormwater diversion components such as open channels are assumed to be uncontaminated and do not have handling and management requirements beyond BMPs for erosion and sedimentation. Where amenable, this alternative could include subsurface components, in conjunction with surface components previously described. Subsurface components, such as interception trenches or french drains, could be constructed to intercept stormwater that has infiltrated into the shallow subsurface and divert it around mine portals or mine waste. Monitoring and maintenance of the diversion/isolation components would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of diversion and isolation components to assess maintenance requirements and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to maintain the integrity of both newly constructed and previously existing diversion and isolation components.
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study		
Base Year:	2018		
Date:	May 2018		

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

BCY Bank Cubic Yard
EA Each
LF Linear Feet
LCY Loose Cubic Yard
LS Lump Sum

Present Value and Cost Estimate Summary

Alternative C1
No Action

TABLE PV-C1

PRESENT VALUE ANALYSIS

Alternative **C1** **Mine Portal Pond Sediments**

No Action

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$0	$0	$0	$0	1.0000	$0
1	$0	$0	$0	$0	0.9346	$0
2	$0	$0	$0	$0	0.8734	$0
3	$0	$0	$0	$0	0.8163	$0
4	$0	$0	$0	$0	0.7629	$0
5	$0	$0	$0	$0	0.7130	$0
6	$0	$0	$0	$0	0.6663	$0
7	$0	$0	$0	$0	0.6227	$0
8	$0	$0	$0	$0	0.5820	$0
9	$0	$0	$0	$0	0.5439	$0
10	$0	$0	$0	$0	0.5083	$0
11	$0	$0	$0	$0	0.4751	$0
12	$0	$0	$0	$0	0.4440	$0
13	$0	$0	$0	$0	0.4150	$0
14	$0	$0	$0	$0	0.3878	$0
15	$0	$0	$0	$0	0.3624	$0
TOTALS:	$0	$0	$0	$0		$0
TOTAL PRESENT VALUE OF ALTERNATIVE C1 [5]						**$0**

Notes:
[1] The period of analysis for Alternative C1 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-C1.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS C1

Alternative **C1** **Mine Portal Pond Sediments**
No Action

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative C1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mine portal pond sediments in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SUBTOTAL						
Contingency (Scope and Bid)		30%			$0	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL						
Project Management		10%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		20%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		15%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL				$0	$0	
TOTAL CAPITAL COST					**$0**	No capital costs are assumed.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations: $0

BCY	Bank Cubic Yard
LF	Linear Feet
LS	Lump Sum
QTY	Quantity

Present Value and Cost Estimate Summary

Alternative C2

Excavation and Interim Local Waste Management

TABLE PV-C2

PRESENT VALUE ANALYSIS

Alternative C2 Mine Portal Pond Sediments
Excavation and Interim Local Waste Management

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,355,000	$0	$0	$1,355,000	1.0000	$1,355,000
1	$0	$74,000	$0	$74,000	0.9346	$69,160
2	$0	$74,000	$11,000	$85,000	0.8734	$74,239
3	$0	$74,000	$462,000	$536,000	0.8163	$437,537
4	$0	$74,000	$11,000	$85,000	0.7629	$64,847
5	$0	$74,000	$0	$74,000	0.7130	$52,762
6	$0	$74,000	$473,000	$547,000	0.6663	$364,466
7	$0	$74,000	$0	$74,000	0.6227	$46,080
8	$0	$74,000	$11,000	$85,000	0.5820	$49,470
9	$0	$74,000	$462,000	$536,000	0.5439	$291,530
10	$0	$74,000	$11,000	$85,000	0.5083	$43,206
11	$0	$74,000	$0	$74,000	0.4751	$35,157
12	$0	$74,000	$473,000	$547,000	0.4440	$242,868
13	$0	$74,000	$0	$74,000	0.4150	$30,710
14	$0	$74,000	$11,000	$85,000	0.3878	$32,963
15	$0	$74,000	$462,000	$536,000	0.3624	$194,246
TOTALS:	$1,355,000	$1,110,000	$2,387,000	$4,852,000		$3,384,241
TOTAL PRESENT VALUE OF ALTERNATIVE C2 [5]						**$3,384,000**

Notes:
[1] The period of analysis for Alternative C2 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-C2.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS C2

Alternative C2 **Mine Portal Pond Sediments**
Excavation and Interim Local Waste Management

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative C2 would involve excavation of existing sediment and construction or repair of berms within mine portal ponds to allow continued function of ponds. Prior to removal of sediment, the mine portal ponds would be drained. MIW within ponds would be managed locally solely to facilitate sediment excavation without treatment or external discharge to surface water.Excavation of sediment would be conducted at mine portal ponds to facilitate continued function of the ponds. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated sediment through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include BMPs, such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to remove future accumulation of sediment in ponds and to maintain the integrity of both newly constructed and previously existing pond berms and interim management location components.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	CW-C2-1	1	LS	$8,599	$8,599	
Mobilization/Demobilization	CW-C2-2	1	LS	$19,619	$19,619	
Pond Draining and Repair of Pond Berms	CW-C2-3	514,600	GAL	$0.06	$32,885	
Mine Portal Pond Sediment Excavation	CW-C2-4	10,192	BCY	$4	$43,070	Includes mine portal pond sediments at 1 nonconventional access-alpine mining related sources, 3 nonconventional access-subalpine mining related sources, and 4 conventional access-subalpine mining related sources
Geotechnical Characterization - Sampling Dewatered Mine Portal Pond Sediment	CW-C2-5	49	EA	$403	$19,751	
Management and Dewatering of Mine Portal Pond Sediment at Interim Local Waste Management Areas	CW-C2-6	12,240	LCY	$22	$265,683	
Access Road Improvements	CW-C2-7	4,800	LF	$47	$224,184	
Development of Borrow Materials	CW-C2-8	2,710	BCY	$28	$75,195	
Transportation of Borrow Materials	CW-C2-9	3,070	LCY	$26	$79,621	
Dust Control	CW-C2-10	1	LS	$47,091	$47,091	
Erosion Control and Reclamation of Areas Disturbed during Construction	CW-C2-11	1	LS	$11,225	$11,225	
SUBTOTAL					$826,923	
Contingency (Scope and Bid)		30%			$248,077	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$1,075,000	
Project Management		6%			$64,500	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		12%			$129,000	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		8%			$86,000	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$1,354,500	
TOTAL CAPITAL COST					**$1,355,000**	Total capital cost is rounded to the nearest $1,000.

Table CS C2

Alternative C2 **Mine Portal Pond Sediments**
Excavation and Interim Local Waste Management

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative C2 would involve excavation of existing sediment and construction or repair of berms within mine portal ponds to allow continued function of ponds. Prior to removal of sediment, the mine portal ponds would be drained. MIW within ponds would be managed locally solely to facilitate sediment excavation without treatment or external discharge to surface water.Excavation of sediment would be conducted at mine portal ponds to facilitate continued function of the ponds. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated sediment through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include BMPs, such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to remove future accumulation of sediment in ponds and to maintain the integrity of both newly constructed and previously existing pond berms and interim management location components.

ANNUAL O&M COSTS (Assumed to be Incurred Annually During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Inspection of Remedial Components	CW-C2-12	1	LS	$4,926	$4,926	
Surface Water Monitoring	CW-C2-13	2	EA	$25,453	$50,906	Includes two surface water monitoring events. Assumes monitoring at 8 mining-related sources to evaluate effectiveness of interim remedy.
				SUBTOTAL	$55,832	
Contingency (Scope and Bid)		20%			$11,166	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$66,998	
Project Management		10%			$6,700	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$73,698	
TOTAL ANNUAL O&M COST					**$74,000**	Total annual O&M cost is rounded to the nearest $1,000.

PERIODIC O&M COSTS - INTERIM LOCAL MANAGEMENT AREA (Assumed to be Incurred Once Every 2 Years During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Post-Construction Maintenance of Interim Local Management Areas	CW-C2-14	1	LS	$8,015	$8,015	
				SUBTOTAL	$8,015	
Contingency (Scope and Bid)		20%			$1,603	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$9,618	
Project Management		10%			$962	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$10,580	
TOTAL PERIODIC O&M COST					**$11,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Table CS C2

Alternative **C2** **Mine Portal Pond Sediments**
Excavation and Interim Local Waste Management

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative C2 would involve excavation of existing sediment and construction or repair of berms within mine portal ponds to allow continued function of ponds. Prior to removal of sediment, the mine portal ponds would be drained. MIW within ponds would be managed locally solely to facilitate sediment excavation without treatment or external discharge to surface water.Excavation of sediment would be conducted at mine portal ponds to facilitate continued function of the ponds. During the excavation process, the excavated wastes would be placed at the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated sediment through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would include BMPs, such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA. Maintenance would be then performed as necessary to remove future accumulation of sediment in ponds and to maintain the integrity of both newly constructed and previously existing pond berms and interim management location components.

PERIODIC O&M COSTS - POND CLEANOUT (Assumed to be Incurred Once Every 3 Years During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Periodic Removal of Mine Portal Pond Sediment	CW-C2-15	1	LS	$267,360	$267,360	
				SUBTOTAL	$267,360	
Contingency (Scope and Bid)		30%			$80,208	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$347,568	
Project Management		8%			$27,805	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		15%			$52,135	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		10%			$34,757	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$462,265	
TOTAL PERIODIC O&M COST					**$462,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

BCY	Bank Cubic Yard
EA	Each
GAL	Gallons
LF	Linear Feet
LCY	Loose Cubic Yard
LS	Lump Sum

Present Value and Cost Estimate Summary

Alternative D1
No Action

TABLE PV-D1

PRESENT VALUE ANALYSIS

Alternative **D1** **In-Stream Mine Wastes**
No Action

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$0	$0	$0	$0	1.0000	$0
1	$0	$0	$0	$0	0.9346	$0
2	$0	$0	$0	$0	0.8734	$0
3	$0	$0	$0	$0	0.8163	$0
4	$0	$0	$0	$0	0.7629	$0
5	$0	$0	$0	$0	0.7130	$0
6	$0	$0	$0	$0	0.6663	$0
7	$0	$0	$0	$0	0.6227	$0
8	$0	$0	$0	$0	0.5820	$0
9	$0	$0	$0	$0	0.5439	$0
10	$0	$0	$0	$0	0.5083	$0
11	$0	$0	$0	$0	0.4751	$0
12	$0	$0	$0	$0	0.4440	$0
13	$0	$0	$0	$0	0.4150	$0
14	$0	$0	$0	$0	0.3878	$0
15	$0	$0	$0	$0	0.3624	$0
TOTALS:	$0	$0	$0	$0		$0
TOTAL PRESENT VALUE OF ALTERNATIVE D1 [5]						**$0**

Notes:
[1] The period of analysis for Alternative D1 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-D1.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS D1

Alternative No Action **D1** **In-Stream Mine Wastes**

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative D1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave in-stream mine wastes in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to the environment.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SUBTOTAL						
Contingency (Scope and Bid)		30%			$0	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL						
Project Management		10%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		20%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		15%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL				$0	$0	
TOTAL CAPITAL COST					**$0**	No capital costs are assumed.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.

Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations: $0

ACR	Acre
BCY	Bank Cubic Yard
LCY	Loose Cubic Yard
LF	Linear Feet
LS	Lump Sum

Present Value and Cost Estimate Summary

Alternative D2
Excavation and Interim Local Waste Management

TABLE PV-D2

PRESENT VALUE ANALYSIS

Alternative D2 In-Stream Mine Wastes

Excavation and Interim Local Waste Management

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$340,000	$0	$0	$340,000	1.0000	$340,000
1	$0	$27,000	$0	$27,000	0.9346	$25,234
2	$0	$27,000	$9,000	$36,000	0.8734	$31,442
3	$0	$27,000	$0	$27,000	0.8163	$22,040
4	$0	$27,000	$9,000	$36,000	0.7629	$27,464
5	$0	$27,000	$0	$27,000	0.7130	$19,251
6	$0	$27,000	$9,000	$36,000	0.6663	$23,987
7	$0	$27,000	$0	$27,000	0.6227	$16,813
8	$0	$27,000	$9,000	$36,000	0.5820	$20,952
9	$0	$27,000	$0	$27,000	0.5439	$14,685
10	$0	$27,000	$9,000	$36,000	0.5083	$18,299
11	$0	$27,000	$0	$27,000	0.4751	$12,828
12	$0	$27,000	$9,000	$36,000	0.4440	$15,984
13	$0	$27,000	$0	$27,000	0.4150	$11,205
14	$0	$27,000	$9,000	$36,000	0.3878	$13,961
15	$0	$27,000	$0	$27,000	0.3624	$9,785
TOTALS:	$340,000	$405,000	$63,000	$808,000		$623,930
TOTAL PRESENT VALUE OF ALTERNATIVE D2 [5]						**$624,000**

Notes:
[1] The period of analysis for Alternative D2 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-D2.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS D2

Alternative D2 In-Stream Mine Wastes Excavation and Interim Local Waste Management

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative D2 would involve excavation of in-stream mine waste at mining-related sources to remove wastes that impedes flow or is susceptible to erosion or leaching of contaminants. During the excavation process, the excavated wastes would be placed outside of the stream channel adjacent to the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated mine wastes through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would BMPs, such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	CW-D2-1	1	LS	$8,599	$8,599	
Mobilization/Demobilization	CW-D2-2	1	LS	$10,991	$10,991	
In-Stream Mine Waste Excavation	CW-D2-3	989	BCY	$4	$4,331	Includes in-stream mine wastes at 2 nonconventional access-alpine mining related sources
Geotechnical Characterization - Sampling Dewatered In-Stream Mine Waste	CW-D2-4	5	EA	$414	$2,072	
Management and Dewatering of In-Stream Mine Waste at Interim Local Waste Management Areas	CW-D2-5	1,190	LCY	$25	$30,038	
Access Road Improvements	CW-D2-6	900	LF	$70	$63,328	
Development of Borrow Materials	CW-D2-7	180	BCY	$34	$6,191	
Transportation of Borrow Materials	CW-D2-8	340	LCY	$55	$18,757	
Dust Control	CW-D2-9	1	LS	$42,220	$42,220	
Erosion Control and Reclamation of Areas Disturbed during Construction	CW-D2-10	1	LS	$10,358	$10,358	
SUBTOTAL					$196,885	
Contingency (Scope and Bid)		30%			$59,066	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$255,951	
Project Management		8%			$20,476	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		15%			$38,393	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		10%			$25,595	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$340,415	
TOTAL CAPITAL COST					**$340,000**	Total capital cost is rounded to the nearest $1,000.

Table CS D2

Alternative D2 **In-Stream Mine Wastes**
Excavation and Interim Local Waste Management

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative D2 would involve excavation of in-stream mine waste at mining-related sources to remove wastes that impedes flow or is susceptible to erosion or leaching of contaminants. During the excavation process, the excavated wastes would be placed outside of the stream channel adjacent to the mining-related source for gravity dewatering. The assumed location for this activity is assumed to be amenable to dewatering without the need for liners or other isolation measures. Additional dewatering could be implemented for saturated mine wastes through ex situ amendment with a dewatering agent, as necessary for handling and geotechnical stability prior to interim management at the mining-related source. Physical characterization, such as analysis of geotechnical parameters, would be conducted as needed on excavated and dewatered sediment to evaluate physical stability. Excavated wastes would be managed locally at the mining-related source on an interim basis. Interim local waste management would BMPs, such as but not limited to berming, as necessary to address fugitive dust and potential erosion and sedimentation issues. Final remedial approaches for managed wastes, if necessary, would be addressed as part of future remedy decisions and response actions. Monitoring and maintenance of the pond berms and interim local waste management locations would be conducted as needed, primarily due to events that could compromise the components (e.g., lack of adherence to ICs, storm events, wildland fires). Monitoring would consist of non-intrusive (surface) visual inspection of interim local waste management locations to assess maintenance requirements and monitor sediment levels in ponds and remedy performance monitoring consisting of surface water measurements and/or sample collection and analysis would be conducted to monitor effectiveness of the implemented IRA.

ANNUAL O&M COSTS (Assumed to be Incurred Annually During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Inspection of Remedial Components	CW-D2-11	1	LS	$3,284	$3,284	
Surface Water Monitoring	CW-D2-12	2	EA	$8,560	$17,120	Includes two surface water monitoring events. Assumes monitoring at 2 mining-related sources to evaluate effectiveness of interim remedy.
				SUBTOTAL	$20,404	
Contingency (Scope and Bid)		20%			$4,081	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$24,485	
Project Management		10%			$2,449	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$26,934	
TOTAL ANNUAL O&M COST					**$27,000**	Total annual O&M cost is rounded to the nearest $1,000.

PERIODIC O&M COSTS (Assumed to be Incurred Once Every 2 Years During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Post-Construction Maintenance	CW-D2-13	1	LS	$7,010	$7,010	
				SUBTOTAL	$7,010	
Contingency (Scope and Bid)		20%			$1,402	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$8,412	
Project Management		10%			$841	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$9,253	
TOTAL PERIODIC O&M COST					**$9,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

ACR	Acre
BCY	Bank Cubic Yard
LCY	Loose Cubic Yard
LF	Linear Feet
LS	Lump Sum

Present Value and Cost Estimate Summary

Alternative E1
No Action

TABLE PV-E1

PRESENT VALUE ANALYSIS

Alternative E1 **Mining-Impacted Recreation Staging Areas**

No Action

Site: **Bonita Peak Mining District Superfund Site**
Location: **San Juan County, Colorado**
Phase: **Focused Feasibility Study**
Base Year: **2018**

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$0	$0	$0	$0	1.0000	$0
1	$0	$0	$0	$0	0.9346	$0
2	$0	$0	$0	$0	0.8734	$0
3	$0	$0	$0	$0	0.8163	$0
4	$0	$0	$0	$0	0.7629	$0
5	$0	$0	$0	$0	0.7130	$0
6	$0	$0	$0	$0	0.6663	$0
7	$0	$0	$0	$0	0.6227	$0
8	$0	$0	$0	$0	0.5820	$0
9	$0	$0	$0	$0	0.5439	$0
10	$0	$0	$0	$0	0.5083	$0
11	$0	$0	$0	$0	0.4751	$0
12	$0	$0	$0	$0	0.4440	$0
13	$0	$0	$0	$0	0.4150	$0
14	$0	$0	$0	$0	0.3878	$0
15	$0	$0	$0	$0	0.3624	$0
TOTALS:	$0	$0	$0	$0		$0
TOTAL PRESENT VALUE OF ALTERNATIVE E1 [5]						**$0**

Notes:

[1] The period of analysis for Alternative E1 is assumed to be 15 years post construction.

[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-E1.

[3] Total annual expenditure is the total cost per year with no discounting.

[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.

[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.

The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS E1			
Alternative **No Action**	**E1**	**Mining-Impacted Recreation Staging Areas**	**COST ESTIMATE SUMMARY**

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative E1 (No Action) is required by the NCP to provide an environmental baseline against which impacts of the other remedial alternatives can be compared. This alternative would leave mining-impacted recreation staging areas in their current state, and no further action would be initiated to remediate them or otherwise mitigate contaminant migration and transport from them with the associated contributions to unacceptable risks to human health.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SUBTOTAL					$0	
Contingency (Scope and Bid)		30%			$0	20% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$0	
Project Management		10%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		20%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		15%			$0	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$0	
TOTAL CAPITAL COST					**$0**	No capital costs are assumed.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

BCY	Bank Cubic Yard
LF	Linear Feet
LS	Lump Sum
QTY	Quantity

Present Value and Cost Estimate Summary

Alternative E2
Containment/Isolation

TABLE PV-E2

PRESENT VALUE ANALYSIS

Alternative E2 Mining-Impacted Recreation Staging Areas Containment/Isolation

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Year[1]	Capital Costs[2]	Annual O&M Costs	Periodic O&M Costs	Total Annual Expenditure[3]	Discount Factor (7.0%)	Present Value[4]
0	$1,210,000	$0	$0	$1,210,000	1.0000	$1,210,000
1	$0	$9,000	$0	$9,000	0.9346	$8,411
2	$0	$9,000	$89,000	$98,000	0.8734	$85,593
3	$0	$9,000	$0	$9,000	0.8163	$7,347
4	$0	$9,000	$89,000	$98,000	0.7629	$74,764
5	$0	$9,000	$0	$9,000	0.7130	$6,417
6	$0	$9,000	$89,000	$98,000	0.6663	$65,297
7	$0	$9,000	$0	$9,000	0.6227	$5,604
8	$0	$9,000	$89,000	$98,000	0.5820	$57,036
9	$0	$9,000	$0	$9,000	0.5439	$4,895
10	$0	$9,000	$89,000	$98,000	0.5083	$49,813
11	$0	$9,000	$0	$9,000	0.4751	$4,276
12	$0	$9,000	$89,000	$98,000	0.4440	$43,512
13	$0	$9,000	$0	$9,000	0.4150	$3,735
14	$0	$9,000	$89,000	$98,000	0.3878	$38,004
15	$0	$9,000	$0	$9,000	0.3624	$3,262
TOTALS:	$1,210,000	$135,000	$623,000	$1,968,000		$1,667,966
TOTAL PRESENT VALUE OF ALTERNATIVE E2 [5]						**$1,668,000**

Notes:

[1] The period of analysis for Alternative E2 is assumed to be 15 years post construction.
[2] Capital costs are assumed to be capital costs distributed as indicated on Table CS-E2.
[3] Total annual expenditure is the total cost per year with no discounting.
[4] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.
[5] Total present value is rounded to the nearest $1,000. Inflation and depreciation are excluded from the present value cost.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
The cost estimates are prepared solely to facilitate relative comparisons between alternatives for FFS evaluation purposes.

Table CS E2

Alternative E2 Containment/Isolation | **Mining-Impacted Recreation Staging Areas**

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative E2 includes containment/isolation of mine wastes within mining-impacted recreation staging areas using a combination of construction covers to reduce disturbances of mine wastes and migration of contaminants. A combination of different types of covers would be constructed at mining-impacted recreation staging areas. The covers would provide an exposure barrier and eliminate surface exposure to mine waste or contaminated soil, but may not entirely reduce infiltration and leaching to the subsurface. The covers would be sloped to promote positive drainage in order to minimize erosion and to reduce infiltration that could saturate the subsurface and compromise the integrity of the covers. The prepared mine waste or contaminated soil surface would then be covered with an engineered layer of soil (which could be vegetated) or a surface layer of rock. The covers would be sloped to have positive drainage and minimize potential for erosion. The specific types of covers would be determined based on specific recreation staging uses of each mining-related source and availability of sufficient quantities of suitable cover materials for that use. Aggregate covers are assumed to be constructed over mine waste or contaminated soil at staging areas exposed to continuous vehicle traffic such as parking areas or guided tour start locations and along stream banks. Soil covers are assumed to be constructed over mine waste at areas not exposed to continuous vehicle traffic such as campgrounds. Monitoring and maintenance of the covers would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of cover components to assess remedy performance and maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of cover components.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	CW-E2-1	1	LS	$8,599	$8,599	
Mobilization/Demobilization	CW-E2-2	1	LS	$12,562	$12,562	
Placement of Gravel Cover	CW-E2-3	2.0	ACR	$13,494	$26,987	Includes covers for dispersed campsites at 1 nonconventional access-subalpine mining related sources, and 4 conventional access-subalpine mining related sources
Placement of Soil Cover	CW-E2-4	6.9	ACR	$21,981	$151,669	
Access Road Improvements	CW-E2-5	1	LS	$50,000	$50,000	
Development of Borrow Materials	CW-E2-6	18,600	BCY	$7	$133,493	
Transportation of Borrow Materials	CW-E2-7	21,900	LCY	$15	$333,371	
Dust Control	CW-E2-8	1	LS	$75,670	$75,670	
Erosion Control	CW-E2-9	1	LS	$8,210	$8,210	
SUBTOTAL					$800,561	
Contingency (Scope and Bid)		20%			$160,112	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
SUBTOTAL					$960,673	
Project Management		6%			$57,640	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Remedial Design		12%			$115,281	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
Construction Management		8%			$76,854	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
TOTAL					$1,210,448	
TOTAL CAPITAL COST					**$1,210,000**	Total capital cost is rounded to the nearest $1,000.

ANNUAL O&M COSTS (Assumed to be Incurred Annually During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Inspection of Remedial Components	CW-E2-10	1	LS	$6,567	$6,567	
				SUBTOTAL	$6,567	
Contingency (Scope and Bid)		20%			$1,313	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$7,880	
Project Management		10%			$788	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$8,668	
TOTAL ANNUAL O&M COST					**$9,000**	Total annual O&M cost is rounded to the nearest $1,000.

Table CS E2

Alternative **E2** **Mining-Impacted Recreation Staging Areas**
Containment/Isolation

COST ESTIMATE SUMMARY

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018
Date: May 2018

Description: Alternative E2 includes containment/isolation of mine wastes within mining-impacted recreation staging areas using a combination of construction covers to reduce disturbances of mine wastes and migration of contaminants. A combination of different types of covers would be constructed at mining-impacted recreation staging areas. The covers would provide an exposure barrier and eliminate surface exposure to mine waste or contaminated soil, but may not entirely reduce infiltration and leaching to the subsurface. The covers would be sloped to promote positive drainage in order to minimize erosion and to reduce infiltration that could saturate the subsurface and compromise the integrity of the covers. The prepared mine waste or contaminated soil surface would then be covered with an engineered layer of soil (which could be vegetated) or a surface layer of rock. The covers would be sloped to have positive drainage and minimize potential for erosion. The specific types of covers would be determined based on specific recreation staging uses of each mining-related source and availability of sufficient quantities of suitable cover materials for that use. Aggregate covers are assumed to be constructed over mine waste or contaminated soil at staging areas exposed to continuous vehicle traffic such as parking areas or guided tour start locations and along stream banks. Soil covers are assumed to be constructed over mine waste at areas not exposed to continuous vehicle traffic such as campgrounds. Monitoring and maintenance of the covers would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Monitoring would consist of non-intrusive (surface) visual inspection of cover components to assess remedy performance and maintenance requirements; maintenance would be then performed as necessary to maintain the integrity of cover components.

PERIODIC O&M COSTS (Assumed to be Incurred Once Every 2 Years During Year 1 through 15)

DESCRIPTION	WORKSHEET	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Post-Construction Maintenance	CW-E2-11	1	LS	$67,385	$67,385	
				SUBTOTAL	$67,385	
Contingency (Scope and Bid)		20%			$13,477	10% Scope, 10% Bid (Based on the recommended range in EPA 540-R-00-002).
				SUBTOTAL	$80,862	
Project Management		10%			$8,086	Percentage from Exhibit 5-8 in EPA 540-R-00-002 was used.
				TOTAL	$88,948	
TOTAL PERIODIC O&M COST					**$89,000**	Total periodic O&M cost is rounded to the nearest $1,000.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented.
Unit costs represent total cost divided by the estimated quantity for each item and are rounded to the nearest whole number. Due to the rounding in the unit costs, multiplying the estimated quantity by unit cost may not exactly equal the total cost.

Abbreviations:

ACR	Acre
BCY	Bank Cubic Yard
EA	Each
LF	Linear Feet
LCY	Loose Cubic Yard
LS	Lump Sum

Cost Assumptions and Cost Worksheets

Alternative A2
Diversion/Isolation

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018
CLIENT:	USACE	CHECKED BY:	EW
		DATE CHECKED:	5/8/2018
		WRKSHT NO.:	Alt A2 Cost Assumptions

Description: General cost estimate assumptions for Alternative A2 - Diversion/Isolation

General Cost Estimate Assumptions: Alternative A2 - Diversion/Isolation

Period of Analysis, YR:	15	*Assumed*
Number of Nonconventional Access-Alpine Mining-Related Sources to be Addressed, EA:	6	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	9	
Number of Conventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	5	
Total Number of Mining-Related Sources to be Addressed, EA:	**20**	

Diversion/Isolation Component Assumptions - Nonconventional Access-Alpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	60%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	30%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	*Assumed*

Diversion/Isolation Component Assumptions - Nonconventional Access-Subalpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	*Assumed*

Diversion/Isolation Component Assumptions - Conventional Access-Subalpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*

CDM Smith	PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY : JN	CHECKED BY: EW		
	JOB NO.: 219758.6460.DK4.WAD3.043	DATE : 5/7/2018	DATE CHECKED: 5/8/2018		
	CLIENT: USACE		WRKSHT NO.: Alt A2 Cost Assumptions		

Description: General cost estimate assumptions for Alternative A2 - Diversion/Isolation

Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	100%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	0%	*Assumed*
Obstructive Mine Waste Assumptions		
Percentage of Mine Waste Amended with Diatomaceous Earth, %:	10%	*Assumed*
Assumed Diatomaceous Earth Amendment Rate, %:	10%	*Assumed*
Borrow Assumptions		
Haul Distance from Borrow Location, MI:	13	*Assumed average distance between borrow and mining-related sources*
Annual O&M Assumptions		
Inspection Frequency, YR/EA:	1	*Annual inspections*
Surface Water Monitoring Events per Year, EA/YR:	2	
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	*Per surface water monitoring event*
Periodic O&M Assumptions		
Maintenance Frequency, YR/EA:	2	*Maintenance every 2 years*
Percentage of Geotextile for Channels to be Replaced, %:	5%	*Per maintenance event*
Percentage of Riprap for Channels to be Replaced, %:	5%	*Per maintenance event*
Percentage of Soil for Berms to be Replaced, %:	5%	*Per maintenance event*

TABLE CW-A2-1

Alternative A2 **Cost Worksheet:** **CW-A2-1**
Capital Cost Sub-Element
Institutional Controls

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves performing institutional controls such as governmental controls, proprietary controls, enforcement tools with IC components, and informational devices. These controls would be implemented as needed to maintain integrity of the proposed diversion and isolation components. These controls would vary by property ownership.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L15	Environmental Lawyer	32	HR	1.00	$40.44	$40.44	$0.00	$0.00	$0.00	$0.00	$40.44	$1,294.08	100%	9%	$2,821	FLC FLC Datacenter	
L16	Paralegal	64	HR	1.00	$24.61	$24.61	$0.00	$0.00	$0.00	$0.00	$24.61	$1,575.04	100%	9%	$3,434	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$8,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,599	$8,599

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-A2-2

Alternative A2
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW-A2-2**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the identified mining-related sources. It includes initial mobilization of equipment to the Site, transporting the equipment between the various mining-related sources, and final demobilization. It assumes that different sized equipment would be mobilized to the different categories of mining-related sources due to access issues preventing large and/or medium sized equipment to certain areas. Includes mobilization/demobilization to 20 total mining-related sources.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA15A	Mob/Demob - Small Equipment (Nonconventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$6,288.35	8%	9%	$7,403	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Nonconventional Access-Subalpine Locations																
AA15B	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,081.51	$1,081.51	$2,163.02	8%	9%	$2,546	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19B	Mob/Demob - Between Mining-Related Sources (Middle Locations)	8	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,399.39	$1,399.39	$11,195.12	8%	9%	$13,179	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Conventional Access-Subalpine Locations																
AA16	Mob/Demob - Medium Equipment (Conventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$2,145.60	8%	9%	$2,526	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19C	Mob/Demob - Between Mining-Related Sources (Conventional Access)	4	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$587.74	$587.74	$2,350.96	8%	9%	$2,768	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Borrow Development/Access Roads																
AA17	Mob/Demob - Large Equipment	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,222.25	$1,222.25	$2,444.50	8%	9%	$2,878	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial location
AA68	Mob/Demob - Medium Equipment	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$3,218.40	8%	9%	$3,789	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial location
AA19D	Mob/Demob - Between Access Road Locations	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.83	$600.83	$1,802.49	8%	9%	$2,122	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
												TOTAL UNIT COST:			$38,639		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$38,639	$38,639

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-A2-3A

Alternative A2 **Cost Worksheet:** **CW-A2-3A**
Capital Cost Sub-Element
Installation of Diversion/Isolation Components for Nonconventional Access-Alpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of new diversion/isolation components for nonconventional access-alpine locations. These components would divert MIW around mine waste or isolate mine waste from MIW in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Diversion/Isolation Components for Nonconventional Access-Alpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	389	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$1,159.22	8%	9%	$1,365	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	8,750	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$875.00	8%	9%	$1,030	MII MII Assemblies	
AA11	Geotextile Placement	8,750	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$787.50	8%	9%	$927	MII MII Assemblies	
MA28	Geotextile - Material Cost	8,750	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$1,575.00	8%	9%	$1,854	V Vendor Quote	Source: GSE, 2017
AA57	Gravel/Riprap Placement (Nonconventional Access)	145	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$1,071.55	8%	9%	$1,261	MII MII Assemblies	
	Open Channel Diversion with Hand Tools (Difficult Access Area)																
AA83	Mobilization of Crew/Tools for Remote Locations	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.69	$1,235.69	$1,235.69	8%	9%	$1,455	MII MII Assemblies	
AA69	Excavation - Hand Digging	23	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.95	$64.95	$1,493.85	8%	9%	$1,759	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	780	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$171.60	8%	9%	$202	MII MII Assemblies	
MA28	Geotextile - Material Cost	780	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$140.40	8%	9%	$165	V Vendor Quote	Source: GSE, 2017
AA85	Hand Placement of Rocks to Anchor Geotextile	6	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$97.43	$97.43	$584.58	8%	9%	$688	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	280	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$1,089.20	8%	9%	$1,282	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	280	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$1,436.40	8%	9%	$1,691	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	7	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$132.44	8%	9%	$156	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	112	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$1,207.36	8%	9%	$1,421	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$7.67	8%	9%	$9	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA58	Rough Grading (Nonconventional Access)	900	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$90.00	8%	9%	$106	MII MII Assemblies	
AA45A	Soil Placement - Berm (Nonconventional Access)	40	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$390.00	8%	9%	$459	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	40	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$72.00	8%	9%	$85	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	54	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$399.06	8%	9%	$470	MII MII Assemblies	
	Culverts Under Roads																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	23	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$68.54	8%	9%	$81	MII MII Assemblies	
AA73	Culvert Installation (Small Equip) - 18"	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.54	$5.54	$166.20	8%	9%	$196	MII MII Assemblies	
MA22	Culvert - 18" Material Cost	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$13.95	$0.00	$13.95	$418.50	8%	9%	$493	CW CostWorks	Source: 33 42 1140 2600
AA54	Soil Placement/Spreading (Nonconventional Access)	28	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$67.76	8%	9%	$80	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	21	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$37.80	8%	9%	$44	MII MII Assemblies	
												TOTAL UNIT COST:			$17,329		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$17,329	$17,329

TABLE CW-A2-3A

Alternative A2 **Cost Worksheet: CW-A2-3A**
Capital Cost Sub-Element
Installation of Diversion/Isolation Components for Nonconventional Access-Alpine Locations

COST WORKSHEET

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** EW	**Date:** 3/12/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** JN	**Date:** 3/13/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-3B

Alternative A2 **Cost Worksheet:** **CW-A2-3B**
Capital Cost Sub-Element
Installation of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:

This sub-element involves the construction of new diversion/isolation components for nonconventional access-subalpine locations. These components would divert MIW around mine waste or isolate mine waste from MIW in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:

Cost for Installation of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	1,066	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$3,176.68	8%	9%	$3,740	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	23,975	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$2,397.50	8%	9%	$2,822	MII MII Assemblies	
AA11	Geotextile Placement	23,975	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$2,157.75	8%	9%	$2,540	MII MII Assemblies	
MA28	Geotextile - Material Cost	23,975	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$4,315.50	8%	9%	$5,080	V Vendor Quote	Source: GSE, 2017
AA57	Gravel/Riprap Placement (Nonconventional Access)	396	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$2,926.44	8%	9%	$3,445	MII MII Assemblies	
	Open Channel Diversion with Hand Tools (Difficult Access Area)																
AA83	Mobilization of Crew/Tools for Remote Locations	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.69	$1,235.69	$2,471.38	8%	9%	$2,909	MII MII Assemblies	
AA69	Excavation - Hand Digging	56	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.95	$64.95	$3,637.20	8%	9%	$4,282	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	1,950	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$429.00	8%	9%	$505	MII MII Assemblies	
MA28	Geotextile - Material Cost	1,950	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$351.00	8%	9%	$413	V Vendor Quote	Source: GSE, 2017
AA85	Hand Placement of Rocks to Anchor Geotextile	15	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$97.43	$97.43	$1,461.45	8%	9%	$1,720	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	190	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$739.10	8%	9%	$870	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	190	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$974.70	8%	9%	$1,147	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$94.60	8%	9%	$111	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$819.28	8%	9%	$964	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$7.67	8%	9%	$9	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA58	Rough Grading (Nonconventional Access)	1,900	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$190.00	8%	9%	$224	MII MII Assemblies	
AA45A	Soil Placement - Berm (Nonconventional Access)	85	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$828.75	8%	9%	$976	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	85	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$153.00	8%	9%	$180	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	114	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$842.46	8%	9%	$992	MII MII Assemblies	
	Culverts Under Roads																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	75	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$223.50	8%	9%	$263	MII MII Assemblies	
AA73	Culvert Installation (Small Equip) - 18"	100	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.54	$5.54	$554.00	8%	9%	$652	MII MII Assemblies	
MA22	Culvert - 18" Material Cost	100	LF	1.00	$0.00	$0.00	$0.00	$0.00	$13.95	$0.00	$13.95	$1,395.00	8%	9%	$1,642	CW CostWorks	Source: 33 42 1140 2600
AA54	Soil Placement/Spreading (Nonconventional Access)	90	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$217.80	8%	9%	$256	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	68	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$122.40	8%	9%	$144	MII MII Assemblies	
													TOTAL UNIT COST:		$35,936		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$35,936	$35,936

TABLE CW-A2-3B

Alternative A2	**Cost Worksheet:** **CW-A2-3B**	
Capital Cost Sub-Element		**COST WORKSHEET**
Installation of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations		

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** EW	**Date:** 3/12/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** JN	**Date:** 3/13/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-3C

Alternative A2 **Cost Worksheet:** **CW-A2-3C**
Capital Cost Sub-Element
Installation of Diversion/Isolation Components for Conventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:

This sub-element involves the construction of new diversion/isolation components for conventional access-subalpine locations. These components would divert MIW around mine waste or isolate mine waste from MIW in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:

Cost for Installation of Diversion/Isolation Components for Conventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6F	Excavation - Soil/Rock (Conventional Access)	452	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.96	$1.96	$885.92	8%	9%	$1,043	MII MII Assemblies	
AA7	Rough Grading (Conventional Access)	10,150	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$304.50	8%	9%	$358	MII MII Assemblies	
AA11	Geotextile Placement	10,150	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$913.50	8%	9%	$1,075	MII MII Assemblies	
MA28	Geotextile - Material Cost	10,150	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$1,827.00	8%	9%	$2,151	V Vendor Quote	Source: GSE, 2017
AA10	Gravel/Riprap Placement (Conventional Access)	168	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.70	$1.70	$285.60	8%	9%	$336	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	70	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$272.30	8%	9%	$321	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	70	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$359.10	8%	9%	$423	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$37.84	8%	9%	$45	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	28	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$301.84	8%	9%	$355	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$7.67	8%	9%	$9	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA7	Rough Grading (Conventional Access)	700	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$21.00	8%	9%	$25	MII MII Assemblies	
AA45C	Soil Placement - Berm (Conventional Access)	32	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.22	$6.22	$199.04	8%	9%	$234	MII MII Assemblies	
AA8	Compaction (Conventional Access)	32	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$49.92	8%	9%	$59	MII MII Assemblies	
AA10	Gravel/Riprap Placement (Conventional Access)	43	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.70	$1.70	$73.10	8%	9%	$86	MII MII Assemblies	
	Culverts Under Roads																
AA6F	Excavation - Soil/Rock (Conventional Access)	23	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.96	$1.96	$45.08	8%	9%	$53	MII MII Assemblies	
AA73	Culvert Installation (Small Equip) - 18"	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.54	$5.54	$166.20	8%	9%	$196	MII MII Assemblies	
MA22	Culvert - 18" Material Cost	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$13.95	$0.00	$13.95	$418.50	8%	9%	$493	CW CostWorks	Source: 33 42 1140 2600
AA22	Soil Placement/Spreading (Conventional Access)	28	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$39.48	8%	9%	$46	MII MII Assemblies	
AA8	Compaction (Conventional Access)	21	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$32.76	8%	9%	$39	MII MII Assemblies	
												TOTAL UNIT COST:			$7,397		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$7,397	$7,397

TABLE CW-A2-3C

Alternative A2 **Cost Worksheet:** **CW-A2-3C**
Capital Cost Sub-Element
Installation of Diversion/Isolation Components for Conventional Access-Subalpine Locations

COST WORKSHEET

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** EW	**Date:** 3/12/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** JN	**Date:** 3/13/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-4

Alternative A2 **Cost Worksheet: CW-A2-4**
Capital Cost Sub-Element
Repairs of Existing Diversion/Isolation Components

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the repair of existing diversion/isolation components including channels, piping, berms and culverts under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included.

Cost Analysis:
Cost for Diversion/Isolation Components Inspection & Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA15C	Mob/Demob - Small Equipment (Maintenance)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA78	Culvert Maintenance	190	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$799.90	8%	9%	$942	MII MII Assemblies	
AA79	Diversion/Isolation Maintenance	4,260	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.13	$2.13	$9,073.80	8%	9%	$10,682	MII MII Assemblies	
MA17C	Repair/Maintenance Allowance for Existing Diversion/Isolation Components	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,000.00	$20,000.00	$20,000.00	0%	0%	$20,000	A Allowance	
												TOTAL UNIT COST:			$33,052		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$33,052	$33,052

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

TABLE CW-A2-5

Alternative A2 **Cost Worksheet:** **CW-A2-5**
Capital Cost Sub-Element
Excavation, Dewatering, and Management of Mine Waste at Local Interim Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of mine waste obstructing mine portal discharges and management of excavated mine waste. Management of mine waste includes moving mine waste to dewatering area, and amending mine waste with diatomaceous earth at the interim local waste management areas. Assumes berms will be placed around interim local waste management areas. It also includes sampling of excavated and dewatered mine waste for physical characterization, including geotechnical analysis.

Cost Analysis:
Cost for Excavation, Dewatering, and Management of Mine Waste at Interim Local Waste Management Areas (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Excavation																
AA81	Excavation - Mine Waste - Obstructive (Nonconventional Access)	**433**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.93	$5.93	$2,567.69	8%	9%	$3,023	MII MII Assemblies	
	Movement to Dewatering Area																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	500	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$2,340.00	8%	9%	$2,755	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	4	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$2,078.56	8%	9%	$2,447	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44A	Mixing Diatomaceous Earth (Nonconventional Access)	60	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.14	$4.14	$248.40	8%	9%	$292	MII MII Assemblies	
	Geotechnical Characterization - Sampling Dewatered Mine Waste																
MA31	Geotechnical Analysis	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$278.00	$278.00	$556.00	8%	9%	$655	CW CostWorks	Source: 01 45 2350 5300. Includes shear strength analysis
L6	Field Engineer	7	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$199.92	100%	9%	$436	FLC FLC Datacenter	
MA19	Equipment, Supplies, and Shipping, per Sample	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$25.00	$0.00	$25.00	$50.00	0%	0%	$50	A Allowance	
	Placement in Interim Local Waste Management Areas																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	60	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$280.80	8%	9%	$331	MII MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	60	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$145.20	8%	9%	$171	MII MII Assemblies	
	Berms for Interim Local Waste Management Areas																
AA58	Rough Grading (Nonconventional Access)	1,418	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$141.79	8%	9%	$167	MII MII Assemblies	Includes grading for positive drainage of interim local waste management areas
AA45A	Soil Placement - Berm (Nonconventional Access)	70	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$682.68	8%	9%	$804	MII MII Assemblies	
												TOTAL UNIT COST:			$8,108		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	433	BCY	$8,108	$19

TABLE CW-A2-5

Alternative A2 **Cost Worksheet: CW-A2-5**
Capital Cost Sub-Element
Excavation, Dewatering, and Management of Mine Waste at Local Interim Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-6

Alternative A2
Capital Cost Sub-Element
Access Road Improvements

Cost Worksheet: **CW-A2-6**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:

This sub-element involves access road improvements. The following cost includes clearing and grubbing, grading, and road improvements. Road improvements would mainly be on non-county roads (i.e. road spurs near the mining-related sources), but costs were included for some incidental road work that could include county roads. Assumes road improvements would be implemented to access mining-related sources. Assumes gravel materials for access road improvements will be uncontaminated borrow developed onsite. Development and transportation of borrow materials are included under separate cost worksheets. Assumes that any gravel that is placed during road improvements would be removed after remedial actions to restore roads to initial condition.

Cost Analysis:

Cost for Access Road Improvements (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Minor Impovements for Access Roads																
AA58	Rough Grading (Nonconventional Access)	25,600	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$2,560.00	8%	9%	$3,014	MII MII Assemblies	
AA13B	Minor Road Improvements	**1,600**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.98	$10.98	$17,568.00	8%	9%	$20,681	MII MII Assemblies	
	Moderate Impovements for Access Roads																
AA5	Clearing and Grubbing	0.7	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,478.29	$2,478.29	$1,734.80	8%	9%	$2,042	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	59,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$5,920.00	8%	9%	$6,969	MII MII Assemblies	
AA13A	Moderate Road Improvements	**3,700**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.03	$21.03	$77,811.00	8%	9%	$91,599	MII MII Assemblies	Assumes placement of gravel for road
	Allowance for Additional Road Improvements																
MA33	Allowance for Additional Road Improvements	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$50,000.00	$50,000.00	$50,000.00	0%	0%	$50,000	A Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
	Removal of Access Road Improvements following Remedial Action																
AA60A	Excavation - Removal of Gravel from Access Roads	2,193	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.08	$2.08	$4,554.86	8%	9%	$5,362	MII MII Assemblies	
AA3I	Hauling - Access Road Gravel to Borrow Location	2,580	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$54,489.60	8%	9%	$64,145	MII MII Assemblies	
												TOTAL UNIT COST:			$243,812		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	5,300	LF	$243,812	$46

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-7

Alternative A2 **Cost Worksheet:** **CW-A2-7**
Capital Cost Sub-Element
Development of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of rock and soil from borrow areas. Assumes soil and gravel borrow materials would be developed onsite. It includes costs for labor, material, and equipment for excavation and crushing/screening of borrow materials. Transportation of borrow materials are included under a separate cost worksheet. Also, includes costs for reclamation of borrow areas following remedial actions.

Cost Analysis:
Cost for Borrow Material Development (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rock Borrow																
AA33	Rock Quarrying	**1,530**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$8,675.10	8%	9%	$10,212	MII MII Assemblies	
AA34	Rock Ripping	**1,530**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$3,549.60	8%	9%	$4,179	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	3,500	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$22,470.00	8%	9%	$26,452	MII MII Assemblies	
AA2	Material Loading	3,500	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$4,362.05	8%	9%	$5,135	MII MII Assemblies	
	Soil Borrow																
AA30	Excavation of Soil	**3,220**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$3,283.43	8%	9%	$3,865	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	3,700	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$3,330.00	8%	9%	$3,920	MII MII Assemblies	
AA2	Material Loading	3,700	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$4,611.31	8%	9%	$5,428	MII MII Assemblies	
	Borrow Area Reclamation																
AA7	Rough Grading (Conventional Access)	217,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$6,534.00	8%	9%	$7,692	MII MII Assemblies	
MA8	Seed Mix	100	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$906.00	8%	9%	$1,067	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$6,175.95	8%	9%	$7,270	MII MII Assemblies	
MA30	Erosion Control Blanket	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$19,932.90	8%	9%	$23,465	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$2,178.90	8%	9%	$2,565	MII MII Assemblies	
												TOTAL UNIT COST:			$101,250		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	6,280	BCY	$101,250	$16

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-8

Alternative A2 — **Cost Worksheet:** **CW-A2-8**
Capital Cost Sub-Element
Transportation of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves hauling of borrow materials from borrow areas to nonconventional access-alpine, nonconventional access-subalpine, conventional access-subalpine, and access road areas for construction of remedial components. It includes costs for labor, material, and equipment. Development of borrow materials are included under a separate cost worksheet.

Cost Analysis:
Cost for Transportation of Borrow Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA3E	Hauling - Rock Borrow for Access Roads	**2,580**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$54,489.60	8%	9%	$64,145	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	**250**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$15,700.00	8%	9%	$18,482	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access Subalpine)	**620**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$13,602.80	8%	9%	$16,013	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	**250**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$2,682.50	8%	9%	$3,158	MII MII Assemblies	
												TOTAL UNIT COST:			$101,798		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	3,700	LCY	$101,798	$28

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-A2-9

Alternative A2 | **Cost Worksheet: CW-A2-9**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assumes water-based dust suppresion during borrow development and access road improvements. It is assumed that water for dust control is obtained from Gladstone Interim Water Treatment Plant at no cost.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA38	Dust Control	296	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$137.94	$137.94	$40,830.24	8%	9%	$48,065	MII MII Assemblies	
												TOTAL UNIT COST:			$48,065		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$48,065	$48,065

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-A2-10

Alternative A2 | **Cost Worksheet:** **CW-A2-10**
Capital Cost Sub-Element
Erosion Control and Reclamation of Areas Disturbed during Construction

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the erosion controls and reclamation of nonconventional access-alpine areas disturbed by construction. Erosion controls shall be installed along roads and streams and consist of silt fencing. Seeding and installation of erosion blankets shall be used for reclamation of areas disturbed by construction.

Cost Analysis:
Cost for Erosion Control and Reclamation of Areas Disturbed during Construction (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Erosion Control																
MA29	Silt Fence	6,000	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.72	$0.00	$0.72	$4,320.00	8%	9%	$5,086	CW CostWorks	Source: 31 25 1416 1000
AA36	Silt Fence Installation	6,000	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.43	$0.43	$2,580.00	8%	9%	$3,037	MII MII Assemblies	
MA32	Crane Mats	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$525.00	$525.00	$5,250.00	8%	9%	$6,180	V Vendor Quote	Source: Matrax, 2018
	Reclamation of Areas Disturbed																
MA8	Seed Mix	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$181.20	8%	9%	$213	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$1,235.19	8%	9%	$1,454	MII MII Assemblies	
MA30	Erosion Control Blanket	230	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$568.10	8%	9%	$669	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	230	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$62.10	8%	9%	$73	MII MII Assemblies	
													TOTAL UNIT COST:		$16,712		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$16,712	$16,712

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-11

Alternative A2
Annual O&M Cost Sub-Element
Inspection of Remedial Components

Cost Worksheet: **CW-A2-11**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves inspection of the remedial components including channels, piping, berms and culverts under roads. Assumes five days for inspection at 20 total mining-related sources.

Cost Analysis:
Cost for Inspection of Remedial Components (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L3	Engineers, Project	40	HR	1.00	$42.06	$42.06	$0.00	$0.00	$0.00	$0.00	$42.06	$1,682.40	100%	9%	$3,668	FLC FLC Datacenter	
L6	Field Engineer	40	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$1,142.40	100%	9%	$2,490	FLC FLC Datacenter	
AA1	Pickup Truck	5	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$519.27	8%	9%	$611	MII MII Assemblies	
MA11	Per Diem	10	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$1,440.00	0%	0%	$1,440	V www.gsa.gov	
												TOTAL UNIT COST:			$8,209		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,209	$8,209

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-12

Alternative A2
Annual O&M Cost Sub-Element
Surface Water Monitoring

Cost Worksheet: **CW-A2-12**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the surface water monitoring to evaluate the effectiveness of the interim remedy. This worksheet includes the cost for two surface water monitoring events and one data summary report in a given year. Assumes that an average of three surface water samples will be collected at each mining-related source that is addressed as part of this issue. Includes stream gauge measurements in addition to analysis of surface water samples. Analytical is assumed to include TAL Metals (total and dissolved), Anions (chloride and fluoride), Alkalinity, Hardness, and Sulfate.

Cost Analysis:
Cost for Surface Water Monitoring (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Analysis																
MA34	TAL Metals (Total)	138	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$11,818.32	8%	9%	$13,913	V Vendor Quote	Source: TestAmerica, 2018
MA35	TAL Metals (Dissolved)	138	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$11,818.32	8%	9%	$13,913	V Vendor Quote	Source: TestAmerica, 2018
MA36	Anions	276	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$22.16	$22.16	$6,116.16	8%	9%	$7,200	V Vendor Quote	Source: TestAmerica, 2018. Chloride and Fluoride
MA37	Sulfate	138	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.08	$11.08	$1,529.04	8%	9%	$1,800	V Vendor Quote	Source: TestAmerica, 2018
MA38	Alkalinity	138	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$1,391.04	8%	9%	$1,638	V Vendor Quote	Source: TestAmerica, 2018
MA40	Hardness	138	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$1,391.04	8%	9%	$1,638	V Vendor Quote	Source: TestAmerica, 2018
MA41	Cooler Sample Shipment	36	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.00	$100.00	$3,600.00	0%	0%	$3,600	A Allowance	Per Estimator
	Equipment																
MA42	Field Meter Rental	16	DY	1.00	$0.00	$0.00	$55.00	$55.00	$0.00	$0.00	$55.00	$880.00	8%	9%	$1,036	V Vendor Quote	Source: Field Environmental, 2018. YSI 556
MA43	Stream Gauge Rental	16	DY	1.00	$0.00	$0.00	$75.00	$75.00	$0.00	$0.00	$75.00	$1,200.00	8%	9%	$1,413	V Vendor Quote	Source: Pine Environmental, 2018. SonTek FlowTracker
MA44	Field Filters	138	EA	1.00	$0.00	$0.00	$0.77	$0.77	$0.00	$0.00	$0.77	$106.26	8%	9%	$125	V Vendor Quote	Source: Hach, 2018
MA45	Miscellaneous Sampling Supplies	2	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$400.00	0%	0%	$400	A Allowance	Per Estimator
	Labor																
L6	Field Engineer	336	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$9,596.16	100%	9%	$20,920	FLC FLC Datacenter	
MA11A	Per Diem (Travel Days)	36	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$131.25	$131.25	$4,725.00	0%	0%	$4,725	V www.gsa.gov	Assumes 75% M&IE on travel days
MA11	Per Diem	36	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$5,184.00	0%	0%	$5,184	V www.gsa.gov	
AA1	Pickup Truck	16	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$1,661.68	8%	9%	$1,956	MII MII Assemblies	
	Reporting																
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L4	Environmental Engineer	60	HR	1.00	$36.33	$36.33	$0.00	$0.00	$0.00	$0.00	$36.33	$2,179.80	100%	9%	$4,752	FLC FLC Datacenter	
L14	Environmental Scientist	20	HR	1.00	$43.20	$43.20	$0.00	$0.00	$0.00	$0.00	$43.20	$864.00	100%	9%	$1,884	FLC FLC Datacenter	
L5	CAD Drafter	12	HR	1.00	$25.25	$25.25	$0.00	$0.00	$0.00	$0.00	$25.25	$303.00	100%	9%	$661	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$89,102		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2	EA	$89,102	$44,551

TABLE CW-A2-12

Alternative A2
Annual O&M Cost Sub-Element
Surface Water Monitoring

Cost Worksheet: **CW-A2-12**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-A2-13

Alternative A2 — **Cost Worksheet: CW-A2-13**
Periodic O&M Cost Sub-Element
Post-Construction Maintenance

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the maintenance of the diversion/isolation components including channels, piping, berms and culverts under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included. Monitoring and maintenance would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Includes monitoring and maintenance for 20 total mining-related sources.

Cost Analysis:
Cost for Post-Construction Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Diversion/Isolation Components																
AA15C	Mob/Demob - Small Equipment (Maintenance)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from off site to the initial mining-related source
AA78	Culvert Maintenance	350	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$1,473.50	8%	9%	$1,735	MII MII Assemblies	
AA79	Diversion/Isolation Maintenance	7,750	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.13	$2.13	$16,507.50	8%	9%	$19,433	MII MII Assemblies	
AA11	Geotextile Placement	2,150	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$193.50	8%	9%	$228	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	140	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$30.80	8%	9%	$36	MII MII Assemblies	
MA28	Geotextile - Material Cost	2,150	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$387.00	8%	9%	$456	V Vendor Quote	Source: GSE, 2017
AA30	Excavation of Soil	7	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$7.14	8%	9%	$8	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	11	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$9.90	8%	9%	$12	MII MII Assemblies	
AA33	Rock Quarrying	15	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$85.05	8%	9%	$100	MII MII Assemblies	
AA34	Rock Ripping	15	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$34.80	8%	9%	$41	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	36	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$231.12	8%	9%	$272	MII MII Assemblies	
AA2	Material Loading	47	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$58.58	8%	9%	$69	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	16	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$1,004.80	8%	9%	$1,183	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access-Subalpine)	16	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$351.04	8%	9%	$413	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	16	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$171.68	8%	9%	$202	MII MII Assemblies	
	Interim Local Management Areas																
AA80	Maintenance Crew	2	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$853.84	$853.84	$1,707.68	8%	9%	$2,010	MII MII Assemblies	
MA17A	Maintenance Allowance for Interim Management Area	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A Allowance	
												TOTAL UNIT COST:			$32,626		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$32,626	$32,626

TABLE CW-A2-13

Alternative A2 **Cost Worksheet: CW-A2-13**
Periodic O&M Cost Sub-Element
Post-Construction Maintenance

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Cost Assumptions and Cost Worksheets

Alternative B2
Stormwater Diversion/Isolation

CDM Smith	PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY: JN	CHECKED BY: EW		
	JOB NO.: 219758.6460.DK4.WAD3.043	DATE: 5/7/2018	DATE CHECKED: 5/8/2018		
	CLIENT: USACE		WRKSHT NO.: Alt B2 Cost Assumptions		

Description: General cost estimate assumptions for Alternative B2 - Diversion/Isolation

General Cost Estimate Assumptions: Alternative B2 - Diversion/Isolation

Period of Analysis, YR:	15	*Assumed*
Number of Nonconventional Access-Alpine Mining-Related Sources to be Addressed, EA:	6	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	4	
Number of Conventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	1	
Total Number of Mining-Related Sources to be Addressed, EA:	**11**	

Diversion/Isolation Component Assumptions - Nonconventional Access-Alpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	60%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	30%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	*Assumed*

Diversion/Isolation Component Assumptions - Nonconventional Access-Subalpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	*Assumed*

Diversion/Isolation Component Assumptions - Conventional Access-Subalpine Only

Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	*Assumed*
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	*Assumed*

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	Alt B2 Cost Assumptions

Description: General cost estimate assumptions for Alternative B2 - Diversion/Isolation

Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	100%	*Assumed*
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	0%	*Assumed*
Borrow Assumptions		
Haul Distance from Borrow Location, MI:	13	*Assumed average distance between borrow and mining-related sources*
Annual O&M Assumptions		
Inspection Frequency, YR/EA:	1	*Annual inspections*
Surface Water Monitoring Events per Year, EA/YR:	2	
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	*Per surface water monitoring event*
Periodic O&M Assumptions		
Maintenance Frequency, YR/EA:	2	*Maintenance every 2 years*
Percentage of Geotextile for Channels to be Replaced, %:	5%	*Per maintenance event*
Percentage of Riprap for Channels to be Replaced, %:	5%	*Per maintenance event*
Percentage of Soil for Berms to be Replaced, %:	5%	*Per maintenance event*

TABLE CW-B2-1

Alternative B2
Capital Cost Sub-Element
Institutional Controls

Cost Worksheet: **CW-B2-1**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves performing institutional controls such as governmental controls, proprietary controls, enforcement tools with IC components, and informational devices. These controls would be implemented as needed to maintain integrity of the proposed diversion and isolation components. These controls would vary by property ownership.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L15	Environmental Lawyer	32	HR	1.00	$40.44	$40.44	$0.00	$0.00	$0.00	$0.00	$40.44	$1,294.08	100%	9%	$2,821	FLC FLC Datacenter	
L16	Paralegal	64	HR	1.00	$24.61	$24.61	$0.00	$0.00	$0.00	$0.00	$24.61	$1,575.04	100%	9%	$3,434	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$8,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,599	$8,599

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-2

Alternative B2
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW-B2-2**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the identified mining-related sources. It includes initial mobilization of equipment to the Site, transporting the equipment between the various mining-related sources, and final demobilization. It assumes that different sized equipment would be mobilized to the different categories of mining-related sources due to access issues preventing large and/or medium sized equipment to certain areas. Includes mobilization/demobilization to 11 total mining-related sources.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA15A	Mob/Demob - Small Equipment (Nonconventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$6,288.35	8%	9%	$7,403	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Nonconventional Access-Subalpine Locations																
AA15B	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,081.51	$1,081.51	$2,163.02	8%	9%	$2,546	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$3,773.01	8%	9%	$4,442	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Conventional Access-Subalpine Locations																
AA16	Mob/Demob - Medium Equipment (Conventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$2,145.60	8%	9%	$2,526	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19C	Mob/Demob - Between Mining-Related Sources (Conventional Access)	0	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$587.74	$587.74	$0.00	8%	9%	$0	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Borrow Development/Access Roads																
AA17	Mob/Demob - Large Equipment	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,222.25	$1,222.25	$2,444.50	8%	9%	$2,878	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial location
AA68	Mob/Demob - Medium Equipment	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$3,218.40	8%	9%	$3,789	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial location
AA19D	Mob/Demob - Between Access Road Locations	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.83	$600.83	$1,802.49	8%	9%	$2,122	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
												TOTAL UNIT COST:			$27,134		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$27,134	$27,134

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-B2-3A

Alternative B2 **Cost Worksheet:** **CW-B2-3A**
Capital Cost Sub-Element
Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of new diversion/isolation components for nonconventional access-alpine locations. These components would divert stormwater around mine waste or isolate mine waste from stormwater in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Diversion/Isolation Components for Nonconventional Access-Alpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	825	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$2,458.50	8%	9%	$2,894	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	18,550	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$1,855.00	8%	9%	$2,184	MII MII Assemblies	
AA11	Geotextile Placement	18,550	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$1,669.50	8%	9%	$1,965	MII MII Assemblies	
MA28	Geotextile - Material Cost	18,550	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$3,339.00	8%	9%	$3,931	V Vendor Quote	Source: GSE, 2017
AA57	Gravel/Riprap Placement (Nonconventional Access)	306	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$2,261.34	8%	9%	$2,662	MII MII Assemblies	
	Open Channel Diversion with Hand Tools (Difficult Access Area)																
AA83	Mobilization of Crew/Tools for Remote Locations	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.69	$1,235.69	$2,471.38	8%	9%	$2,909	MII MII Assemblies	
AA69	Excavation - Hand Digging	45	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.95	$64.95	$2,922.75	8%	9%	$3,441	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	1,560	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$343.20	8%	9%	$404	MII MII Assemblies	
MA28	Geotextile - Material Cost	1,560	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$280.80	8%	9%	$331	V Vendor Quote	Source: GSE, 2017
AA85	Hand Placement of Rocks to Anchor Geotextile	12	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$97.43	$97.43	$1,169.16	8%	9%	$1,376	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	590	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$2,295.10	8%	9%	$2,702	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	590	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$3,026.70	8%	9%	$3,563	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	15	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$283.80	8%	9%	$334	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	236	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$2,544.08	8%	9%	$2,995	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$15.34	8%	9%	$18	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA58	Rough Grading (Nonconventional Access)	2,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$200.00	8%	9%	$235	MII MII Assemblies	
AA45A	Soil Placement - Berm (Nonconventional Access)	89	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$867.75	8%	9%	$1,022	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	89	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$160.20	8%	9%	$189	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	119	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$879.41	8%	9%	$1,035	MII MII Assemblies	
	Culverts Under Roads																
AA78	Culvert Maintenance	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$126.30	8%	9%	$149	MII MII Assemblies	
												TOTAL UNIT COST:			$34,389		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$34,389	$34,389

TABLE CW-B2-3A

Alternative B2 **Cost Worksheet: CW-B2-3A**
Capital Cost Sub-Element
Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-3B

Alternative B2 **Cost Worksheet: CW-B2-3B**
Capital Cost Sub-Element
Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of new diversion/isolation components for nonconventional access-subalpine locations. These components would divert stormwater around mine waste or isolate mine waste from stormwater in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	1,019	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$3,036.62	8%	9%	$3,575	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	22,925	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$2,292.50	8%	9%	$2,699	MII MII Assemblies	
AA11	Geotextile Placement	22,925	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$2,063.25	8%	9%	$2,429	MII MII Assemblies	
MA28	Geotextile - Material Cost	22,925	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$4,126.50	8%	9%	$4,858	V Vendor Quote	Source: GSE, 2017
AA57	Gravel/Riprap Placement (Nonconventional Access)	378	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$2,793.42	8%	9%	$3,288	MII MII Assemblies	
	Open Channel Diversion with Hand Tools (Difficult Access Area)																
AA83	Mobilization of Crew/Tools for Remote Locations	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.69	$1,235.69	$1,235.69	8%	9%	$1,455	MII MII Assemblies	
AA69	Excavation - Hand Digging	56	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.95	$64.95	$3,637.20	8%	9%	$4,282	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	1,950	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$429.00	8%	9%	$505	MII MII Assemblies	
MA28	Geotextile - Material Cost	1,950	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$351.00	8%	9%	$413	V Vendor Quote	Source: GSE, 2017
AA85	Hand Placement of Rocks to Anchor Geotextile	15	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$97.43	$97.43	$1,461.45	8%	9%	$1,720	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	180	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$700.20	8%	9%	$824	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	180	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$923.40	8%	9%	$1,087	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$94.60	8%	9%	$111	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	72	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$776.16	8%	9%	$914	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$7.67	8%	9%	$9	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA58	Rough Grading (Nonconventional Access)	1,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$180.00	8%	9%	$212	MII MII Assemblies	
AA45A	Soil Placement - Berm (Nonconventional Access)	80	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$780.00	8%	9%	$918	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	80	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$144.00	8%	9%	$170	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	107	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$790.73	8%	9%	$931	MII MII Assemblies	
	Culverts Under Roads																
AA78	Culvert Maintenance	30	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$126.30	8%	9%	$149	MII MII Assemblies	
												TOTAL UNIT COST:			$30,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$30,599	$30,599

TABLE CW-B2-3B

Alternative B2 **Cost Worksheet: CW-B2-3B**

Capital Cost Sub-Element

Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations

COST WORKSHEET

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** EW	**Date:** 3/12/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** JN	**Date:** 3/13/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-3C

Alternative B2 **Cost Worksheet: CW-B2-3C**
Capital Cost Sub-Element
Installation of Surface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of new diversion/isolation components for conventional access-subalpine locations. These components would divert stormwater around mine waste or isolate mine waste from stormwater in order to limit co-mingling of the two media. It includes open channels, piping, and berms. It also includes installation of culverts to convey water under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Diversion/Isolation Components for Conventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Open Channel Diversion																
AA6F	Excavation - Soil/Rock (Conventional Access)	296	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.96	$1.96	$580.16	8%	9%	$683	MII MII Assemblies	
AA7	Rough Grading (Conventional Access)	6,650	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$199.50	8%	9%	$235	MII MII Assemblies	
AA11	Geotextile Placement	6,650	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$598.50	8%	9%	$705	MII MII Assemblies	
MA28	Geotextile - Material Cost	6,650	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$1,197.00	8%	9%	$1,409	V Vendor Quote	Source: GSE, 2017
AA10	Gravel/Riprap Placement (Conventional Access)	110	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.70	$1.70	$187.00	8%	9%	$220	MII MII Assemblies	
	Open Channel Diversion with Hand Tools (Difficult Access Area)																
AA83	Mobilization of Crew/Tools for Remote Locations	0	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.69	$1,235.69	$0.00	8%	9%	$0	MII MII Assemblies	
AA69	Excavation - Hand Digging	0	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$64.95	$64.95	$0.00	8%	9%	$0	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	0	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$0.00	8%	9%	$0	MII MII Assemblies	
MA28	Geotextile - Material Cost	0	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$0.00	8%	9%	$0	V Vendor Quote	Source: GSE, 2017
AA85	Hand Placement of Rocks to Anchor Geotextile	0	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$97.43	$97.43	$0.00	8%	9%	$0	MII MII Assemblies	
	Piping																
AA75A	Installation of 4" HDPE Piping	50	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.89	$3.89	$194.50	8%	9%	$229	MII MII Assemblies	
MA24A	4" HDPE Pipe - Material Cost	50	LF	1.00	$0.00	$0.00	$0.00	$0.00	$5.13	$0.00	$5.13	$256.50	8%	9%	$302	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$37.84	8%	9%	$45	MII MII Assemblies	
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42.50	$42.50	$42.50	8%	9%	$50	CW CostWorks	Source: 22 11 1378 4360
MA26	Steel Stakes	20	EA	1.00	$0.00	$0.00	$0.00	$0.00	$10.78	$0.00	$10.78	$215.60	8%	9%	$254	V Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7.67	$0.00	$7.67	$7.67	8%	9%	$9	V Vendor Quote	Source: Home Depot, 2018
	Berm																
AA7	Rough Grading (Conventional Access)	500	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$15.00	8%	9%	$18	MII MII Assemblies	
AA45C	Soil Placement - Berm (Conventional Access)	23	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.22	$6.22	$143.06	8%	9%	$168	MII MII Assemblies	
AA8	Compaction (Conventional Access)	23	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$35.88	8%	9%	$42	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	31	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$229.09	8%	9%	$270	MII MII Assemblies	
	Culverts Under Roads																
AA78	Culvert Maintenance	0	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$0.00	8%	9%	$0	MII MII Assemblies	
												TOTAL UNIT COST:			$4,639		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$4,639	$4,639

TABLE CW-B2-3C

Alternative B2 **Cost Worksheet: CW-B2-3C**
Capital Cost Sub-Element
Installation of Surface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-4A

Alternative B2 **Cost Worksheet: CW-B2-4A**
Capital Cost Sub-Element
Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of subsurface diversions through the use of passive interflow controls at nonconventional access-alpine locations. These components include the installation of perforated piping installed at approximately 4 feet deep to intercept shallow subsurface stormwater. Assumes rock materials for subsurface components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Excavation																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	825	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$2,458.50	8%	9%	$2,894	MII MII Assemblies	
	Passive Interflow Control Installation																
AA75B	Installation of 6" HDPE Piping	200	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.09	$4.09	$818.00	8%	9%	$963	MII MII Assemblies	
MA24B	6" HDPE Perforated Pipe - Material Cost	200	LF	1.00	$0.00	$0.00	$0.00	$0.00	$10.69	$0.00	$10.69	$2,138.00	8%	9%	$2,517	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$94.60	8%	9%	$111	MII MII Assemblies	
MA25B	HDPE Weld Machine Rental (6" to 8"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$95.50	$95.50	$95.50	8%	9%	$112	CW CostWorks	Source: 22 11 1378 4370
AA57	Gravel/Riprap Placement (Nonconventional Access)	78	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$576.42	8%	9%	$679	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	66	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$118.80	8%	9%	$140	MII MII Assemblies	
AA11	Geotextile Placement	2,400	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$216.00	8%	9%	$254	MII MII Assemblies	
MA28	Geotextile - Material Cost	2,400	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$432.00	8%	9%	$509	V Vendor Quote	Source: GSE, 2017
	Soil Backfill																
AA54	Soil Placement/Spreading (Nonconventional Access)	107	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$258.94	8%	9%	$305	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	80	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$144.00	8%	9%	$170	MII MII Assemblies	
												TOTAL UNIT COST:			$8,654		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	200	LF	$8,654	$43

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-4B

Alternative B2 **Cost Worksheet: CW-B2-4B**
Capital Cost Sub-Element
Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of subsurface diversions through the use of passive interflow controls at nonconventional access-subalpine locations. These components include the installation of perforated piping installed at approximately 4 feet deep to intercept shallow subsurface stormwater. Assumes rock materials for subsurface components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Excavation																
AA6D	Excavation - Soil/Rock (Nonconventional Access)	85	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.98	$2.98	$253.30	8%	9%	$298	MII MII Assemblies	
	Passive Interflow Control Installation																
AA75B	Installation of 6" HDPE Piping	190	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.09	$4.09	$777.10	8%	9%	$915	MII MII Assemblies	
MA24B	6" HDPE Perforated Pipe - Material Cost	190	LF	1.00	$0.00	$0.00	$0.00	$0.00	$10.69	$0.00	$10.69	$2,031.10	8%	9%	$2,391	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$94.60	8%	9%	$111	MII MII Assemblies	
MA25B	HDPE Weld Machine Rental (6" to 8"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$95.50	$95.50	$95.50	8%	9%	$112	CW CostWorks	Source: 22 11 1378 4370
AA57	Gravel/Riprap Placement (Nonconventional Access)	73	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$539.47	8%	9%	$635	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	62	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$111.60	8%	9%	$131	MII MII Assemblies	
AA11	Geotextile Placement	2,280	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$205.20	8%	9%	$242	MII MII Assemblies	
MA28	Geotextile - Material Cost	2,280	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$410.40	8%	9%	$483	V Vendor Quote	Source: GSE, 2017
	Soil Backfill																
AA54	Soil Placement/Spreading (Nonconventional Access)	102	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$246.84	8%	9%	$291	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	77	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$138.60	8%	9%	$163	MII MII Assemblies	
												TOTAL UNIT COST:			$5,772		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	190	LF	$5,772	$30

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-4C

Alternative B2 **Cost Worksheet: CW-B2-4C**
Capital Cost Sub-Element
Installation of Subsurface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the construction of subsurface diversions through the use of passive interflow controls at conventional access-subalpine locations. These components include the installation of perforated piping installed at approximately 4 feet deep to intercept shallow subsurface stormwater. Assumes rock materials for subsurface components will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Installation of Subsurface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Excavation																
AA6F	Excavation - Soil/Rock (Conventional Access)	23	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.96	$1.96	$45.08	8%	9%	$53	MII MII Assemblies	
	Passive Interflow Control Installation																
AA75B	Installation of 6" HDPE Piping	50	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.09	$4.09	$204.50	8%	9%	$241	MII MII Assemblies	
MA24B	6" HDPE Perforated Pipe - Material Cost	50	LF	1.00	$0.00	$0.00	$0.00	$0.00	$10.69	$0.00	$10.69	$534.50	8%	9%	$629	V Vendor Quote	Source: HDPE Supply, 2018
AA76	HDPE Welding	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.92	$18.92	$37.84	8%	9%	$45	MII MII Assemblies	
MA25B	HDPE Weld Machine Rental (6" to 8"Diameter)	1	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$95.50	$95.50	$95.50	8%	9%	$112	CW CostWorks	Source: 22 11 1378 4370
AA10	Gravel/Riprap Placement (Conventional Access)	20	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.70	$1.70	$34.00	8%	9%	$40	MII MII Assemblies	
AA8	Compaction (Conventional Access)	17	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$26.52	8%	9%	$31	MII MII Assemblies	
AA11	Geotextile Placement	600	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$54.00	8%	9%	$64	MII MII Assemblies	
MA28	Geotextile - Material Cost	600	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$108.00	8%	9%	$127	V Vendor Quote	Source: GSE, 2017
	Soil Backfill																
AA22	Soil Placement/Spreading (Conventional Access)	28	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$39.48	8%	9%	$46	MII MII Assemblies	
AA8	Compaction (Conventional Access)	21	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$32.76	8%	9%	$39	MII MII Assemblies	
												TOTAL UNIT COST:			$1,427		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	50	LF	$1,427	$29

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

TABLE CW-B2-5

Alternative B2 **Cost Worksheet: CW-B2-5**
Capital Cost Sub-Element
Access Road Improvements

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves access road improvements. The following cost includes clearing and grubbing, grading, and road improvements. Road improvements would mainly be on non-county roads (i.e. road spurs near the mining-related sources), but costs were included for some incidental road work that could include county roads. Assumes road improvements would be implemented to access mining-related sources. Assumes gravel materials for access road improvements will be uncontaminated borrow developed onsite. Development and transportation of borrow materials are included under separate cost worksheets. Assumes that any gravel that is placed during road improvements would be removed after remedial actions to restore roads to initial condition.

Cost Analysis:
Cost for Access Road Improvements (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Minor Impovements for Access Roads																
AA58	Rough Grading (Nonconventional Access)	20,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$2,080.00	8%	9%	$2,449	MII MII Assemblies	
AA13B	Minor Road Improvements	**1,300**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.98	$10.98	$14,274.00	8%	9%	$16,803	MII MII Assemblies	
	Moderate Impovements for Access Roads																
AA5	Clearing and Grubbing	0.7	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,478.29	$2,478.29	$1,734.80	8%	9%	$2,042	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	59,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$5,920.00	8%	9%	$6,969	MII MII Assemblies	
AA13A	Moderate Road Improvements	**3,700**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.03	$21.03	$77,811.00	8%	9%	$91,599	MII MII Assemblies	Assumes placement of gravel for road
	Allowance for Additional Road Improvements																
MA33	Allowance for Additional Road Improvements	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$50,000.00	$50,000.00	$50,000.00	0%	0%	$50,000	A Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
	Removal of Access Road Improvements following Remedial Action																
AA60A	Excavation - Removal of Gravel from Access Roads	2,193	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.08	$2.08	$4,554.86	8%	9%	$5,362	MII MII Assemblies	
AA3I	Hauling - Access Road Gravel to Borrow Location	2,580	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$54,489.60	8%	9%	$64,145	MII MII Assemblies	
												TOTAL UNIT COST:			$239,369		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	5,000	LF	$239,369	$48

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-B2-6

Alternative B2
Capital Cost Sub-Element
Development of Borrow Materials

Cost Worksheet: **CW-B2-6**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of rock and soil from borrow areas. Assumes soil and gravel borrow materials would be developed onsite. It includes costs for labor, material, and equipment for excavation and crushing/screening of borrow materials. Transportation of borrow materials are included under a separate cost worksheet. Also, includes costs for reclamation of borrow areas following remedial actions.

Cost Analysis:
Cost for Borrow Material Development (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rock Borrow																
AA33	Rock Quarrying	**1,610**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$9,128.70	8%	9%	$10,746	MII MII Assemblies	
AA34	Rock Ripping	**1,610**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$3,735.20	8%	9%	$4,397	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	3,800	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$24,396.00	8%	9%	$28,719	MII MII Assemblies	
AA2	Material Loading	3,800	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$4,735.94	8%	9%	$5,575	MII MII Assemblies	
	Soil Borrow																
AA30	Excavation of Soil	**220**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$224.33	8%	9%	$264	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	260	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$234.00	8%	9%	$275	MII MII Assemblies	
AA2	Material Loading	260	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$324.04	8%	9%	$381	MII MII Assemblies	
	Borrow Area Reclamation																
AA7	Rough Grading (Conventional Access)	217,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$6,534.00	8%	9%	$7,692	MII MII Assemblies	
MA8	Seed Mix	100	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$906.00	8%	9%	$1,067	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$6,175.95	8%	9%	$7,270	MII MII Assemblies	
MA30	Erosion Control Blanket	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$19,932.90	8%	9%	$23,465	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$2,178.90	8%	9%	$2,565	MII MII Assemblies	
												TOTAL UNIT COST:			$92,416		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	3,440	BCY	$92,416	$27

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-7

Alternative B2 **Cost Worksheet: CW-B2-7**
Capital Cost Sub-Element
Transportation of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves hauling of borrow materials from borrow areas to nonconventional access-alpine, nonconventional access-subalpine, conventional access-subalpine, and access road areas for construction of remedial components. It includes costs for labor, material, and equipment. Development of borrow materials are included under a separate cost worksheet.

Cost Analysis:
Cost for Transportation of Borrow Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA3E	Hauling - Rock Borrow for Access Roads	**2,580**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$54,489.60	8%	9%	$64,145	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	**500**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$31,400.00	8%	9%	$36,964	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access Subalpine)	**560**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$12,286.40	8%	9%	$14,464	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	**160**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$1,716.80	8%	9%	$2,021	MII MII Assemblies	
												TOTAL UNIT COST:			$117,594		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	3,800	LCY	$117,594	$31

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-B2-8

Alternative B2 **Cost Worksheet:** **CW-B2-8**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assumes water-based dust suppresion during borrow development and access road improvements. It is assumed that water for dust control is obtained from Gladstone Interim Water Treatment Plant at no cost.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA38	Dust Control	298	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$137.94	$137.94	$41,106.12	8%	9%	$48,390	MII MII Assemblies	
												TOTAL UNIT COST:			$48,390		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$48,390	$48,390

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-9

Alternative B2 **Cost Worksheet: CW-B2-9**
Capital Cost Sub-Element
Erosion Control and Reclamation of Areas Disturbed during Construction

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the erosion controls and reclamation of nonconventional access-alpine areas disturbed by construction. Erosion controls shall be installed along roads and streams and consist of silt fencing. Seeding and installation of erosion blankets shall be used for reclamation of areas disturbed by construction.

Cost Analysis:
Cost for Erosion Control and Reclamation of Areas Disturbed during Construction (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Erosion Control																
MA29	Silt Fence	3,300	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.72	$0.00	$0.72	$2,376.00	8%	9%	$2,797	CW CostWorks	Source: 31 25 1416 1000
AA36	Silt Fence Installation	3,300	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.43	$0.43	$1,419.00	8%	9%	$1,670	MII MII Assemblies	
MA32	Crane Mats	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$525.00	$525.00	$5,250.00	8%	9%	$6,180	V Vendor Quote	Source: Matrax, 2018
	Reclamation of Areas Disturbed																
MA8	Seed Mix	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$181.20	8%	9%	$213	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$1,235.19	8%	9%	$1,454	MII MII Assemblies	
MA30	Erosion Control Blanket	230	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$568.10	8%	9%	$669	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	230	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$62.10	8%	9%	$73	MII MII Assemblies	
												TOTAL UNIT COST:			$13,056		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$13,056	$13,056

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-10

Alternative B2 **Cost Worksheet: CW-B2-10**
Annual O&M Cost Sub-Element
Inspection of Remedial Components

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves inspection of the remedial components including channels, piping, berms and culverts under roads. Assumes four days for inspection at 11 total mining-related sources.

Cost Analysis:
Cost for Inspection of Remedial Components (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L3	Engineers, Project	32	HR	1.00	$42.06	$42.06	$0.00	$0.00	$0.00	$0.00	$42.06	$1,345.92	100%	9%	$2,934	FLC FLC Datacenter	
L6	Field Engineer	32	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$913.92	100%	9%	$1,992	FLC FLC Datacenter	
AA1	Pickup Truck	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$415.42	8%	9%	$489	MII MII Assemblies	
MA11	Per Diem	8	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$1,152.00	0%	0%	$1,152	V www.gsa.gov	
												TOTAL UNIT COST:			$6,567		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$6,567	$6,567

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-11

Alternative B2 **Cost Worksheet: CW-B2-11**
Annual O&M Cost Sub-Element
Surface Water Monitoring

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the surface water monitoring to evaluate the effectiveness of the interim remedy. This worksheet includes the cost for two surface water monitoring events and one data summary report in a given year. Assumes that an average of three surface water samples will be collected at each mining-related source that is addressed as part of this issue. Includes stream gauge measurements in addition to analysis of surface water samples. Analytical is assumed to include TAL Metals (total and dissolved), Anions (chloride and fluoride), Alkalinity, Hardness, and Sulfate.

Cost Analysis:
Cost for Surface Water Monitoring (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Analysis																
MA34	TAL Metals (Total)	78	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$6,679.92	8%	9%	$7,864	V Vendor Quote	Source: TestAmerica, 2018
MA35	TAL Metals (Dissolved)	78	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$6,679.92	8%	9%	$7,864	V Vendor Quote	Source: TestAmerica, 2018
MA36	Anions	156	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$22.16	$22.16	$3,456.96	8%	9%	$4,070	V Vendor Quote	Source: TestAmerica, 2018. Chloride and Fluoride
MA37	Sulfate	78	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.08	$11.08	$864.24	8%	9%	$1,017	V Vendor Quote	Source: TestAmerica, 2018
MA38	Alkalinity	78	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$786.24	8%	9%	$926	V Vendor Quote	Source: TestAmerica, 2018
MA40	Hardness	78	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$786.24	8%	9%	$926	V Vendor Quote	Source: TestAmerica, 2018
MA41	Cooler Sample Shipment	20	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.00	$100.00	$2,000.00	0%	0%	$2,000	A Allowance	Per Estimator
	Equipment																
MA42	Field Meter Rental	12	DY	1.00	$0.00	$0.00	$55.00	$55.00	$0.00	$0.00	$55.00	$660.00	8%	9%	$777	V Vendor Quote	Source: Field Environmental, 2018. YSI 556
MA43	Stream Gauge Rental	12	DY	1.00	$0.00	$0.00	$75.00	$75.00	$0.00	$0.00	$75.00	$900.00	8%	9%	$1,059	V Vendor Quote	Source: Pine Environmental, 2018. SonTek FlowTracker
MA44	Field Filters	78	EA	1.00	$0.00	$0.00	$0.77	$0.77	$0.00	$0.00	$0.77	$60.06	8%	9%	$71	V Vendor Quote	Source: Hach, 2018
MA45	Miscellaneous Sampling Supplies	2	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$400.00	0%	0%	$400	A Allowance	Per Estimator
	Labor																
L6	Field Engineer	228	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$6,511.68	100%	9%	$14,195	FLC FLC Datacenter	
MA11A	Per Diem (Travel Days)	24	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$131.25	$131.25	$3,150.00	0%	0%	$3,150	V www.gsa.gov	Assumes 75% M&IE on travel days
MA11	Per Diem	12	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$1,728.00	0%	0%	$1,728	V www.gsa.gov	
AA1	Pickup Truck	12	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$1,246.26	8%	9%	$1,467	MII MII Assemblies	
	Reporting																
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L4	Environmental Engineer	60	HR	1.00	$36.33	$36.33	$0.00	$0.00	$0.00	$0.00	$36.33	$2,179.80	100%	9%	$4,752	FLC FLC Datacenter	
L14	Environmental Scientist	20	HR	1.00	$43.20	$43.20	$0.00	$0.00	$0.00	$0.00	$43.20	$864.00	100%	9%	$1,884	FLC FLC Datacenter	
L5	CAD Drafter	12	HR	1.00	$25.25	$25.25	$0.00	$0.00	$0.00	$0.00	$25.25	$303.00	100%	9%	$661	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$57,155		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2	EA	$57,155	$28,578

TABLE CW-B2-11

Alternative B2
Annual O&M Cost Sub-Element
Surface Water Monitoring

Cost Worksheet: **CW-B2-11**

COST WORKSHEET

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** JN	**Date:** 5/7/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** EW	**Date:** 5/8/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-B2-12		
Alternative B2 **Periodic O&M Cost Sub-Element** **Post-Construction Maintenance**	**Cost Worksheet: CW-B2-12**	**COST WORKSHEET**

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** JN	**Date:** 5/7/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** EW	**Date:** 5/8/2018
Base Year:	2018		

Work Statement:

This sub-element involves the maintenance of the diversion/isolation components including channels, piping, berms and culverts under roads. Assumes soil and rock materials for diversion/isolation components will be developed onsite. Development and transportation of borrow materials are included. Monitoring and maintenance would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Includes monitoring and maintenance for 11 total mining-related sources.

Cost Analysis:

Cost for Post-Construction Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA15C	Mob/Demob - Small Equipment (Maintenance)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from off site to the initial mining-related source
AA78	Culvert Maintenance	60	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.21	$4.21	$252.60	8%	9%	$297	MII MII Assemblies	
AA79	Diversion/Isolation Maintenance	4,270	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.13	$2.13	$9,095.10	8%	9%	$10,707	MII MII Assemblies	
AA11	Geotextile Placement	2,410	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09	$0.09	$216.90	8%	9%	$255	MII MII Assemblies	
AA84	Geotextile Placement - Remote Locations	180	SF	2.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.22	$39.60	8%	9%	$47	MII MII Assemblies	
MA28	Geotextile - Material Cost	2,410	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.00	$0.18	$433.80	8%	9%	$511	V Vendor Quote	Source: GSE, 2017
AA30	Excavation of Soil	9	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$9.18	8%	9%	$11	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	14	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$12.60	8%	9%	$15	MII MII Assemblies	
AA33	Rock Quarrying	17	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$96.39	8%	9%	$113	MII MII Assemblies	
AA34	Rock Ripping	17	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$39.44	8%	9%	$46	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	40	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$256.80	8%	9%	$302	MII MII Assemblies	
AA2	Material Loading	54	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$67.30	8%	9%	$79	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	18	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$1,130.40	8%	9%	$1,331	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access-Subalpine)	18	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$394.92	8%	9%	$465	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	18	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$193.14	8%	9%	$227	MII MII Assemblies	
												TOTAL UNIT COST:			$15,834		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$15,834	$15,834

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Cost Assumptions and Cost Worksheets

Alternative C2

Excavation and Interim Local Waste Management

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	Alt C2 Cost Assumptions

Description: General cost estimate assumptions for Alternative C2 - Excavation and Interim Local Waste Mangement

General Cost Estimate Assumptions: Alternative C2 - Excavation and Interim Local Waste Mangement

Period of Analysis, YR:	15	*Assumed*
Number of Nonconventional Access-Alpine Mining-Related Sources to be Addressed, EA:	1	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	3	
Number of Conventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	4	
Total Number of Mining-Related Sources to be Addressed, EA:	**8**	
Mine Portal Pond Assumptions		
Assumed Depth of Sediment in Ponds, FT:	4	*Assumed*
Assumed Water Depth in Ponds, FT:	1	*Assumed*
Mine Portal Pond Sediment Assumptions		
Percentage of Sediment Amended with Diatomaceous Earth, %:	10%	*Assumed*
Assumed Diatomaceous Earth Amendment Rate, %:	10%	*Assumed*
Borrow Assumptions		
Haul Distance from Borrow Location, MI:	13	*Assumed average distance between borrow and mining-related sources*
Annual O&M Assumptions		
Inspection Frequency, YR/EA:	1	*Annual inspections*
Surface Water Monitoring Events per Year, EA/YR:	2	
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	4	*Per surface water monitoring event*
Periodic O&M Assumptions		
Maintenance Frequency, YR/EA:	2	*Maintenance every 2 years*
Duration for Maintenance Crew per Maintenance Event, DY/EA:	3	*Per maintenance event*

TABLE CW-C2-1

Alternative C2
Capital Cost Sub-Element
Institutional Controls

Cost Worksheet: **CW-C2-1**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves performing institutional controls such as governmental controls, proprietary controls, enforcement tools with IC components, and informational devices. These controls would be implemented as needed to maintain integrity of the proposed interim management areas. These controls would vary by property ownership.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L15	Environmental Lawyer	32	HR	1.00	$40.44	$40.44	$0.00	$0.00	$0.00	$0.00	$40.44	$1,294.08	100%	9%	$2,821	FLC FLC Datacenter	
L16	Paralegal	64	HR	1.00	$24.61	$24.61	$0.00	$0.00	$0.00	$0.00	$24.61	$1,575.04	100%	9%	$3,434	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$8,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,599	$8,599

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-2

Alternative C2
Capital Cost Sub-Element
Mobilization/Demobilization

Cost Worksheet: **CW-C2-2**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the identified mining-related sources. It includes initial mobilization of equipment to the Site, transporting the equipment between the various mining-related sources, and final demobilization. It assumes that different sized equipment would be mobilized to the different categories of mining-related sources due to access issues preventing large and/or medium sized equipment to certain areas. Includes mobilization/demobilization to 8 total mining-related sources.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA15A	Mob/Demob - Small Equipment (Nonconventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	0	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$0.00	8%	9%	$0	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Nonconventional Access-Subalpine Locations																
AA15B	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,081.51	$1,081.51	$2,163.02	8%	9%	$2,546	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$2,515.34	8%	9%	$2,961	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Conventional Access-Subalpine Locations																
AA16	Mob/Demob - Medium Equipment (Conventiona Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$2,145.60	8%	9%	$2,526	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA19C	Mob/Demob - Between Mining-Related Sources (Conventional Access)	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$587.74	$587.74	$1,763.22	8%	9%	$2,076	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
	Borrow Development/Access Roads																
AA17	Mob/Demob - Large Equipment	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,222.25	$1,222.25	$2,444.50	8%	9%	$2,878	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial location
AA68	Mob/Demob - Medium Equipment	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$3,218.40	8%	9%	$3,789	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial location
AA19D	Mob/Demob - Between Access Road Locations	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.83	$600.83	$1,201.66	8%	9%	$1,415	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
												TOTAL UNIT COST:			$19,619		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$19,619	$19,619

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-3

Alternative C2 **Cost Worksheet: CW-C2-3**
Capital Cost Sub-Element
Pond Draining and Repair of Pond Berms

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves using a pump and hoses to drain the MIW from each pond. Assumes that draining of ponds would include displacing MIW between ponds and would not include external discharge of MIW. Assumes that mining-related sources with only one pond would require a berm placed across the pond temporarily in order to displace water on either side of the berm during excavation of sediment.

Cost Analysis:
Cost for Pond Draining (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Pond Draining - Nonconventional Access- Alpine Locations																
AA40A	Draining Ponds	**62,800**	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$3,140.00	8%	9%	$3,696	MII MII Assemblies	
	Pond Draining - Nonconventional Access- Subalpine Locations																
AA40A	Draining Ponds	**212,400**	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$10,620.00	8%	9%	$12,502	MII MII Assemblies	
	Pond Draining - Conventional Access- Subalpine Locations																
AA40A	Draining Ponds	**239,400**	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$11,970.00	8%	9%	$14,091	MII MII Assemblies	
AA45F	Soil Placement - Pond Berm (Conventional Access)	134	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.22	$6.22	$833.48	8%	9%	$981	MII MII Assemblies	
	Repair of Pond Berms																
AA45D	Soil Placement - Pond Berm (Nonconventional Access)	112	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$1,092.00	8%	9%	$1,286	MII MII Assemblies	
AA45F	Soil Placement - Pond Berm (Conventional Access)	45	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.22	$6.22	$279.90	8%	9%	$329	MII MII Assemblies	
												TOTAL UNIT COST:			$32,885		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	514,600	GAL	$32,885	$0.06

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-4

Alternative C2
Capital Cost Sub-Element
Mine Portal Pond Sediment Excavation

Cost Worksheet: **CW-C2-4**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves excavation of mine portal pond sediment from the ponds following the draining of the ponds. Assumes that excavated sediment will be placed adjacent to pond to allow for gravity dewatering before moving to interim management area.

Cost Analysis:
Cost for Mine Portal Pond Sediment Excavation (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	**1,244**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.72	$3.72	$4,627.68	8%	9%	$5,448	MII MII Assemblies	
	Nonconventional Access-Subalpine Locations																
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	**4,207**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.72	$3.72	$15,650.04	8%	9%	$18,423	MII MII Assemblies	
	Conventional Access-Subalpine Locations																
AA6C	Excavation - Sediment/In-Stream Mine Waste (Conventional Access)	**4,741**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.44	$3.44	$16,309.04	8%	9%	$19,199	MII MII Assemblies	
												TOTAL UNIT COST:			$43,070		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	10,192	BCY	$43,070	$4

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-5

Alternative C2 **Cost Worksheet: CW-C2-5**
Capital Cost Sub-Element
Geotechnical Characterization - Sampling Dewatered Mine Portal Pond Sediment

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves sampling excavated and dewatered mine portal pond sediment for physical characterization, including geotechnical analysis.

Cost Analysis:
Cost for Geotechnical Characterization - Sampling Dewatered Mine Portal Pond Sediment (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
MA31	Geotechnical Analysis	**49**	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$278.00	$278.00	$13,622.00	8%	9%	$16,036	CW CostWorks	Source: 01 45 2350 5300. Includes shear strength analysis
L6	Field Engineer	40	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$1,142.40	100%	9%	$2,490	FLC FLC Datacenter	
MA19	Equipment, Supplies, and Shipping, per Sample	49	EA	1.00	$0.00	$0.00	$0.00	$0.00	$25.00	$0.00	$25.00	$1,225.00	0%	0%	$1,225	A Allowance	
												TOTAL UNIT COST:			$19,751		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	49	EA	$19,751	$403

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-6

Alternative C2 **Cost Worksheet: CW-C2-6**
Capital Cost Sub-Element
Management and Dewatering of Mine Portal Pond Sediment at Interim Local Waste Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the management of excavated mine portal pond sediment, moving sediment to dewatering area, amending sediment with diatomaceous earth, and spreading of sediment at the interim local waste management areas. It assumes that sediment will be moved to a dewatering area prior to placement in interim local management areas. Assumes berms will be placed around interim local waste management areas.

Cost Analysis:
Cost for Management and Dewatering of Mine Portal Pond Sediment at Interim Local Waste Management Areas (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Movement to Dewatering Area																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	6,550	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$30,654.00	8%	9%	$36,086	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	5,690	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$14,907.80	8%	9%	$17,549	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	190	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$98,731.60	8%	9%	$116,227	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44A	Mixing Diatomaceous Earth (Nonconventional Access)	940	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.14	$4.14	$3,891.60	8%	9%	$4,581	MII MII Assemblies	
AA44C	Mixing Diatomaceous Earth (Conventional Access)	810	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.35	$2.35	$1,903.50	8%	9%	$2,241	MII MII Assemblies	
	Placement in Interim Local Waste Management Areas																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	**6,830**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$31,964.40	8%	9%	$37,628	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	**5,930**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$15,536.60	8%	9%	$18,290	MII MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	6,830	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$16,528.60	8%	9%	$19,457	MII MII Assemblies	
AA4C	Material Spreading - Excavated Materials (Conventional Access)	5,930	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$8,361.30	8%	9%	$9,843	MII MII Assemblies	
	Berms for Interim Local Waste Management Areas																
AA58	Rough Grading (Nonconventional Access)	3,176	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$317.58	8%	9%	$374	MII MII Assemblies	Includes grading for positive drainage of interim local waste management areas
AA7	Rough Grading (Conventional Access)	2,172	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$65.16	8%	9%	$77	MII MII Assemblies	Includes grading for positive drainage of interim local waste management areas
AA45A	Soil Placement - Berm (Nonconventional Access)	220	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$2,145.00	8%	9%	$2,525	MII MII Assemblies	
AA45C	Soil Placement - Berm (Conventional Access)	110	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.22	$6.22	$684.20	8%	9%	$805	MII MII Assemblies	
												TOTAL UNIT COST:			$265,683		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	12,240	LCY	$265,683	$22

TABLE CW-C2-6

Alternative C2 **Cost Worksheet:** **CW-C2-6**
Capital Cost Sub-Element
Management and Dewatering of Mine Portal Pond Sediment at Interim Local Waste Management Areas

COST WORKSHEET

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** EW	**Date:** 3/12/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** JN	**Date:** 3/13/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-7

Alternative C2
Capital Cost Sub-Element
Access Road Improvements

Cost Worksheet: **CW-C2-7**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves access road improvements. The following cost includes clearing and grubbing, grading, and road improvements. Road improvements would mainly be on non-county roads (i.e. road spurs near the mining-related sources), but costs were included for some incidental road work that could include county roads. Assumes road improvements would be implemented to access mining-related sources. Assumes gravel materials for access road improvements will be uncontaminated borrow developed onsite. Development and transportation of borrow materials are included under separate cost worksheets. Assumes that any gravel that is placed during road improvements would be removed after remedial actions to restore roads to initial condition.

Cost Analysis:
Cost for Access Road Improvements (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Minor Impovements for Access Roads																
AA58	Rough Grading (Nonconventional Access)	24,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$2,400.00	8%	9%	$2,825	MII MII Assemblies	
AA13B	Minor Road Improvements	**1,500**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.98	$10.98	$16,470.00	8%	9%	$19,388	MII MII Assemblies	
	Moderate Impovements for Access Roads																
AA5	Clearing and Grubbing	0.7	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,478.29	$2,478.29	$1,734.80	8%	9%	$2,042	MII MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	52,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$5,280.00	8%	9%	$6,216	MII MII Assemblies	
AA13A	Moderate Road Improvements	**3,300**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.03	$21.03	$69,399.00	8%	9%	$81,697	MII MII Assemblies	Assumes placement of gravel for road
	Allowance for Additional Road Improvements																
MA33	Allowance for Additional Road Improvements	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$50,000.00	$50,000.00	$50,000.00	0%	0%	$50,000	A Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
	Removal of Access Road Improvements following Remedial Action																
AA60A	Excavation - Removal of Gravel from Access Roads	1,956	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.08	$2.08	$4,062.61	8%	9%	$4,783	MII MII Assemblies	
AA3I	Hauling - Access Road Gravel to Borrow Location	2,302	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$48,618.24	8%	9%	$57,233	MII MII Assemblies	
												TOTAL UNIT COST:			$224,184		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	4,800	LF	$224,184	$47

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-8

Alternative C2
Capital Cost Sub-Element
Development of Borrow Materials

Cost Worksheet: **CW-C2-8**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of rock and soil from borrow areas. Assumes soil and gravel borrow materials would be developed onsite. It includes costs for labor, material, and equipment for excavation and crushing/screening of borrow materials. Transportation of borrow materials are included under a separate cost worksheet. Also, includes costs for reclamation of borrow areas following remedial actions.

Cost Analysis:
Cost for Borrow Material Development (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rock Borrow																
AA33	Rock Quarrying	**1,025**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$5,811.75	8%	9%	$6,842	MII MII Assemblies	
AA34	Rock Ripping	**1,025**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$2,378.00	8%	9%	$2,799	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	2,300	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$14,766.00	8%	9%	$17,383	MII MII Assemblies	
AA2	Material Loading	2,300	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$2,866.49	8%	9%	$3,374	MII MII Assemblies	
	Soil Borrow																
AA30	Excavation of Soil	**660**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$673.00	8%	9%	$792	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	770	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$693.00	8%	9%	$816	MII MII Assemblies	
AA2	Material Loading	770	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$959.65	8%	9%	$1,130	MII MII Assemblies	
	Borrow Area Reclamation																
AA7	Rough Grading (Conventional Access)	217,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$6,534.00	8%	9%	$7,692	MII MII Assemblies	
MA8	Seed Mix	100	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$906.00	8%	9%	$1,067	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$6,175.95	8%	9%	$7,270	MII MII Assemblies	
MA30	Erosion Control Blanket	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$19,932.90	8%	9%	$23,465	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	8,070	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$2,178.90	8%	9%	$2,565	MII MII Assemblies	
												TOTAL UNIT COST:			$75,195		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2,710	BCY	$75,195	$28

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-9

Alternative C2 **Cost Worksheet: CW-C2-9**
Capital Cost Sub-Element
Transportation of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves hauling of borrow materials from borrow areas to nonconventional access-alpine, nonconventional access-subalpine, conventional access-subalpine, and access road areas for construction of remedial components. It includes costs for labor, material, and equipment. Development of borrow materials are included under a separate cost worksheet.

Cost Analysis:
Cost for Transportation of Borrow Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA3E	Hauling - Rock Borrow for Access Roads	**2,300**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$48,576.00	8%	9%	$57,184	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	**160**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$10,048.00	8%	9%	$11,829	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access-Subalpine)	**220**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$4,826.80	8%	9%	$5,682	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	**390**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$4,184.70	8%	9%	$4,926	MII MII Assemblies	
													TOTAL UNIT COST:		$79,621		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	3,070	LCY	$79,621	$26

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-10

Alternative C2 **Cost Worksheet:** **CW-C2-10**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assumes water-based dust suppresion during borrow development and access road improvements. It is assumed that water for dust control is obtained from Gladstone Interim Water Treatment Plant at no cost.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA38	Dust Control	290	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$137.94	$137.94	$40,002.60	8%	9%	$47,091	MII MII Assemblies	
												TOTAL UNIT COST:			$47,091		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$47,091	$47,091

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-11

Alternative C2 **Cost Worksheet: CW-C2-11**
Capital Cost Sub-Element
Erosion Control and Reclamation of Areas Disturbed during Construction

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the erosion controls and reclamation of nonconventional access-alpine areas disturbed by construction. Erosion controls shall be installed along roads and streams and consist of silt fencing. Seeding and installation of erosion blankets shall be used for reclamation of areas disturbed by construction.

Cost Analysis:
Cost for Erosion Control and Reclamation of Areas Disturbed during Construction (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Erosion Control																
MA29	Silt Fence	2,400	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.72	$0.00	$0.72	$1,728.00	8%	9%	$2,034	CW CostWorks	Source: 31 25 1416 1000
AA36	Silt Fence Installation	2,400	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.43	$0.43	$1,032.00	8%	9%	$1,215	MII MII Assemblies	
MA32	Crane Mats	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$525.00	$525.00	$5,250.00	8%	9%	$6,180	V Vendor Quote	Source: Matrax, 2018
	Reclamation of Areas Disturbed																
MA8	Seed Mix	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$181.20	8%	9%	$213	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$1,235.19	8%	9%	$1,454	MII MII Assemblies	
MA30	Erosion Control Blanket	40	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$98.80	8%	9%	$116	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	40	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$10.80	8%	9%	$13	MII MII Assemblies	
												TOTAL UNIT COST:			$11,225		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$11,225	$11,225

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-12

Alternative C2 **Cost Worksheet:** **CW-C2-12**
Annual O&M Cost Sub-Element
Inspection of Remedial Components

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves inspection of the remedial components. Includes inspection for 8 total mining-related sources. Assumes inspection would also include measurements of sediment buildup in the mine portal ponds. Assumes three days for inspection at 8 total mining-related sources.

Cost Analysis:
Cost for Inspection of Remedial Components (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L3	Engineers, Project	24	HR	1.00	$42.06	$42.06	$0.00	$0.00	$0.00	$0.00	$42.06	$1,009.44	100%	9%	$2,201	FLC FLC Datacenter	
L6	Field Engineer	24	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$685.44	100%	9%	$1,494	FLC FLC Datacenter	
AA1	Pickup Truck	3	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$311.56	8%	9%	$367	MII MII Assemblies	
MA11	Per Diem	6	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$864.00	0%	0%	$864	V www.gsa.gov	
												TOTAL UNIT COST:			$4,926		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$4,926	$4,926

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-13

Alternative C2 **Cost Worksheet: CW-C2-13**
Annual O&M Cost Sub-Element
Surface Water Monitoring

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the surface water monitoring to evaluate the effectiveness of the interim remedy. This worksheet includes the cost for two surface water monitoring events and one data summary report in a given year. Assumes that an average of three surface water samples will be collected at each mining-related source that is addressed as part of this issue. Includes stream gauge measurements in addition to analysis of surface water samples. Analytical is assumed to include TAL Metals (total and dissolved), Anions (chloride and fluoride), Alkalinity, Hardness, and Sulfate.

Cost Analysis:
Cost for Surface Water Monitoring (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Analysis																
MA34	TAL Metals (Total)	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$6,508.64	8%	9%	$7,662	V Vendor Quote	Source: TestAmerica, 2018
MA35	TAL Metals (Dissolved)	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$6,508.64	8%	9%	$7,662	V Vendor Quote	Source: TestAmerica, 2018
MA36	Anions	152	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$22.16	$22.16	$3,368.32	8%	9%	$3,965	V Vendor Quote	Source: TestAmerica, 2018. Chloride and Fluoride
MA37	Sulfate	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.08	$11.08	$842.08	8%	9%	$991	V Vendor Quote	Source: TestAmerica, 2018
MA38	Alkalinity	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$766.08	8%	9%	$902	V Vendor Quote	Source: TestAmerica, 2018
MA40	Hardness	76	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$766.08	8%	9%	$902	V Vendor Quote	Source: TestAmerica, 2018
MA41	Cooler Sample Shipment	20	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.00	$100.00	$2,000.00	0%	0%	$2,000	A Allowance	Per Estimator
	Equipment																
MA42	Field Meter Rental	8	DY	1.00	$0.00	$0.00	$55.00	$55.00	$0.00	$0.00	$55.00	$440.00	8%	9%	$518	V Vendor Quote	Source: Field Environmental, 2018. YSI 556
MA43	Stream Gauge Rental	8	DY	1.00	$0.00	$0.00	$75.00	$75.00	$0.00	$0.00	$75.00	$600.00	8%	9%	$706	V Vendor Quote	Source: Pine Environmental, 2018. SonTek FlowTracker
MA44	Field Filters	76	EA	1.00	$0.00	$0.00	$0.77	$0.77	$0.00	$0.00	$0.77	$58.52	8%	9%	$69	V Vendor Quote	Source: Hach, 2018
MA45	Miscellaneous Sampling Supplies	2	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$400.00	0%	0%	$400	A Allowance	Per Estimator
	Labor																
L6	Field Engineer	180	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$5,140.80	100%	9%	$11,207	FLC FLC Datacenter	
MA11A	Per Diem (Travel Days)	12	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$131.25	$131.25	$1,575.00	0%	0%	$1,575	V www.gsa.gov	Assumes 75% M&IE on travel days
MA11	Per Diem	12	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$1,728.00	0%	0%	$1,728	V www.gsa.gov	
AA1	Pickup Truck	8	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$830.84	8%	9%	$978	MII MII Assemblies	
	Reporting																
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L4	Environmental Engineer	60	HR	1.00	$36.33	$36.33	$0.00	$0.00	$0.00	$0.00	$36.33	$2,179.80	100%	9%	$4,752	FLC FLC Datacenter	
L14	Environmental Scientist	20	HR	1.00	$43.20	$43.20	$0.00	$0.00	$0.00	$0.00	$43.20	$864.00	100%	9%	$1,884	FLC FLC Datacenter	
L5	CAD Drafter	12	HR	1.00	$25.25	$25.25	$0.00	$0.00	$0.00	$0.00	$25.25	$303.00	100%	9%	$661	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$50,906		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2	EA	$50,906	$25,453

TABLE CW-C2-13

Alternative C2
Annual O&M Cost Sub-Element
Surface Water Monitoring

Cost Worksheet: **CW-C2-13**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-C2-14

Alternative C2 **Cost Worksheet: CW-C2-14**
Periodic O&M Cost Sub-Element
Post-Construction Maintenance of Interim Local Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves maintenance to protect the integrity of the interim local management areas. Maintenance would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Includes maintenance for 8 total mining-related sources.

Cost Analysis:
Cost for Post-Construction Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA80	Maintenance Crew	3	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$853.84	$853.84	$2,561.52	8%	9%	$3,015	MII MII Assemblies	
MA17A	Maintenance Allowance for Interim Management Area	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A Allowance	
													TOTAL UNIT COST:		$8,015		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,015	$8,015

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-C2-15

Alternative C2 **Cost Worksheet: CW-C2-15**
Periodic O&M Cost Sub-Element
Periodic Removal of Mine Portal Pond Sediment

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the periodic removal of mine portal pond sediment. It assumes that mine portal pond sediment will be removed when ponds have reached 50% capacity. It includes draining ponds, excavation of mine portal pond sediment, moving sediment to dewatering area, amending sediment with diatomaceous earth, and spreading of sediment at the interim local waste management areas.

Cost Analysis:
Cost for Periodic Removal of Mine Portal Pond Sediment (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA40A	Draining Ponds	157,100	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$7,855.00	8%	9%	$9,247	MII MII Assemblies	
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	780	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.72	$3.72	$2,901.60	8%	9%	$3,416	MII MII Assemblies	
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	940	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$4,399.20	8%	9%	$5,179	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	14	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$7,274.96	8%	9%	$8,564	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44A	Mixing Diatomaceous Earth (Nonconventional Access)	130	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.14	$4.14	$538.20	8%	9%	$634	MII MII Assemblies	
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	980	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$4,586.40	8%	9%	$5,399	MII MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	980	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$2,371.60	8%	9%	$2,792	MII MII Assemblies	
	Nonconventional Access-Subalpine Locations																
AA40A	Draining Ponds	531,100	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$26,555.00	8%	9%	$31,261	MII MII Assemblies	
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	2,630	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.72	$3.72	$9,783.60	8%	9%	$11,517	MII MII Assemblies	
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	3,160	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$14,788.80	8%	9%	$17,409	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	50	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$25,982.00	8%	9%	$30,586	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44A	Mixing Diatomaceous Earth (Nonconventional Access)	460	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.14	$4.14	$1,904.40	8%	9%	$2,242	MII MII Assemblies	
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	3,300	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$15,444.00	8%	9%	$18,181	MII MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	3,300	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$7,986.00	8%	9%	$9,401	MII MII Assemblies	
	Conventional Access-Subalpine Locations																
AA40A	Draining Ponds	598,400	GAL	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.05	$29,920.00	8%	9%	$35,222	MII MII Assemblies	
AA6C	Excavation - Sediment/In-Stream Mine Waste (Conventional Access)	2,960	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.44	$3.44	$10,182.40	8%	9%	$11,987	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	3,560	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$9,327.20	8%	9%	$10,980	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	56	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$29,099.84	8%	9%	$34,256	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44C	Mixing Diatomaceous Earth (Conventional Access)	520	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.35	$2.35	$1,222.00	8%	9%	$1,439	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	3,720	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$9,746.40	8%	9%	$11,473	MII MII Assemblies	
AA4C	Material Spreading - Excavated Materials (Conventional Access)	3,720	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$5,245.20	8%	9%	$6,175	MII MII Assemblies	
												TOTAL UNIT COST:			$267,360		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$267,360	$267,360

TABLE CW-C2-15

Alternative C2 **Cost Worksheet: CW-C2-15**
Periodic O&M Cost Sub-Element
Periodic Removal of Mine Portal Pond Sediment

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Assumptions and Cost Worksheets

Alternative D2

Excavation and Interim Local Waste Management

CDM Smith

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	Alt D2 Cost Assumptions

Description: General cost estimate assumptions for Alternative D2 - Excavation and Interim Waste Local Mangement

General Cost Estimate Assumptions: Alternative D2 - Excavation and Interim Local Waste Mangement

Period of Analysis, YR:	15	*Assumed*
Number of Nonconventional Access-Alpine Mining-Related Sources to be Addressed, EA:	2	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	0	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	0	
Total Number of Mining-Related Sources to be Addressed, EA:	**2**	
In-Stream Mine Waste Assumptions		
Assumed Depth of Mine Waste in Streams, FT:	3	*Assumed*
Percentage of Mine Waste Amended with Diatomaceous Earth, %:	10%	*Assumed*
Assumed Diatomaceous Earth Amendment Rate, %:	10%	*Assumed*
Borrow Assumptions		
Haul Distance from Borrow Location, MI:	13	*Assumed average distance between borrow and mining-related sources*
Annual O&M Assumptions		
Inspection Frequency, YR/EA:	1	*Annual inspections*
Surface Water Monitoring Events per Year, EA/YR:	2	
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	*Per surface water monitoring event*
Periodic O&M Assumptions		
Maintenance Frequency, YR/EA:	2	*Maintenance every 2 years*
Duration for Maintenance Crew per Maintenance Event, DY/EA:	2	*Per maintenance event*

TABLE CW-D2-1

Alternative D2
Capital Cost Sub-Element
Institutional Controls

Cost Worksheet: **CW-D2-1**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves performing institutional controls such as governmental controls, proprietary controls, enforcement tools with IC components, and informational devices. These controls would be implemented as needed to maintain integrity of the proposed interim local waste management areas. These controls would vary by property ownership.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L15	Environmental Lawyer	32	HR	1.00	$40.44	$40.44	$0.00	$0.00	$0.00	$0.00	$40.44	$1,294.08	100%	9%	$2,821	FLC FLC Datacenter	
L16	Paralegal	64	HR	1.00	$24.61	$24.61	$0.00	$0.00	$0.00	$0.00	$24.61	$1,575.04	100%	9%	$3,434	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$8,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,599	$8,599

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-2

Alternative D2 **Cost Worksheet: CW-D2-2**
Capital Cost Sub-Element
Mobilization/Demobilization

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the identified mining-related sources. It includes initial mobilization of equipment to the Site, transporting the equipment between the various mining-related sources, and final demobilization. It assumes that different sized equipment would be mobilized to the different categories of mining-related sources due to access issues preventing large and/or medium sized equipment to certain areas. Includes mobilization/demobilization to 2 total mining-related sources.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA15A	Mob/Demob - Small Equipment (Nonconventional Access)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,257.67	$1,257.67	$1,257.67	8%	9%	$1,481	MII MII Assemblies	Includes moving equipment between mining-relatec sources after initial mobilization
	Borrow Development/Access Roads																
AA17	Mob/Demob - Large Equipment	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,222.25	$1,222.25	$2,444.50	8%	9%	$2,878	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial location
AA68	Mob/Demob - Medium Equipment	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$3,218.40	8%	9%	$3,789	MII MII Assemblies	
AA19D	Mob/Demob - Between Access Road Locations	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.83	$600.83	$1,201.66	8%	9%	$1,415	MII MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
												TOTAL UNIT COST:			$10,991		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$10,991	$10,991

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-3

Alternative D2 | **Cost Worksheet:** **CW-D2-3**
Capital Cost Sub-Element
In-Stream Mine Waste Excavation

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves excavation of in-stream mine waste. Assumes that excavated mine waste will be placed adjacent to stream to allow for gravity dewatering before moving to interim management area.

Cost Analysis:
Cost for In-Stream Mine Waste Excavation (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Alpine Locations																
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	**989**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3.72	$3.72	$3,679.08	8%	9%	$4,331	MII MII Assemblies	
												TOTAL UNIT COST:			$4,331		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	989	BCY	$4,331	$4

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-D2-4

Alternative D2 **Cost Worksheet: CW-D2-4**
Capital Cost Sub-Element
Geotechnical Characterization - Sampling Dewatered In-Stream Mine Waste

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves sampling excavated and dewatered in-stream mine waste for physical characterization, including geotechnical analysis.

Cost Analysis:
Cost for Geotechnical Characterization - Sampling Dewatered In-Stream Mine Waste (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
MA31	Geotechnical Analysis	**5**	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$278.00	$278.00	$1,390.00	8%	9%	$1,636	CW CostWorks	Source: 01 45 2350 5300. Includes shear strength analysis
L6	Field Engineer	5	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$142.80	100%	9%	$311	FLC FLC Datacenter	
MA19	Equipment, Supplies, and Shipping, per Sample	5	EA	1.00	$0.00	$0.00	$0.00	$0.00	$25.00	$0.00	$25.00	$125.00	0%	0%	$125	A Allowance	
												TOTAL UNIT COST:			$2,072		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	5	EA	$2,072	$414

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-5

Alternative D2 **Cost Worksheet:** **CW-D2-5**
Capital Cost Sub-Element
Management and Dewatering of In-Stream Mine Waste at Interim Local Waste Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the management of excavated in-stream mine wastes, moving mine wastes to dewatering area, and amending mine wastes with diatomaceous earth at the interim local waste management areas. It assumes that mine wastes will be moved to a dewatering area prior to placement in interim local waste management areas. Assumes berms will be placed around interim local waste management areas.

Cost Analysis:
Cost for Management and Dewatering of In-Stream Mine Waste at Interim Local Waste Management Areas (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Movement to Dewatering Area																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	1,190	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$5,569.20	8%	9%	$6,556	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	0	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$0.00	8%	9%	$0	MII MII Assemblies	
MA16	Diatomaceous Earth for Dewatering	19	TON	1.00	$0.00	$0.00	$0.00	$0.00	$386.25	$133.39	$519.64	$9,873.16	8%	9%	$11,623	V Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
AA44A	Mixing Diatomaceous Earth (Nonconventiona Access)	170	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.14	$4.14	$703.80	8%	9%	$829	MII MII Assemblies	
AA44C	Mixing Diatomaceous Earth (Conventional Access)	0	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.35	$2.35	$0.00	8%	9%	$0	MII MII Assemblies	
	Placement in Interim Local Waste Management Areas																
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	**1,240**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.68	$4.68	$5,803.20	8%	9%	$6,832	MII MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	**0**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.62	$2.62	$0.00	8%	9%	$0	MII MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	1,240	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$2,879.80	8%	9%	$3,390	MII MII Assemblies	
AA4C	Material Spreading - Excavated Materials (Conventional Access)	0	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$0.00	8%	9%	$0	MII MII Assemblies	
	Berms for Interim Local Waste Management Areas																
AA58	Rough Grading (Nonconventional Access)	1,180	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$118.01	8%	9%	$139	MII MII Assemblies	Includes grading for positive drainage of interim local waste management areas
AA45A	Soil Placement - Berm (Nonconventional Access)	58	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.75	$9.75	$568.19	8%	9%	$669	MII MII Assemblies	
												TOTAL UNIT COST:			$30,038		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1,190	LCY	$30,038	$25

TABLE CW-D2-5

Alternative D2 **Cost Worksheet: CW-D2-5**
Capital Cost Sub-Element
Management and Dewatering of In-Stream Mine Waste at Interim Local Waste Management Areas

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-D2-6

Alternative D2 **Cost Worksheet:** **CW-D2-6**
Capital Cost Sub-Element
Access Road Improvements

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves access road improvements. The following cost includes clearing and grubbing, grading, and road improvements. Road improvements would mainly be on non-county roads (i.e. road spurs near the mining-related sources), but costs were included for some incidental road work that could include county roads. Assumes road improvements would be implemented to access mining-related sources. Assumes gravel materials for access road improvements will be uncontaminated borrow developed onsite. Development and transportation of borrow materials are included under separate cost worksheets. Assumes that any gravel that is placed during road improvements would be removed after remedial actions to restore roads to initial condition.

Cost Analysis:
Cost for Access Road Improvements (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Minor Impovements for Access Roads																
AA58	Rough Grading (Nonconventional Access)	14,400	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$1,440.00	8%	9%	$1,695	MII MII Assemblies	
AA13B	Minor Road Improvements	**900**	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.98	$10.98	$9,882.00	8%	9%	$11,633	MII MII Assemblies	
	Allowance for Additional Road Improvements																
MA33	Allowance for Additional Road Improvements	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$50,000.00	$50,000.00	$50,000.00	0%	0%	$50,000	A Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
												TOTAL UNIT COST:			$63,328		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	900	LF	$63,328	$70

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-7

Alternative D2 **Cost Worksheet: CW-D2-7**
Capital Cost Sub-Element
Development of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of rock and soil from borrow areas. Assumes soil and gravel borrow materials would be developed onsite. It includes costs for labor, material, and equipment for excavation and crushing/screening of borrow materials. Transportation of borrow materials are included under a separate cost worksheet. Also, includes costs for reclamation of borrow areas following remedial actions.

Cost Analysis:
Cost for Borrow Material Development (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rock Borrow																
AA33	Rock Quarrying	**55**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$311.85	8%	9%	$367	MII MII Assemblies	
AA34	Rock Ripping	**55**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$127.60	8%	9%	$150	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	130	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$834.60	8%	9%	$982	MII MII Assemblies	
AA2	Material Loading	130	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$162.02	8%	9%	$191	MII MII Assemblies	
	Soil Borrow																
AA30	Excavation of Soil	**70**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$71.38	8%	9%	$84	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$72.00	8%	9%	$85	MII MII Assemblies	
AA2	Material Loading	80	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$99.70	8%	9%	$117	MII MII Assemblies	
	Borrow Area Reclamation																
AA7	Rough Grading (Conventional Access)	21,780	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$653.40	8%	9%	$769	MII MII Assemblies	
MA8	Seed Mix	10	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$90.60	8%	9%	$107	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	0.5	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$617.60	8%	9%	$727	MII MII Assemblies	
MA30	Erosion Control Blanket	810	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$2,000.70	8%	9%	$2,355	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	810	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$218.70	8%	9%	$257	MII MII Assemblies	
												TOTAL UNIT COST:			$6,191		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	180	BCY	$6,191	$34

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-D2-8

Alternative D2 **Cost Worksheet: CW-D2-8**
Capital Cost Sub-Element
Transportation of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves hauling of borrow materials from borrow areas to nonconventional access-alpine and access road areas for construction of remedial components. It includes costs for labor, material, and equipment. Development of borrow materials are included under a separate cost worksheet.

Cost Analysis:
Cost for Transportation of Borrow Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA3E	Hauling - Rock Borrow for Access Roads	**130**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.12	$21.12	$2,745.60	8%	9%	$3,232	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	**210**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$13,188.00	8%	9%	$15,525	MII MII Assemblies	
												TOTAL UNIT COST:			$18,757		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	340	LCY	$18,757	$55

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
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Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

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MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
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ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
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UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-9

Alternative D2
Capital Cost Sub-Element
Dust Control

Cost Worksheet: **CW-D2-9**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assumes water-based dust suppresion during borrow development and access road improvements. It is assumed that water for dust control is obtained from Gladstone Interim Water Treatment Plant at no cost.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA38	Dust Control	260	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$137.94	$137.94	$35,864.40	8%	9%	$42,220	MII MII Assemblies	
												TOTAL UNIT COST:			$42,220		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$42,220	$42,220

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-10

Alternative D2 **Cost Worksheet: CW-D2-10**
Capital Cost Sub-Element
Erosion Control and Reclamation of Areas Disturbed during Construction

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the erosion controls and reclamation of nonconventional access-alpine areas disturbed by construction. Erosion controls shall be installed along roads and streams and consist of silt fencing. Seeding and installation of erosion blankets shall be used for reclamation of areas disturbed by construction. Also include minimal stream rehabilitation for stream areas disturbed.

Cost Analysis:
Cost for Erosion Control and Reclamation of Areas Disturbed during Construction (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Erosion Control																
MA29	Silt Fence	600	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.72	$0.00	$0.72	$432.00	8%	9%	$509	CW CostWorks	Source: 31 25 1416 1000
AA36	Silt Fence Installation	600	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.43	$0.43	$258.00	8%	9%	$304	MII MII Assemblies	
MA32	Crane Mats	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$525.00	$525.00	$5,250.00	8%	9%	$6,180	V Vendor Quote	Source: Matrax, 2018
	Minimal Stream Rehabilitation																
AA58	Rough Grading (Nonconventional Access)	3,000	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$300.00	8%	9%	$353	MII MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventiona Access)	125	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$923.75	8%	9%	$1,087	MII MII Assemblies	
	Reclamation of Areas Disturbed																
MA8	Seed Mix	20	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$181.20	8%	9%	$213	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$1,235.19	8%	9%	$1,454	MII MII Assemblies	
MA30	Erosion Control Blanket	80	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$197.60	8%	9%	$233	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	80	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$21.60	8%	9%	$25	MII MII Assemblies	
												TOTAL UNIT COST:			$10,358		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$10,358	$10,358

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-D2-11

Alternative D2
Annual O&M Cost Sub-Element
Inspection of Remedial Components

Cost Worksheet: CW-D2-11

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves inspection of the remedial components. Assumes two days for inspection at 2 total mining-related sources.

Cost Analysis:
Cost for Inspection of Remedial Components (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L3	Engineers, Project	16	HR	1.00	$42.06	$42.06	$0.00	$0.00	$0.00	$0.00	$42.06	$672.96	100%	9%	$1,467	FLC FLC Datacenter	
L6	Field Engineer	16	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$456.96	100%	9%	$996	FLC FLC Datacenter	
AA1	Pickup Truck	2	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$207.71	8%	9%	$245	MII MII Assemblies	
MA11	Per Diem	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$576.00	0%	0%	$576	V www.gsa.gov	
												TOTAL UNIT COST:			$3,284		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$3,284	$3,284

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-D2-12

Alternative D2
Annual O&M Cost Sub-Element
Surface Water Monitoring

Cost Worksheet: **CW-D2-12**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves the surface water monitoring to evaluate the effectiveness of the interim remedy. This worksheet includes the cost for two surface water monitoring events and one data summary report in a given year. Assumes that an average of three surface water samples will be collected at each mining-related source that is addressed as part of this issue. Includes stream gauge measurements in addition to analysis of surface water samples. Analytical is assumed to include TAL Metals (total and dissolved), Anions (chloride and fluoride), Alkalinity, Hardness, and Sulfate.

Cost Analysis:
Cost for Surface Water Monitoring (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Analysis																
MA34	TAL Metals (Total)	16	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$1,370.24	8%	9%	$1,613	V Vendor Quote	Source: TestAmerica, 2018
MA35	TAL Metals (Dissolved)	16	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$85.64	$85.64	$1,370.24	8%	9%	$1,613	V Vendor Quote	Source: TestAmerica, 2018
MA36	Anions	32	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$22.16	$22.16	$709.12	8%	9%	$835	V Vendor Quote	Source: TestAmerica, 2018. Chloride and Fluoride
MA37	Sulfate	16	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.08	$11.08	$177.28	8%	9%	$209	V Vendor Quote	Source: TestAmerica, 2018
MA38	Alkalinity	16	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$161.28	8%	9%	$190	V Vendor Quote	Source: TestAmerica, 2018
MA40	Hardness	16	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.08	$10.08	$161.28	8%	9%	$190	V Vendor Quote	Source: TestAmerica, 2018
MA41	Cooler Sample Shipment	4	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100.00	$100.00	$400.00	0%	0%	$400	A Allowance	Per Estimator
	Equipment																
MA42	Field Meter Rental	4	DY	1.00	$0.00	$0.00	$55.00	$55.00	$0.00	$0.00	$55.00	$220.00	8%	9%	$259	V Vendor Quote	Source: Field Environmental, 2018. YSI 556
MA43	Stream Gauge Rental	4	DY	1.00	$0.00	$0.00	$75.00	$75.00	$0.00	$0.00	$75.00	$300.00	8%	9%	$353	V Vendor Quote	Source: Pine Environmental, 2018. SonTek FlowTracker
MA44	Field Filters	16	EA	1.00	$0.00	$0.00	$0.77	$0.77	$0.00	$0.00	$0.77	$12.32	8%	9%	$15	V Vendor Quote	Source: Hach, 2018
MA45	Miscellaneous Sampling Supplies	2	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$400.00	0%	0%	$400	A Allowance	Per Estimator
	Labor																
L6	Field Engineer	72	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$2,056.32	100%	9%	$4,483	FLC FLC Datacenter	
MA11A	Per Diem (Travel Days)	12	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$131.25	$131.25	$1,575.00	0%	0%	$1,575	V www.gsa.gov	Assumes 75% M&IE on travel days
MA11	Per Diem	0	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$0.00	0%	0%	$0	V www.gsa.gov	
AA1	Pickup Truck	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$415.42	8%	9%	$489	MII MII Assemblies	
	Reporting																
L9	Project Managers	8	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$468.24	100%	9%	$1,021	FLC FLC Datacenter	
L4	Environmental Engineer	24	HR	1.00	$36.33	$36.33	$0.00	$0.00	$0.00	$0.00	$36.33	$871.92	100%	9%	$1,901	FLC FLC Datacenter	
L14	Environmental Scientist	10	HR	1.00	$43.20	$43.20	$0.00	$0.00	$0.00	$0.00	$43.20	$432.00	100%	9%	$942	FLC FLC Datacenter	
L5	CAD Drafter	6	HR	1.00	$25.25	$25.25	$0.00	$0.00	$0.00	$0.00	$25.25	$151.50	100%	9%	$330	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$17,120		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2	EA	$17,120	$8,560

TABLE CW-D2-12

Alternative D2 **Annual O&M Cost Sub-Element** **Surface Water Monitoring**	**Cost Worksheet:** **CW-D2-12**	**COST WORKSHEET**

Site:	Bonita Peak Mining District Superfund Site	**Prepared By:** JN	**Date:** 5/7/2018
Location:	San Juan County, Colorado		
Phase:	Focused Feasibility Study	**Checked By:** EW	**Date:** 5/8/2018
Base Year:	2018		

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.

The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost		
UNBUR LIC	Unburdened Line Item Cost		
PC OH	Prime Contractor Overhead		
PC PF	Prime Contractor Profit		
BUR LIC	Burdened Line Item Cost		

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-D2-13

Alternative D2 | **Cost Worksheet:** **CW-D2-13**
Periodic O&M Cost Sub-Element
Post-Construction Maintenance

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:

This sub-element involves maintenance to protect the integrity of the interim local management areas. Maintenance would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Includes maintenance for 2 total mining-related sources.

Cost Analysis:

Cost for Post-Construction Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA80	Maintenance Crew	2	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$853.84	$853.84	$1,707.68	8%	9%	$2,010	MII MII Assemblies	
MA17A	Maintenance Allowance for Interim Management Area	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$5,000.00	0%	0%	$5,000	A Allowance	
												TOTAL UNIT COST:			$7,010		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$7,010	$7,010

Notes:

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

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Source of Cost Data:

NA Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
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Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Assumptions and Cost Worksheets

Alternative E2
Containment/Isolation

PROJECT:	Bonita Peak Mining District Superfund Site	**COMPUTED BY :**	JN	**CHECKED BY:**	EW
JOB NO.:	219758.6460.DK4.WAD3.043	**DATE :**	5/7/2018	**DATE CHECKED:**	5/8/2018
CLIENT:	USACE			**WRKSHT NO.:**	Alt E2 Cost Assumptions

Description: General cost estimate assumptions for Alternative E2 - Containment/Isolation

General Cost Estimate Assumptions: Alternative E2 - Containment/Isolation

Period of Analysis, YR:	15	*Assumed*
Number of Nonconventional Access-Alpine Mining-Related Sources to be Addressed, EA:	0	
Number of Nonconventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	1	
Number of Conventional Access-Subalpine Mining-Related Sources to be Addressed, EA:	4	
Total Number of Mining-Related Sources to be Addressed, EA:	**5**	
Cover Assumptions - All Areas		
Gravel Cover		
Assumed Gravel Depth for Cover, IN:	18	*Assumed*
Soil Cover (Subsoil and Growth Media)		
Assumed Subsoil Depth for Cover, IN:	12	*Assumed*
Assumed Surface Layer Depth for Cover, IN:	6	*Assumed*
Cover Assumptions - Nonconventional Access-Alpine Only		
Assumed Percentage of Covers addressed with Gravel Covers, %:	NA	*Not applicable, no nonconventional access-alpine mining-related sources*
Assumed Percentage of Covers addressed with Soil Covers, %:	NA	*Not applicable, no nonconventional access-alpine mining-related sources*
Cover Assumptions - Nonconventional Access-Subalpine Only		
Assumed Percentage of Covers addressed with Gravel Covers, %:	10%	*Assumed, for high traffic areas or near riverbanks*
Assumed Percentage of Covers addressed with Soil Covers, %:	90%	*Assumed for low traffic areas*
Cover Assumptions - Conventional Access-Subalpine Only		
Assumed Percentage of Covers addressed with Gravel Covers, %:	25%	*Assumed, for high traffic areas or near riverbanks*
Assumed Percentage of Covers addressed with Soil Covers, %:	75%	*Assumed for low traffic areas*
Amendment and Revegetation of Soil Cover Assumptions		
Lime for Parent Surface Amendment, TON/AC-FT:	40	*Assumed*
Compost for Growth Media Amendment, TON/AC-FT:	40	*Assumed*
Seed Mix, LB/AC:	20	*Assumed*
Hydromulch, LB/AC:	3,000	*Assumed*
Fertilizer, LB/AC:	135	*Assumed*

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	Alt E2 Cost Assumptions

Description: General cost estimate assumptions for Alternative E2 - Containment/Isolation

Borrow Assumptions

Haul Distance from Borrow Location, MI:	13	*Assumed average distance between borrow and mining-related sources*

Annual O&M Assumptions

Inspection Frequency, YR/EA:	1	*Annual inspections*

Periodic O&M Assumptions

Maintenance Frequency, YR/EA:	2	*Maintenance every 2 years*
Percentage of Gravel for Covers to be Replaced, %:	5%	*Per maintenance event*
Percentage of Soil for Covers to be Replaced, %:	5%	*Per maintenance event*
Percentage of Seeding for Covers to be Replaced, %:	10%	*Per maintenance event*
Duration for Maintenance Crew per Maintenance Event, DY/EA:	4	*Per maintenance event*

TABLE CW-E2-1

Alternative E2
Capital Cost Sub-Element
Institutional Controls

Cost Worksheet: **CW-E2-1**

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves performing institutional controls such as governmental controls, proprietary controls, enforcement tools with IC components, and informational devices. These controls would be implemented as needed to maintain integrity of the proposed covers. These controls would vary by property ownership.

Cost Analysis:
Cost for Institutional Controls (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L9	Project Managers	16	HR	1.00	$58.53	$58.53	$0.00	$0.00	$0.00	$0.00	$58.53	$936.48	100%	9%	$2,042	FLC FLC Datacenter	
L15	Environmental Lawyer	32	HR	1.00	$40.44	$40.44	$0.00	$0.00	$0.00	$0.00	$40.44	$1,294.08	100%	9%	$2,821	FLC FLC Datacenter	
L16	Paralegal	64	HR	1.00	$24.61	$24.61	$0.00	$0.00	$0.00	$0.00	$24.61	$1,575.04	100%	9%	$3,434	FLC FLC Datacenter	
L1	Admin (Clerks, Typists)	8	HR	1.00	$17.32	$17.32	$0.00	$0.00	$0.00	$0.00	$17.32	$138.56	100%	9%	$302	FLC FLC Datacenter	
												TOTAL UNIT COST:			$8,599		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,599	$8,599

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-2

Alternative E2 | **Cost Worksheet:** **CW-E2-2**
Capital Cost Sub-Element
Mobilization/Demobilization

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves mobilization and demobilization of all the required equipment to and from the identified mining-related sources. It includes initial mobilization of equipment to the Site, transporting the equipment between the various mining-related sources, and final demobilization. It assumes that different sized equipment would be mobilized to the different categories of mining-related sources due to access issues preventing large and/or medium sized equipment to certain areas. Includes mobilization/demobilization to 5 total mining-related sources.

Cost Analysis:
Cost for Mobilization/Demobilization (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Nonconventional Access-Subalpine Locations																
AA15B	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,081.51	$1,081.51	$3,244.53	8%	9%	$3,819	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
	Conventional Access-Subalpine Locations																
AA16	Mob/Demob - Medium Equipment (Conventiona Access)	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,072.80	$1,072.80	$3,218.40	8%	9%	$3,789	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial mining-related source
AA19C	Mob/Demob - Between Mining-Related Sources (Conventional Access)	3	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$587.74	$587.74	$1,763.22	8%	9%	$2,076	MII MII Assemblies	Includes moving equipment between mining-relatec sources after initial mobilization
	Borrow Development																
AA17	Mob/Demob - Large Equipment	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,222.25	$1,222.25	$2,444.50	8%	9%	$2,878	MII MII Assemblies	Includes mobilization/demobilization of equipment from of site to the initial location
												TOTAL UNIT COST:			$12,562		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$12,562	$12,562

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-E2-3

Alternative E2 — **Cost Worksheet:** **CW-E2-3**
Capital Cost Sub-Element
Placement of Gravel Cover

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the placement of gravel covers at mining-impacted recreation staging areas. It is assumed that gravel covers would be used in areas of high traffic or near riverbanks. It assumes an 18" gravel layer for the cover. Assumes rock materials for the gravel covers will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Placement of Gravel Cover (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Grading																
AA58	Rough Grading (Nonconventional Access)	5,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$580.00	8%	9%	$683	MII MII Assemblies	
AA7	Rough Grading (Conventional Access)	82,300	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$2,469.00	8%	9%	$2,907	MII MII Assemblies	
	Gravel Cap																
AA57	Gravel/Riprap Placement (Nonconventiona Access)	400	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.39	$7.39	$2,956.00	8%	9%	$3,480	MII MII Assemblies	
AA10	Gravel/Riprap Placement (Conventional Access)	5,400	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.70	$1.70	$9,180.00	8%	9%	$10,807	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	330	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$594.00	8%	9%	$699	MII MII Assemblies	
AA8	Compaction (Conventional Access)	4,580	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$7,144.80	8%	9%	$8,411	MII MII Assemblies	
												TOTAL UNIT COST:			$26,987		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	2.0	ACR	$26,987	$13,494

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-4

Alternative E2 **Cost Worksheet: CW-E2-4**
Capital Cost Sub-Element
Placement of Soil Cover

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the placement of soil covers at mining-impacted recreation staging areas. It is assumed that soil covers would be used in areas of low traffic. It assumes an 18" gravel layer for the cover. Assumes rock materials for the gravel covers will be developed onsite. Development and transportation of borrow materials are included under separate cost worksheets.

Cost Analysis:
Cost for Placement of Soil Cover (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Grading																
AA58	Rough Grading (Nonconventional Access)	52,200	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10	$5,220.00	8%	9%	$6,145	MII MII Assemblies	
AA7	Rough Grading (Conventional Access)	246,800	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$7,404.00	8%	9%	$8,716	MII MII Assemblies	
	Soil Placement																
AA54	Soil Placement/Spreading (Nonconventiona Access)	3,900	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.42	$2.42	$9,438.00	8%	9%	$11,110	MII MII Assemblies	
AA22	Soil Placement/Spreading (Conventional Access)	18,400	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$1.41	$25,944.00	8%	9%	$30,541	MII MII Assemblies	
AA55	Compaction (Nonconventional Access)	1,940	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.80	$1.80	$3,492.00	8%	9%	$4,111	MII MII Assemblies	
AA8	Compaction (Conventional Access)	9,150	ECY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$1.56	$14,274.00	8%	9%	$16,803	MII MII Assemblies	
	Amendment for Growth Media											$0.00					
MA15	Lime, Material Amendment	188	TON	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$60.77	$60.77	$11,424.76	8%	9%	$13,449	V Vendor Quote	Source: Colorado Lime Company, 2017.
AA3C	Hauling - Lime to Site	188	TON	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.31	$21.31	$4,006.28	8%	9%	$4,716	MII MII Assemblies	
MA20	Compost	376	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$36.05	$21.63	$57.68	$21,687.68	8%	9%	$25,531	V Vendor Quote	Source: Beaver Lakes Nursery & Landscape Supply , 2017. Includes delivery
AA43	Organic and Lime Amendment and Processing - Ripping	6.9	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,336.31	$1,336.31	$9,220.54	8%	9%	$10,854	MII MII Assemblies	
	Seeding of Soil Cover											$0.00					
AA24	Hydroseeding	6.9	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$8,522.81	8%	9%	$10,033	MII MII Assemblies	
MA8	Seed Mix	138	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$1,250.28	8%	9%	$1,472	V Vendor Quote	Source: Southwest Seed, 2017
MA10	Hydromulch	20,700	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.30	$0.00	$0.30	$6,210.00	8%	9%	$7,310	V Vendor Quote	Source: Ewing Irrigation Supply, 2018
MA9	Fertilizer (N2 and P2O5)	932	LB	1.00	$0.00	$0.00	$0.00	$0.00	$0.80	$0.00	$0.80	$745.60	8%	9%	$878	CW CostWorks	Source: 32 92 1914 7025. Assume materials only
												TOTAL UNIT COST:			$151,669		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	6.9	ACR	$151,669	$21,981

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-5

Alternative E2 **Cost Worksheet:** **CW-E2-5**
Capital Cost Sub-Element
Access Road Improvements

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves access road improvements. Road improvements would mainly be on non-county roads (i.e. road spurs near the mining-related sources), but costs were included for some incidental road work that could include county roads. Assumes road improvements would be implemented to access mining-related sources. Assumes gravel materials for access road improvements will be uncontaminated borrow developed onsite. Assumes that any gravel that is placed during road improvements would be removed after remedial actions to restore roads to initial condition.

Cost Analysis:
Cost for Access Road Improvements (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Allowance for Additional Road Improvements																
MA33	Allowance for Additional Road Improvements	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$50,000.00	$50,000.00	$50,000.00	0%	0%	$50,000	A Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
												TOTAL UNIT COST:			$50,000		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$50,000	$50,000

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-6

Alternative E2
Capital Cost Sub-Element
Development of Borrow Materials

Cost Worksheet: CW-E2-6

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the excavation of rock and soil from borrow areas. Assumes soil and gravel borrow materials would be developed onsite. It includes costs for labor, material, and equipment for excavation and crushing/screening of borrow materials. Transportation of borrow materials are included under a separate cost worksheet. Also, includes costs for reclamation of borrow areas following remedial actions.

Cost Analysis:
Cost for Borrow Material Development (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Rock Borrow																
AA33	Rock Quarrying	**2,590**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$14,685.30	8%	9%	$17,288	MII MII Assemblies	
AA34	Rock Ripping	**2,590**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$6,008.80	8%	9%	$7,074	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	5,800	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$37,236.00	8%	9%	$43,834	MII MII Assemblies	
AA2	Material Loading	5,800	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$7,228.54	8%	9%	$8,509	MII MII Assemblies	
	Soil Borrow																
AA30	Excavation of Soil	**13,420**	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$13,684.37	8%	9%	$16,109	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	16,100	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$14,490.00	8%	9%	$17,058	MII MII Assemblies	
AA2	Material Loading	16,100	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$20,065.43	8%	9%	$23,621	MII MII Assemblies	
	Borrow Area Reclamation																
AA7	Rough Grading (Conventional Access)	435,600	SF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.03	$13,068.00	8%	9%	$15,384	MII MII Assemblies	
MA8	Seed Mix	200	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$1,812.00	8%	9%	$2,133	V Vendor Quote	Source: Southwest Seed, 2017
AA24	Hydroseeding	10	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$12,351.90	8%	9%	$14,541	MII MII Assemblies	
MA30	Erosion Control Blanket	16,140	SY	1.00	$0.00	$0.00	$0.00	$0.00	$2.47	$0.00	$2.47	$39,865.80	8%	9%	$46,930	V Vendor Quote	Source: Home Depot, 2018
AA25	Erosion Control Blankets Installation	16,140	SY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	$0.27	$4,357.80	8%	9%	$5,130	MII MII Assemblies	
												TOTAL UNIT COST:			$133,493		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	18,600	BCY	$133,493	$7

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
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Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-7

Alternative E2 **Cost Worksheet: CW-E2-7**
Capital Cost Sub-Element
Transportation of Borrow Materials

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves hauling of borrow materials from borrow areas to nonconventional access-subalpine, conventional access-subalpine, and access road areas for construction of remedial components. It includes costs for labor, material, and equipment. Development of borrow materials are included under a separate cost worksheet.

Cost Analysis:
Cost for Transportation of Borrow Material (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA3G	Hauling - Borrow (Nonconventional Access Subalpine)	**4,300**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$94,342.00	8%	9%	$111,059	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	**17,600**	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$188,848.00	8%	9%	$222,312	MII MII Assemblies	
												TOTAL UNIT COST:			$333,371		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	21,900	LCY	$333,371	$15

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

TABLE CW-E2-8

Alternative E2 **Cost Worksheet:** **CW-E2-8**
Capital Cost Sub-Element
Dust Control

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018
Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves dust control during implementation of remedial activities at the site. Assumes water-based dust suppresion during borrow development and access road improvements. It is assumed that water for dust control is obtained from Gladstone Interim Water Treatment Plant at no cost.

Cost Analysis:
Cost for Dust Control (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA38	Dust Control	466	HR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$137.94	$137.94	$64,280.04	8%	9%	$75,670	MII MII Assemblies	
												TOTAL UNIT COST:			$75,670		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$75,670	$75,670

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-9

Alternative E2 **Cost Worksheet:** **CW-E2-9**
Capital Cost Sub-Element
Erosion Control

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: EW **Date:** 3/12/2018

Checked By: JN **Date:** 3/13/2018

Work Statement:
This sub-element involves the erosion controls. Erosion controls shall be installed along roads and streams and consist of silt fencing.

Cost Analysis:
Cost for Erosion Control and Reclamation of Areas Disturbed during Construction (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
	Erosion Control																
MA29	Silt Fence	1,500	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.72	$0.00	$0.72	$1,080.00	8%	9%	$1,271	CW CostWorks	Source: 31 25 1416 1000
AA36	Silt Fence Installation	1,500	LF	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.43	$0.43	$645.00	8%	9%	$759	MII MII Assemblies	
MA32	Crane Mats	10	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$525.00	$525.00	$5,250.00	8%	9%	$6,180	V Vendor Quote	Source: Matrax, 2018
												TOTAL UNIT COST:			$8,210		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$8,210	$8,210

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Abbreviations:

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UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
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PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-10

Alternative E2 **Cost Worksheet: CW-E2-10**
Annual O&M Cost Sub-Element
Inspection of Remedial Components

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves inspection of the remedial components. Assumes four days for inspection of covers at 5 total mining-related sources.

Cost Analysis:
Cost for Inspection of Remedial Components (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
L3	Engineers, Project	32	HR	1.00	$42.06	$42.06	$0.00	$0.00	$0.00	$0.00	$42.06	$1,345.92	100%	9%	$2,934	FLC FLC Datacenter	
L6	Field Engineer	32	HR	1.00	$28.56	$28.56	$0.00	$0.00	$0.00	$0.00	$28.56	$913.92	100%	9%	$1,992	FLC FLC Datacenter	
AA1	Pickup Truck	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$103.85	$103.85	$415.42	8%	9%	$489	MII MII Assemblies	
MA11	Per Diem	8	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$144.00	$144.00	$1,152.00	0%	0%	$1,152	V www.gsa.gov	
												TOTAL UNIT COST:			$6,567		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$6,567	$6,567

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
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Cost Adjustment Checklist:	NOTES:
FACTOR:	Field work will be in Level "D" PPE.
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ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
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UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

TABLE CW-E2-11

Alternative E2 **Cost Worksheet:** **CW-E2-11**
Periodic O&M Cost Sub-Element
Post-Construction Maintenance

COST WORKSHEET

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Prepared By: JN **Date:** 5/7/2018
Checked By: EW **Date:** 5/8/2018

Work Statement:
This sub-element involves maintenance for covers. Maintenance would be conducted as needed, primarily due to events that could compromise the components (e.g. lack of adherence to ICs, storm events, wildland fires, etc.). Includes maintenance for 5 total mining-related sources.

Cost Analysis:
Cost for Post-Construction Maintenance (Lump Sum)

COST DATABASE CODE	DESCRIPTION	QTY	UNIT(S)	HPF	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	PC OH	PC PF	BUR LIC	COST SOURCE CITATION	COMMENTS
AA15C	Mob/Demob - Small Equipment (Maintenance)	2	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$606.70	$606.70	$1,213.40	8%	9%	$1,428	MII MII Assemblies	Includes mobilization/demobilization of equipment from o site to the initial mining-related source
AA80	Maintenance Crew	4	DY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$853.84	$853.84	$3,415.36	8%	9%	$4,021	MII MII Assemblies	
AA30	Excavation of Soil	700	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.02	$1.02	$713.79	8%	9%	$840	MII MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	1,120	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.90	$1,008.00	8%	9%	$1,187	MII MII Assemblies	
AA33	Rock Quarrying	130	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.67	$5.67	$737.10	8%	9%	$868	MII MII Assemblies	
AA34	Rock Ripping	130	BCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.32	$2.32	$301.60	8%	9%	$355	MII MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	290	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.42	$6.42	$1,861.80	8%	9%	$2,192	MII MII Assemblies	
AA2	Material Loading	1,410	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.25	$1.25	$1,757.28	8%	9%	$2,069	MII MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	470	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$62.80	$62.80	$29,516.00	8%	9%	$34,746	MII MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access-Subalpine)	470	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$21.94	$21.94	$10,311.80	8%	9%	$12,139	MII MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	470	LCY	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.73	$10.73	$5,043.10	8%	9%	$5,937	MII MII Assemblies	
AA24	Hydroseeding	1	ACR	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,235.19	$1,235.19	$1,235.19	8%	9%	$1,454	MII MII Assemblies	
MA8	Seed Mix	14	LB	1.00	$0.00	$0.00	$0.00	$0.00	$9.06	$0.00	$9.06	$126.84	8%	9%	$149	V Vendor Quote	Source: Southwest Seed, 2017
												TOTAL UNIT COST:			$67,385		

	Representative Unit Quantity	Unit(s)	Total Cost	Unit Cost
COST WORKSHEET SUMMARY	1	LS	$67,385	$67,385

Notes:
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000
The Cost Database Code is a reference code for linking with line item cost information with the cost source database and is not otherwise used within these cost worksheets.
The quantity bolded in the QTY column is the quantity selected as the representative unit quantity for this cost worksheet. If multiple quantities are bolded, the representative unit quantity is the sum of those quantities. When the LS unit is utilized, the default representative unit quantity is 1.

Source of Cost Data:
NA Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
MII (MII Assemblies), GSA (www.gsa.gov), FLC (FLC Datacenter), A (Allowance), V (Vendor Quote), CW (Means CostWorks 2018), P (Previous Work), CB (MII English Cost Book), and FRTR (www.frtr.gov)

Abbreviations:

QTY	Quantity	DY	Days
EQUIP	Equipment	EA	Each
MATL	Material	HR	Hours
HPF	HTRW Productivity Factor	LS	Lump Sum
ADJ LABOR	Adjusted Labor for HFP	MO	Months
ADJ EQUIP	Adjusted Equipment for HFP	WK	Weeks
UNMOD UC	Unmodified Unit Cost	YR	Years
UNMOD LIC	Unmodified Line Item Cost	ECY	Embankment Cubic Yard
UNBUR LIC	Unburdened Line Item Cost	BCY	Bank Cubic Yard
PC OH	Prime Contractor Overhead	LCY	Loose Cubic Yard
PC PF	Prime Contractor Profit	GAL	Gallon
BUR LIC	Burdened Line Item Cost	SF	Square Feet
		SY	Square Yard
		ACR	Acre
		LF	Linear Feet

Cost Adjustment Checklist:	**NOTES:**
FACTOR:	Field work will be in Level "D" PPE.
H&S Productivity (labor and equipment only)	MII assembly costs include HPF adjustments.
Escalation to Base Year	2018 cost sources are not escalated (EF=1.00). All other costs are escalated based on the USACE CWCCIS, EM 1110-2-1304, 30 Sept 2017
Area Cost Factor	An AF of 0.96 is used for Colorado, except that an AF of 1.00 (national unmodified average) is used for MII assembly costs and local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 8% and profit is 9% for the Prime Contractor. Professional labor overhead is 100%. Allowances and items with mandated costs such as per diem do not have overhead and profit applied.

Calculations

CDM Smith

PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY: JN	CHECKED BY: EW
JOB NO.: 219758.6460.DK4.WAD3.043	DATE: 3/8/2018	DATE CHECKED: 3/12/2018
CLIENT: USACE		WRKSHT NO.: A2 Quantities

Description: Estimated quantites for mine portal MIW discharges

Mine Portal MIW Discharges Quantities								
Site Category	Number of Mining-Related Sources Identified	Length of New Diversion / Isolation Components	Length of Existing Diversion / Isolation Components	Length of New Culvert Installation	Length of Existing Culverts	Length of Moderate Road Improvements	Length of Minor Road Improvements	Number of Access Road Improvements
	EA	ft	ft	ft	ft	ft	ft	EA
Nonconventional Access-Alpine	**6**	**930**	**390**	**30**	**0**	**3,100**	-	**1**
Conventional Access-Alpine	**0**	**0**	**0**	**0**	**0**	-	-	**0**
Nonconventional Access-Subalpine	**9**	**1,900**	**3,780**	**100**	**130**	**600**	**1,200**	**2**
Conventional Access-Subalpine	**5**	**730**	**90**	**30**	**60**	-	**400**	**1**
Total	**20**	**3,560**	**4,260**	**160**	**190**	**3,700**	**1,600**	**4**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources)

Obstructive Mine Waste Quantities					
Site Name	Number of Mining-Related Sources Identified	Area of Impacted Solid Media	Depth of Impacted Solid Media	Volume of Impacted Solid Media	Volume of Impacted Solid Media
	ea	sq ft	ft	cubic ft	cubic yd
Nonconventional Access-Alpine	**3**	**9,010**	**-**	**9,065**	**406**
Conventional Access-Subalpine	**0**	**0**	**-**	**0**	**0**
Nonconventional Access-Subalpine	**1**	**370**	**-**	**740**	**27**
Conventional Access-Subalpine	**0**	**0**	**-**	**0**	**0**
Total	**4**	**9,380**	**-**	**9,810**	**440**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources)

PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY : JN	CHECKED BY: EW
JOB NO.: 219758.6460.DK4.WAD3.043	DATE : 5/7/2018	DATE CHECKED: 5/8/2018
CLIENT: USACE		WRKSHT NO.: CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

General Assumptions		
Soil Bulking factor:	1.2	*Conversion from BCY to LCY*
Soil Compaction Factor:	0.9	*Conversion from BCY to ECY*
Soil Compaction Factor:	0.75	*Conversion from LCY to ECY*
Rock / Mine Waste Bulking factor:	1.2	*Conversion from BCY to LCY*
Rock / Mine Waste Compaction Factor:	1.08	*Conversion from BCY to ECY*
Rock / Mine Waste Compaction Factor:	0.9	*Conversion from LCY to ECY*
Density of Riprap, TN/CY:	1.5	*Means Handbook, Fig 2.5, Pg.47 (Granite, Loose)*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of Gravel, TN/CY:	1.39	*Means Handbook, Gravel, Dry*
Capital Costs		
Institutional Controls		
Project Manager, HR:	**16**	
Lawyer, HR:	**32**	
Paralegal, HR:	**64**	
Admin (Clerks, Typists), HR:	**8**	
Mobilization/Demobilization		
Nonconventional Access-Alpine Locations		
No. of Locations, EA:	6	*See A2 Quantities*
Mob/Demob - Small Equipment (Nonconventional Locations), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Locations), EA:	**5**	
Nonconventional Access-Subalpine Locations		
No. of Locations, EA:	9	*See A2 Quantities*
Mob/Demob - Small/Med Equipment (Nonconventional Locations), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Locations), EA:	**8**	
Conventional Access-Subalpine Locations		
No. of Locations, EA:	5	*See A2 Quantities*
Mob/Demob - Medium Equipment (Conventional Access), EA:	**2**	
Mob/Demob - Between Prop. (Conventional Access), EA:	**4**	
Borrow Development/Access Roads		
Borrow Development		
Mobilization/Demoblization - Large Equipment, EA:	**2**	
Access Road Improvements		
No. of Access Road Improvements, EA:	4	*See A2 Quantities*
Mobilization/Demoblization - Medium Equipment, EA:	**3**	
Mob/Demob - Between Access Road Locations, EA:	**3**	

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Installation of Diversion/Isolation Components

Diversion Channel Assumptions		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	3	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	13	*Assumed*
Depth of Rock for Channel, FT:	1	*Assumed*
Piping Assumptions		
Piping Length between Weld, FT:	40	*Assumes 40 ft length of pipe*
Estimated Welds per Day, EA/DY:	40	
Piping Length between Stakes, FT:	5	*Assumes 2 stakes every 5 feet*
Tie Wire Length (Per Pair of Stakes), FT:	3	*Assumed, for securing stakes and piping*
Berm Assumptions		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Height of Soil Berm, FT:	2	*Assumed*
Top Width - Soil Berm, FT:	2	*Assumed*
Bottom Width - Soil Berm, FT:	10	*Assumed*
Assumed Rock Armor Depth, FT:	1	*Assumed*
Top Width - Soil Berm w/Armoring, FT:	2	*Assumed*
Bottom Width - Soil Berm w/Armoring, FT:	14	*Assumed*
Culvert Assumptions		
Culvert Diameter, IN:	18	*Assumed*
Excavation Depth, FT:	5	*Assumed*
Excavation Width, FT:	4	*Assumed*
Installation of Diversion/Isolation Components for Nonconventional Access-Alpine Locations		
Total Length of Diversion/Isolation Components for Nonconventional Access-Alpine Locations, LF:	930	*See A2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	60%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	30%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	

PROJECT:	Bonita Peak Mining District Superfund Site	**COMPUTED BY :**	JN	**CHECKED BY:**	EW
JOB NO.:	219758.6460.DK4.WAD3.043	**DATE :**	5/7/2018	**DATE CHECKED:**	5/8/2018
CLIENT:	USACE			**WRKSHT NO.:**	CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Total Length for New Drainage Diversion Channel, LF:	500	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**389**	*Rounded up to nearest whole number*
Excavation, LCY:	467	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**8,750**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**8,750**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	130	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**145**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	218	*Rounded up to nearest whole number*
Open Channel Diversion with Hand Tools (Difficult Access Area)		
Assumes one mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	
Mob/Demob for Crews/Tools for Remote Locations, EA:	1	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	60	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	*Rounded up to nearest whole number*
Excavation, BCY:	**23**	*Rounded up to nearest whole number*
Excavation, LCY:	28	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	**780**	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**6**	*Rounded up to nearest whole number*
Piping		
Total Pipe Length to be Installed, LF:	**280**	*Rounded up to the nearest tens*
Welds Required, EA:	**7**	
Days for Welding Machine Rental, DY:	**1**	

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Stakes, EA:	**112**	
Tie Wire, LF:	336	
Rolls of Tie Wire, EA:	**1**	*400 ft roll. Rounded up to nearest whole number*
Berm		
Total Berm Length to be Installed, LF:	90	*Rounded up to the nearest tens*
Grading, SF:	**900**	
Volume of Soil Berm Material, ECF:	1,080	
Volume of Soil Berm Material, ECY:	**40**	
Volume of Soil Berm Material, LCY:	54	
Volume of Rock Armoring Berm Material, ECF:	1,080	
Volume of Rock Armoring Berm Material, ECY:	40	
Volume of Rock Armoring Berm Material, LCY:	**54**	
Culverts Under Roads		
Total Culvert Length to be Installed, LF:	**30**	*See A2 Quantities*
Excavation, BCY:	**23**	*Rounded up to nearest whole number*
Excavation, LCY:	28	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, LCY:	**28**	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, ECY:	**21**	*Rounded up to nearest whole number*
Installation of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations		
Total Length of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations, LF:	1,900	*See A2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	90%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	
Total Length for New Drainage Diversion Channel, LF:	1,370	*Rounded up to the nearest tens*

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**1,066**	*Rounded up to nearest whole number*
Excavation, LCY:	1,280	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**23,975**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**23,975**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	356	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**396**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	594	*Rounded up to nearest whole number*

Open Channel Diversion with Hand Tools (Difficult Access Area)

Assumes one mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap

Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	*Assumed*
Mob/Demob for Crews/Tools for Remote Locations, EA:	2	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	150	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	
Excavation, BCY:	**56**	*Rounded up to nearest whole number*
Excavation, LCY:	68	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	**1,950**	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**15**	*Rounded up to nearest whole number*

Piping

Total Pipe Length to be Installed, LF:	**190**	*Rounded up to the nearest tens*
Welds Required, EA:	**5**	
Days for Welding Machine Rental, DY:	**1**	

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Stakes, EA:	**76**	
Tie Wire, LF:	228	
Rolls of Tie Wire, EA:	**1**	*400 ft roll. Rounded up to nearest whole number*
Berm		
Total Berm Length to be Installed, LF:	190	*Rounded up to the nearest tens*
Grading, SF:	**1,900**	
Volume of Soil Berm Material, ECF:	2,280	
Volume of Soil Berm Material, ECY:	**85**	
Volume of Soil Berm Material, LCY:	114	
Volume of Rock Armoring Berm Material, ECF:	2,280	
Volume of Rock Armoring Berm Material, ECY:	85	
Volume of Rock Armoring Berm Material, LCY:	**114**	
Culverts Under Roads		
Total Culvert Length to be Installed, LF:	**100**	*See A2 Quantities*
Excavation, BCY:	**75**	*Rounded up to nearest whole number*
Excavation, LCY:	90	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, LCY:	**90**	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, ECY:	**68**	*Rounded up to nearest whole number*
Installation of Diversion/Isolation Components for Conventional Access-Subalpine Locations		
Total Length of Diversion/Isolation Components for Conventional Access-Subalpine Locations, LF:	730	*See A2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Standard Construction Equipment, %:	100%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	0%	
Total Length for New Drainage Diversion Channel, LF:	580	*Rounded up to the nearest tens*

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**452**	*Rounded up to nearest whole number*
Excavation, LCY:	543	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**10,150**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**10,150**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	151	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**168**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	252	*Rounded up to nearest whole number*

Open Channel Diversion with Hand Tools (Difficult Access Area)

Assumes one mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap

Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	0	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	
Excavation, BCY:	0	*Rounded up to nearest whole number*
Excavation, LCY:	0	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	0	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**0**	*Rounded up to nearest whole number*

Piping

Total Pipe Length to be Installed, LF:	**70**	*Rounded up to the nearest tens*
Welds Required, EA:	**2**	
Days for Welding Machine Rental, DY:	**1**	
Stakes, EA:	**28**	
Tie Wire, LF:	84	
Rolls of Tie Wire, EA:	**1**	*400 ft roll. Rounded up to nearest whole number*

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Berm		
Total Berm Length to be Installed, LF:	70	*Rounded up to the nearest tens*
Grading, SF:	**700**	
Volume of Soil Berm Material, ECF:	840	
Volume of Soil Berm Material, ECY:	**32**	
Volume of Soil Berm Material, LCY:	43	
Volume of Rock Armoring Berm Material, ECF:	840	
Volume of Rock Armoring Berm Material, ECY:	32	
Volume of Rock Armoring Berm Material, LCY:	**43**	
Culverts Under Roads		
Total Culvert Length to be Installed, LF:	**30**	*See A2 Quantities*
Excavation, BCY:	**23**	*Rounded up to nearest whole number*
Excavation, LCY:	28	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, LCY:	**28**	*Rounded up to nearest whole number*
Backfill and Compaction following Culvert Placement, ECY:	**21**	*Rounded up to nearest whole number*
Repairs of Existing Diversion/Isolation Components		
Mob/Demob - Small Equipment, EA:	**2**	
Previously Installed Culvert Maintenance		
Estimated Length of Previously Installed Culverts, LF:	**190**	*See A2 Quantities*
Estimated Length of Previously Installed Diversion/Isolation Components		
Estimated Length of Previously Installed Channels, LF:	4,260	*See A2 Quantities*
Total Length of Previously Installed Diversion/Isolation Components, LF:	**4,260**	
Repair/Maintenance Allowance for Existing Diversion/Isolation Components, LS:	**1**	
Excavation, Dewatering, and Management of Mine Waste at Local Interim Management Areas		
Excavation of Obstructive Mine Waste		
Nonconventional Access-Alpine Locations		
Mine Waste Excavation Volume, BCY:	**406**	*See A2 Quantities*
Mine Waste Excavation Volume, LCY:	**460**	*Rounded to nearest tens*
Nonconventional Access-Subalpine Locations		
Mine Waste Excavation Volume, BCY:	**27**	*See A2 Quantities*
Mine Waste Excavation Volume, LCY:	**40**	*Rounded to nearest tens*

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CLIENT:	USACE			WRKSHT NO.:	CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Total Excavation		
Total Excavation Volume, BCY:	**433**	
Total Excavation Volume, LCY:	500	
Geotechnical Characterization - Sampling Dewatered Mine Waste		
No. of Samples Required, EA/EA	1	
Frequency of Sampling, LCY/EA:	250	
Mine Waste Volume, LCY:	500	
Geotechnical Analysis, EA:	**2**	*Rounded up to the nearest whole number*
No. of Samples Collected per Hour, EA/HR:	1.5	
Travel Time Between Sampling Locations, HR/EA:	1.0	
Mobilizing between Sampling Locations, EA:	5	
Time Required for Field Engineer, HR:	**7**	*Rounded up to the nearest whole number*
Equipment, Supplies, and Shipping, per Sample, EA:	**2**	
Placement and Dewatering of Mine Waste at Local Interim Management Areas		
Movement of Mine Waste to Dewatering Area		
Short Haul to Dewatering Area (Nonconventional Locations), LCY:	**500**	
Diatomaceous Earth (D.E.) Amendment to Aid Dewatering		
Percentage of Mine Waste Amended, %:	10%	
Volume of Mine Waste Amended (Nonconventional Location), LCY:	50	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Nonconventional Locations), TN:	40	*Rounded to the nearest tens*
D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Nonconventional Locations), TN:	4	*Rounded to the nearest whole number*
Total Weight of D.E., TN:	**4**	
Volume of D.E. (Nonconventional Locations), LCY:	10	*Rounded to the nearest tens*
Mixing D.E. (Nonconventional Locations), LCY:	**60**	*Includes volume of mine waste and diatomaceous earth*
Movement of Mine Waste to Local Interim Management Areas		
Short Haul to Management Areas (Nonconventional Locations), LCY:	**60**	

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CLIENT:	USACE			WRKSHT NO.:	CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Perimeter of Trapezoidal Berm		
Nonconventional Access-Alpine Locations		
Total Area for Nonconventional Access-Alpine Locations, SF:	9,010	*See A2 Quantities*
Side Length of Interim Storage Area, LF:	95	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	388	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	1,163	
Volume of Berm Material, ECF:	1,551	
Volume of Berm Material, ECY:	57	
Nonconventional Access-Subalpine Locations		
Total Area for Nonconventional Access-Subalpine Locations, SF:	370	*See A2 Quantities*
Side Length of Interim Storage Area, LF:	19	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	85	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	255	
Volume of Berm Material, ECF:	340	
Volume of Berm Material, ECY:	13	
Total Grading, SF:	**1,418**	
Total Volume of Berm Material, ECY:	**70**	
Access Road Improvements		
Minor Improvements for Access Roads		
Estimated Length of Road for Minor Improvements, LF:	**1,600**	*See A2 Quantities*
Assumed Width of Access Road, FT:	16	
Rough Grading, SF:	25,600	
Minor Road Improvements, LF:	1,600	
Moderate Improvements for Access Roads		
Estimated Length of Road for Moderate Improvements, LF:	**3,700**	*See A2 Quantities*
Assumed Width of Access Road, FT:	16	
Assumed Depth of Gravel for Access Road, IN:	12	
Area for Clearing and Grubbing, AC:	**0.7**	*Assumes 50% of area will need to be cleared*
Rough Grading, SF:	59,200	

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Volume of Gravel for Access Roads, ECY:	2,193	
Volume of Gravel for Access Roads, LCY:	2,580	
Volume of Gravel for Access Roads, TON:	3,587	
Removal of Acess Road following Remedial Action		
Volume of Gravel for Access Roads, LCY:	**2,580**	
Volume of Gravel for Access Roads, BCY:	**2,193**	
Development of Borrow Materials		
Assumes gravel and soil borrow materials are developed onsite.		
Access Roads		
Gravel Borrow Volume Required, ECY:	2,190	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	2,580	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	2,300	*Rounded to the nearest tens*
Soil for Berm Material - Isolation/Diversion Component		
Nonconventional Access-Alpine Locations		
Borrow Soil, ECY:	40	*Rounded to the nearest tens*
Borrow Soil, LCY:	50	*Rounded to the nearest tens*
Borrow Soil, BCY:	40	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Borrow Soil, ECY:	90	*Rounded to the nearest tens*
Borrow Soil, LCY:	110	*Rounded to the nearest tens*
Borrow Soil, BCY:	90	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Borrow Soil, ECY:	30	*Rounded to the nearest tens*
Borrow Soil, LCY:	40	*Rounded to the nearest tens*
Borrow Soil, BCY:	30	*Rounded to the nearest tens*
Rock for Armoring Berms - Isolation/Diversion Component		
Nonconventional Access-Alpine Locations		
Rock Borrow, ECY:	40	*Rounded to the nearest tens*
Rock Borrow, LCY:	50	*Rounded to the nearest tens*
Rock Borrow, BCY:	40	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Rock Borrow, ECY:	90	*Rounded to the nearest tens*
Rock Borrow, LCY:	110	*Rounded to the nearest tens*
Rock Borrow, BCY:	90	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Rock Borrow, ECY:	30	*Rounded to the nearest tens*
Rock Borrow, LCY:	40	*Rounded to the nearest tens*
Rock Borrow, BCY:	30	*Rounded to the nearest tens*

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Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Rock for Open Channels - Isolation/Diversion Component		
Nonconventional Access-Alpine Locations		
Rock Borrow, ECY:	130	*Rounded to the nearest tens*
Rock Borrow, LCY:	150	*Rounded to the nearest tens*
Rock Borrow, BCY:	130	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Rock Borrow, ECY:	360	*Rounded to the nearest tens*
Rock Borrow, LCY:	400	*Rounded to the nearest tens*
Rock Borrow, BCY:	330	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Rock Borrow, ECY:	150	*Rounded to the nearest tens*
Rock Borrow, LCY:	170	*Rounded to the nearest tens*
Rock Borrow, BCY:	140	*Rounded to the nearest tens*
Total Quantities for Borrow		
Total Borrow Soil, BCY:	**160**	
Total Borrow Soil, LCY:	**200**	
Borrow Rock, BCY:	**3,060**	
Borrow Rock, LCY:	**3,500**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**1,530**	
Rock Ripping, BCY:	**1,530**	
Total Soil and Rock Borrow, BCY:	**3,220**	
Total Soil and Rock Borrow, LCY:	**3,700**	
Reclamation of Borrow Area		
Assumed Area for Borrow Reclamation, AC:	5	
Assumed Area for Borrow Reclamation, SF:	217,800	
Seed Mix, LB/AC:	20	
Grading, SF:	**217,800**	
Seeding, AC:	**5**	*Rounded up to the nearest whole number*
Seeding, LB:	**100**	
Erosion Control Blanket, SF:	217,800	
Erosion Control Blanket, SY:	**8,070**	*Rounded to the nearest tens*

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Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Transportation of Borrow Materials

Haul Distance, MI:	13	
Hauling - Rock Borrow for Access Roads, LCY:	**2,580**	
Hauling - Borrow for Nonconventional Access-Alpine Locations, LCY:	**250**	
Hauling - Borrow for Nonconventional Access-Subalpine Locations, LCY:	**620**	
Hauling - Borrow for Conventional Access-Subalpine Locations, LCY:	**250**	
Total Borrow Material, LCY:	**3,700**	
Volume Transported per Truckload - Nonconventional Access-Alpine, LCY/EA:	5	
Volume Transported per Truckload - Nonconventional Access-Subalpine & Access Roads, LCY/EA:	8	
Volume Transported per Truckload - Conventional Access-Subalpine, LCY/EA:	16	
Total Amount of Truckloads, EA:	466	

Dust Control

Assumes water-based dust suppression during implementation of remedial work, including borrow development and access road improvements.

Borrow Area Development

Assumed Excavation Productivity (Borrow Materials), BCY/HR:	117.9	
Total Borrow Volume, BCY:	3,220	
Estimated Borrow Excavation Time, HR:	27	*Rounded up to nearest whole number*
Estimated Borrow Dust Control Time, HR:	27	*Assumes water truck on hand for all excavation*

Access Road

Estimated Access Road Improvements Time, HR:	200	*Assumed*
Subtotal of Dust Control Time, HR:	227	
Additonal Time for Returning and Refilling Water Truck, %:	30%	*Assumed*
Total Dust Control Time, HR:	**296**	

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Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Erosion Control and Reclamation of Areas Disturbed during Construction		
Erosion Control Installation		
No. of Mining-Related Sources, EA:	20	*See A2 Quantities*
Silt Fencing per Mining-Related Source, LF/EA:	300	*Assume 300 LF per mining-related source.*
Total Silt Fencing, LF:	**6,000**	*Rounded up to the nearest tens*
Crane Mats, EA:	**10**	*Assumed*
Reclamation of Nonconventional Access-Alpine Locations		
Seed Mix, LB/AC:	20	
Reclamation of Area per Alpine Location, SF:	1,000	
No. of Alpine Mining-Related Sources, EA:	6	*See B2 Quantities*
Seeding, AC:	1	*Rounded up to the nearest whole number*
Seeding, LB:	**20**	
Erosion Control Blanket, SF:	6,000	
Erosion Control Blanket, SY:	**230**	*Rounded to the nearest tens*
Annual O&M Costs		
Inspection of Remedial Components		
Total Days for Inspection, DY:	5	
Project Engineer, HR:	**40**	
Field Engineer, HR:	**40**	
Truck Rental, DY:	**5**	
Per Diem, DY:	**10**	*Assumes two inspectors*
Surface Water Monitoring		
Surface Water Monitoring Events per Year, EA/YR:	2	
Number of Crew Members per Crew, EA/EA:	3	
Number of Crews, EA:	2	
Assumed Samples Collected per Day (per Crew), EA/DY:	12	
Assumed Hours per Workday, HR/DY:	8	
Number of Mining-Related Sources for Monitoring, EA:	20	*Assumes all mining-related sources identified for this issue will require monitoring*
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	
Total Number of Sample Locations, EA:	60	

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CLIENT:	USACE			WRKSHT NO.:	CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Estimated Sampling Hours per Monitoring Event, HR:		20	*Rounded up to nearest whole number*
Mobilization/Demobilization Time per Monitoring Event, HR:		8	*Assumes 4 hours each way*
Total Hours per Monitoring Event (per Crew Member), HR:		28	*Hours per crew member*
Total Days per Monitoring Event (per Crew Member), DY:		4	*Days per crew member, rounded up to nearest whole number*
Analysis			
Sample Locations, EA:		60	
Assumed Duplicate Frequency, EA/EA:		10	*One duplicate per 10 samples*
Assumed Field Blank Frequency, EA/EA:		20	*One field blank per 20 samples*
	Per Event	Total (Per Year)	
Total Samples for Analysis, EA:	69	138	*Includes QC samples*
TAL Metals (Total), EA:	69	**138**	
TAL Metals (Dissolved), EA:	69	**138**	
Anions, EA:	138	**276**	*Chloride and Fluoride*
Sulfate, EA:	69	**138**	
Alkalinity, EA:	69	**138**	
Hardness, EA:	69	**138**	
Overnight Sample Shipment, EA:	18	**36**	*Assumes 4 samples per shipment, rounded up to whole number*
Equipment			
	Per Event	Total (Per Year)	
Field Meter Rental, DY:	8	**16**	*1 field meter per sampling crew for each event*
Stream Gauge Rental, DY:	8	**16**	*1 stream gauge per sampling crew for each event*
Field Filters, EA:	69	**138**	
Miscellaneous Sampling Supplies, LS:	1	**2**	*Includes disposable gloves, ice, etc.*
Labor			
	Per Event	Total (Per Year)	
Field Engineer, HR:	168	**336**	
Per Diem (Travel Days), DY:	12	**36**	
Per Diem (Full Days), DY:	12	**36**	
Truck Rental, DY:	8	**16**	*Assumes 1 truck per crew*
Reporting			
	Per Event	Total (Per Year)	
Project Manager, HR:	-	**16**	*Assumes 1 annual report summarizing all monitoring events in a given year*
Environmental Engineer, HR:	-	**60**	
Environmental Scientist, HR:	-	**20**	
CAD Drafter, HR:	-	**12**	
Admin Clerk, HR:	-	**8**	

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CLIENT:	USACE			WRKSHT NO.:	CALC-A2

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Periodic O&M Costs

Post-Construction Maintenance

Diversion/Isolation Component Maintenance

Percentage of Geotextile for Channels to be Replaced, %:	5%	
Percentage of Riprap for Channels to be Replaced, %:	5%	
Percentage of Soil for Berms to be Replaced, %:	5%	
Mob/Demob - Small Equipment, EA:	**2**	
Culverts for Maintenance		
Total Culvert Lengths for Maintenance, LF:	**350**	*Summation of newly installed and previously existing*
Diversion/Isolation for Maintenance (Diversion Channel, Piping, and Berms)		
Total Length of Previously Installed Diversion/Isolation Components, LF:	**7,750**	*Summation of newly installed and previously existing*
Geotextile for Channel Maintenance		
Geotextile Placed During Initial Installation, SF:	42,875	*Summation of installed geotextile*
Geotextile Placed During Installation - Remote Location, SF:	2,730	*Summation of installed geotextile*
Geotextile Placement per Maintenance Event, SF:	**2,150**	*Rounded up to nearest tens*
Geotextile Placement per Maintenance Event - Remote Locations, SF:	**140**	*Rounded up to nearest tens*
Riprap for Channel Maintenance		
Riprap Placed During Initial Installation, LCY:	709	
Riprap Volume Placement per Maintenance Event, LCY:	36	*Rounded up to nearest whole number*
Riprap Volume Placement per Maintenance Event, BCY:	30	*Rounded up to nearest whole number*
Soil for Berm Maintenance		
Soil Placed During Initial Installation, ECY:	157	
Soil Volume Placement per Maintenance Event, ECY:	8	*Rounded up to nearest whole number*
Soil Volume Placement per Maintenance Event, LCY:	11	
Soil Volume Placement per Maintenance Event, BCY:	7	*Rounded up to nearest whole number*

Description: Calculations and assumptions for the development of quantities for Alternative A2 - Diversion/Isolation cost estimate.

Borrow Development and Transportation for Maintenance		
Total Soil Borrow per Maintenance Event, BCY:	**7**	
Total Soil Borrow per Maintenance Event, LCY:	**11**	
Total Rock Borrow per Maintenance Event, BCY:	**30**	
Total Rock Borrow per Maintenance Event, LCY:	**36**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**15**	
Rock Ripping, BCY:	**15**	
Total Soil and Rock Borrow, BCY:	**37**	
Total Soil and Rock Borrow, LCY:	**47**	
Haul Distance, MI:	13	
Hauling - Borrow for Nonconventional Access-Alpine Locations, LCY:	**16**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Nonconventional Access-Subalpine Locations, LCY:	**16**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Conventional Access-Subalpine Locations, LCY:	**16**	*Assumes 1/3 of borrow materials*
Interim Local Management Areas Maintenance		
Maintenance Crew, DY:	2	
Maintenance Allowance for Local Interim Management Areas, LS:	1	

CDM Smith

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CLIENT:	USACE			WRKSHT NO.:	B2 Quantities

Description: Estimated quantites for mining-related source/stormwater interactions

Mining-Related Source/Stormwater Interactions Quantities

Site Category	Number of Mining-Related Sources Identified	Length of New Diversion / Isolation Components	Length of New Culvert Installation	Length of Existing Culverts	Length of Moderate Road Improvements	Length of Minor Road Improvements	Number of Access Road Improvements
	EA	ft	ft	ft	ft	ft	EA
Nonconventional Access-Alpine	**6**	**1,970**	**0**	**30**	**3,100**	**100**	**2**
Conventional Access-Alpine	**0**	**0**	**0**	**0**	**-**	**-**	**0**
Nonconventional Access-Subalpine	**4**	**1,820**	**0**	**30**	**600**	**1,200**	**2**
Conventional Access-Subalpine	**1**	**480**	**0**	**0**	**-**	**-**	**0**
Total	**11**	**4,270**	**0**	**60**	**3,700**	**1,300**	**4**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources)

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CLIENT:	USACE			WRKSHT NO.:	CALC-B2

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

General Assumptions		
Soil Bulking factor:	1.2	*Conversion from BCY to LCY*
Soil Compaction Factor:	0.9	*Conversion from BCY to ECY*
Soil Compaction Factor:	0.75	*Conversion from LCY to ECY*
Rock / Mine Waste Bulking factor:	1.2	*Conversion from BCY to LCY*
Rock / Mine Waste Compaction Factor:	1.08	*Conversion from BCY to ECY*
Rock / Mine Waste Compaction Factor:	0.9	*Conversion from LCY to ECY*
Density of Riprap, TN/CY:	1.5	*Means Handbook, Fig 2.5, Pg.47 (Granite, Loose)*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of Gravel, TN/CY:	1.39	*Means Handbook, Gravel, Dry*
Capital Costs		
Institutional Controls		
Project Manager, HR:	16	
Lawyer, HR:	32	
Paralegal, HR:	64	
Admin (Clerks, Typists), HR:	8	
Mobilization/Demobilization		
Nonconventional Access-Alpine Locations		
No. of Locations, EA:	6	*See B2 Quantities*
Mob/Demob - Small Equipment (Nonconventional Access), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**5**	
Nonconventional Access-Subalpine Locations		
No. of Locations, EA:	4	*See B2 Quantities*
Mob/Demob - Small/Med Equipment (Nonconventional Access), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**3**	
Conventional Access-Subalpine Locations		
No. of Locations, EA:	1	*See B2 Quantities*
Mob/Demob - Medium Equipment (Conventional Access), EA:	**2**	
Mob/Demob - Between Prop. (Conventional Access), EA:	**0**	
Borrow Development/Access Roads		
Borrow Development		
Mobilization/Demoblization - Large Equipment, EA:	**2**	
Access Road Improvements		
Mob/Demob - Between Access Road Locations, EA:	4	*See B2 Quantities*
Mobilization/Demoblization - Medium Equipment, EA:	**3**	
Mob/Demob - Between Access Road Locations, EA:	**3**	

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CLIENT:	USACE			WRKSHT NO.:	CALC-B2

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Installation of Surface Stormwater Diversion/Isolation Components

Diversion Channel Assumptions		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	3	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	13	*Assumed*
Depth of Rock for Channel, FT:	1	*Assumed*
Piping Assumptions		
Piping Length between Weld, FT:	40	*Assumes 40 ft length of pipe*
Estimated Welds per Day, EA/DY:	40	
Piping Length between Stakes, FT:	5	*Assumes 2 stakes every 5 feet*
Tie Wire Length (Per Pair of Stakes), FT:	3	*Assumed, for securing stakes and piping*
Berm Assumptions		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Height of Berm, FT:	2	*Assumed*
Top Width, FT:	2	*Assumed*
Bottom Width, FT:	10	*Assumed*
Assumed Rock Armor Depth, FT:	1	*Assumed*
Top Width - Soil Berm w/Armoring, FT:	2	*Assumed*
Bottom Width - Soil Berm w/Armoring, FT:	14	*Assumed*
Culvert Assumptions		
Culvert Diameter, IN:	18	*Assumed*
Excavation Depth, FT:	5	*Assumed*
Excavation Width, FT:	4	*Assumed*

Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations

Total Length of Diversion/Isolation Components for Nonconventional Access-Alpine Locations, LF:	1,970	*See B2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	60%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	30%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Convential Construction Equipment, %:	90%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Total Length for New Drainage Diversion Channel, LF:	1,060	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**825**	*Rounded up to nearest whole number*
Excavation, LCY:	990	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**18,550**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**18,550**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	275	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**306**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	459	*Rounded up to nearest whole number*
Open Channel Diversion with Hand Tools (Difficult Access Area)		
Assumes two mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	*Assumed*
Mob/Demob for Crews/Tools for Remote Locations, EA:	2	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	120	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	
Excavation, BCY:	**45**	*Rounded up to nearest whole number*
Excavation, LCY:	54	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	**1,560**	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**12**	*Rounded up to nearest whole number*
Piping		
Total Pipe Length to be Installed, LF:	**590**	*Rounded up to the nearest tens*
Welds Required, EA:	**15**	
Days for Welding Machine Rental, DY:	**1**	

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Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Stakes, EA:	**236**	
Tie Wire, LF:	708	
Rolls of Tie Wire, EA:	**2**	*400 ft roll. Rounded up to nearest whole number*
Berm		
Total Berm Length to be Installed, LF:	**200**	*Rounded up to the nearest tens*
Grading, SF:	**2,000**	
Volume of Soil Berm Material, ECF:	2,400	
Volume of Soil Berm Material, ECY:	**89**	
Volume of Soil Berm Material, LCY:	119	
Volume of Rock Armoring Berm Material, ECF:	2,400	
Volume of Rock Armoring Berm Material, ECY:	89	
Volume of Rock Armoring Berm Material, LCY:	**119**	
Culvert Under Roads		
Culvert Length to be Installed, LF:	0	
Culvert Length to be Maintenanced:	**30**	
Installation of Surface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations		
Total Length of Diversion/Isolation Components for Nonconventional Access-Subalpine Locations, LF:	1,820	*See B2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Convential Construction Equipment, %:	90%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	10%	
Total Length for New Drainage Diversion Channel, LF:	1,310	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**1,019**	*Rounded up to nearest whole number*
Excavation, LCY:	1,223	*Rounded up to nearest whole number*

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**22,925**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**22,925**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	340	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**378**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	567	*Rounded up to nearest whole number*
Open Channel Diversion with Hand Tools (Difficult Access Area)		
Assumes one mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap		
Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	*Assumed*
Mob/Demob for Crews/Tools for Remote Locations, EA:	1	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	150	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	
Excavation, BCY:	**56**	*Rounded up to nearest whole number*
Excavation, LCY:	68	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	**1,950**	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**15**	*Rounded up to nearest whole number*
Piping		
Total Pipe Length to be Installed, LF:	**180**	*Rounded up to the nearest tens*
Welds Required, EA:	**5**	
Days for Welding Machine Rental, DY:	**1**	
Stakes, EA:	**72**	
Tie Wire, LF:	216	
Rolls of Tie Wire, EA:	**1**	*400 ft roll. Rounded up to nearest whole number*
Berm		
Total Berm Length to be Installed, LF:	**180**	*Rounded up to the nearest tens*
Grading, SF:	**1,800**	

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Volume of Soil Berm Material, ECF:	2,160	
Volume of Soil Berm Material, ECY:	**80**	
Volume of Soil Berm Material, LCY:	107	
Volume of Rock Armoring Berm Material, ECF:	2,160	
Volume of Rock Armoring Berm Material, ECY:	80	
Volume of Rock Armoring Berm Material, LCY:	**107**	
Culvert Under Roads		
Culvert Length to be Installed, LF:	0	
Culvert Length to be Maintenanced:	**30**	
Installation of Surface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations		
Total Length of Diversion/Isolation Components for Conventional Access-Subalpine Locations, LF:	480	*See B2 Quantities*
Assumed Percentage of Diversion/Isolation Addressed with Open Channels, %:	80%	
Assumed Percentage of Diversion/Isolation Addressed with Piping, %:	10%	
Assumed Percentage of Diversion/Isolation Addressed with Berms, %:	10%	
Open Channel Diversion		
Assumed Percentage of Open Channel Diversion Addressed using Convential Construction Equipment, %:	100%	
Assumed Percentage of Open Channel Diversion Addressed using Hand Tools, %:	0%	
Total Length for New Drainage Diversion Channel, LF:	380	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	21	
Riprap Cross Section Channel Area, SF:	7	*Rounded up to nearest whole number*
Excavation, BCY:	**296**	*Rounded up to nearest whole number*
Excavation, LCY:	356	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	17.5	*Rounded up to nearest tenth*
Grading Slopes, SF:	**6,650**	*Rounded up to nearest whole number*
Geotextile Placement, SF:	**6,650**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, ECY:	99	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, LCY:	**110**	*Rounded up to nearest whole number*
Rock Volume for Runoff Channel, TON:	165	*Rounded up to nearest whole number*

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Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Open Channel Diversion with Hand Tools (Difficult Access Area)

Assumes one mining-related source area would require hand tools due to very difficult access. The channel using hand tools is assumed to be lined with geotextile but not gravel/riprap

Side Slopes (H:V), FT/FT:	2	*Assumed*
Depth of Channel, FT:	2	*Assumed*
Bottom Width, FT:	1	*Assumed*
Top Width, FT:	9	*Assumed*
Mob/Demob for Crews/Tools for Remote Locations, EA:	0	*Assumed*
Total Length for New Drainage Diversion Channel, LF:	0	*Rounded up to the nearest tens*
Excavation Cross Section, SF:	10	
Excavation, BCY:	**0**	*Rounded up to nearest whole number*
Excavation, LCY:	0	*Rounded up to nearest whole number*
Wetted Perimeter of Trench, FT:	13.0	*Rounded up to nearest tenth*
Geotextile Placement - Remote Locations, SF:	**0**	*Rounded up to nearest whole number*
Assumed Hand Placement of Rocks to Anchor Geotextile, LF/HR:	10	*Assumed*
Hand Placement of Rocks to Anchor Geotextile, HR:	**0**	*Rounded up to nearest whole number*
Piping		
Total Pipe Length to be Installed, LF:	**50**	*Rounded up to the nearest tens*
Welds Required, EA:	**2**	
Days for Welding Machine Rental, DY:	**1**	
Stakes, EA:	**20**	
Tie Wire, LF:	60	
Rolls of Tie Wire, EA:	**1**	*400 ft roll. Rounded up to nearest whole number*
Berm		
Total Berm Length to be Installed, LF:	**50**	*Rounded up to the nearest tens*
Grading, SF:	**500**	
Volume of Soil Berm Material, ECF:	600	
Volume of Soil Berm Material, ECY:	**23**	
Volume of Soil Berm Material, LCY:	31	
Volume of Rock Armoring Berm Material, ECF:	600	
Volume of Rock Armoring Berm Material, ECY:	23	
Volume of Rock Armoring Berm Material, LCY:	**31**	

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Culvert Under Roads		
Culvert Length to be Installed, LF:	0	
Culvert Length to be Maintenanced:	**0**	
Installation of Subsurface Stormwater Diversion/Isolation Components		
It is assumed that diversion/isolation will also include subsurface components in select locations. For purposes of estimating costs, it was assumed that 10% of the total length of surface controls would also include subsurface controls		
Assumed Percentage of Surface Diversion/Isolation that will also be Addressed with Subsurface Component, %:	10%	
Subsurface Passive Interflow Control (PIC) Assumptions		
Depth of Excavation, FT:	4	*Assumed*
Width of Excavation, FT:	3	*Assumed*
Backfill Depth of Coarse Gravel for Subsurface PIC, FT:	3	*Assumed*
Piping Length between Weld, FT:	40	*Assumes 40 ft length of pipe*
Estimated Welds per Day, EA/DY:	40	
Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Alpine Locations		
Total Length of Surface Diversion/Isolation Components for Nonconventional Access-Alpine Locations, LF:	1,970	*See B2 Quantities worksheet*
Total Length for Subsurface Controls for Nonconventional Access-Alpine Locations, LF:	200	*Rounded up to the nearest tens*
Excavation, BCY:	**89**	*Rounded up to nearest whole number*
Excavation, LCY:	107	*Rounded up to nearest whole number*
Length of 6" Perforated Pipe, LF:	200	
Welds Required, EA:	**5**	
Days for Welding Machine Rental, DY:	**1**	
Volume of Piping, CF:	40	
Coarse Gravel Backfill, ECY:	**66**	
Coarse Gravel Backfill, LCY:	**78**	
Geotextile Cross Sectional Perimeter, FT:	12	*Assumes geotextile will be installed along the perimeter of the 3' wide x 3' deep coarse gravel*
Total Geotextile Installation, SF:	**2,400**	
Soil Backfill, ECY:	23	
Soil Backfill, LCY:	31	
Trench Spoils Spreading, ECY:	57	*Assumes Spoils from trench excavation will be spread and compacted nearby*
Trench Spoils Spreading, LCY:	76	

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Total Soil Backfill and Compaction, ECY:	**80**	
Total Soil Backfill and Compaction, LCY:	**107**	

Installation of Subsurface Stormwater Diversion/Isolation Components for Nonconventional Access-Subalpine Locations

Total Length of Surface Diversion/Isolation Components for Nonconventional Access-Subalpine Locations, LF:	1,820	*See B2 Quantities worksheet*
Total Length for Subsurface Controls for Nonconventional Access-Subalpine Locations, LF:	190	*Rounded up to the nearest tens*
Excavation, BCY:	**85**	*Rounded up to nearest whole number*
Excavation, LCY:	102	*Rounded up to nearest whole number*
Length of 6" Perforated Pipe, LF:	**190**	
Welds Required, EA:	**5**	
Days for Welding Machine Rental, DY:	**1**	
Volume of Piping, CF:	38	
Coarse Gravel Backfill, ECY:	**62**	
Coarse Gravel Backfill, LCY:	**73**	
Geotextile Cross Sectional Perimeter, FT:	12	*Assumes geotextile will be installed along the perimeter of the 3' wide x 3' deep coarse gravel*
Total Geotextile Installation, SF:	**2,280**	
Soil Backfill, ECY:	23	
Soil Backfill, LCY:	31	
Trench Spoils Spreading, ECY:	54	*Assumes Spoils from trench excavation will be spread and compacted nearby*
Trench Spoils Spreading, LCY:	71	
Total Soil Backfill and Compaction, ECY:	**77**	
Total Soil Backfill and Compaction, LCY:	**102**	

Installation of Subsurface Stormwater Diversion/Isolation Components for Conventional Access-Subalpine Locations

Total Length of Surface Diversion/Isolation Components for Conventional Access-Subalpine Locations, LF:	480	*See B2 Quantities worksheet*
Total Length for Subsurface Controls for Conventional Access-Subalpine Locations, LF:	50	*Rounded up to the nearest tens*
Excavation, BCY:	**23**	*Rounded up to nearest whole number*
Excavation, LCY:	28	*Rounded up to nearest whole number*

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Length of 6" Perforated Pipe, LF:	**50**	
Welds Required, EA:	**2**	
Days for Welding Machine Rental, DY:	**1**	
Volume of Piping, CF:	10	
Coarse Gravel Backfill, ECY:	**17**	
Coarse Gravel Backfill, LCY:	**20**	
Geotextile Cross Sectional Perimeter, FT:	12	*Assumes geotextile will be installed along the perimeter of the 3' wide x 3' deep coarse gravel*
Total Geotextile Installation, SF:	**600**	
Soil Backfill, ECY:	6	
Soil Backfill, LCY:	8	
Trench Spoils Spreading, ECY:	15	*Assumes Spoils from trench excavation will be spread and compacted nearby*
Trench Spoils Spreading, LCY:	20	
Total Soil Backfill and Compaction, ECY:	**21**	
Total Soil Backfill and Compaction, LCY:	**28**	
Repairs of Existing Diversion/Isolation Components		
Mob/Demob - Small Equipment, EA:	**2**	
Previously Installed Culvert Maintenance		
Estimated Length of Previously Installed Culverts, LF:	**60**	*See B2 Quantities*
Access Road Improvements		
Minor Improvements for Access Roads		
Estimated Length of Road for Minor Improvements, LF:	**1,300**	*See B2 Quantities*
Assumed Width of Access Road, FT:	16	
Rough Grading, SF:	20,800	
Minor Road Improvements, LF:	1,300	
Moderate Improvements for Access Roads		
Estimated Length of Road for Moderate Improvements, LF:	**3,700**	*See B2 Quantities*
Assumed Width of Access Road, FT:	16	
Assumed Depth of Gravel for Access Road, IN:	12	
Area for Clearing and Grubbing, AC:	**0.7**	*Assumes 50% of area will need to be cleared*
Rough Grading, SF:	59,200	

Volume of Gravel for Access Roads, ECY:	2,193	
Volume of Gravel for Access Roads, LCY:	2,580	
Volume of Gravel for Access Roads, TON:	3,587	
Removal of Acess Road following Remedial Action		
Volume of Gravel for Access Roads, LCY:	**2,580**	
Volume of Gravel for Access Roads, BCY:	**2,193**	
Development of Borrow Materials		
Assumes gravel and soil borrow materials are developed onsite.		
Access Roads		
Gravel Borrow Volume Required, ECY:	2,190	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	2,580	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	2,190	*Rounded to the nearest tens*
Soil for Berm Material - Isolation/Diversion Component		
Nonconventional Access-Alpine Locations		
Borrow Soil, ECY:	90	*Rounded to the nearest tens*
Borrow Soil, LCY:	120	*Rounded to the nearest tens*
Borrow Soil, BCY:	100	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Borrow Soil, ECY:	80	*Rounded to the nearest tens*
Borrow Soil, LCY:	110	*Rounded to the nearest tens*
Borrow Soil, BCY:	90	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Borrow Soil, ECY:	20	*Rounded to the nearest tens*
Borrow Soil, LCY:	30	*Rounded to the nearest tens*
Borrow Soil, BCY:	30	*Rounded to the nearest tens*
Rock for Armoring Berms - Isolation/Diversion Components		
Nonconventional Access-Alpine Locations		
Rock Borrow, ECY:	90	*Rounded to the nearest tens*
Rock Borrow, LCY:	120	*Rounded to the nearest tens*
Rock Borrow, BCY:	100	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Rock Borrow, ECY:	80	*Rounded to the nearest tens*
Rock Borrow, LCY:	110	*Rounded to the nearest tens*
Rock Borrow, BCY:	90	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Rock Borrow, ECY:	20	*Rounded to the nearest tens*
Rock Borrow, LCY:	30	*Rounded to the nearest tens*
Rock Borrow, BCY:	30	*Rounded to the nearest tens*
Rock for Open Channels - Surface and Subsurface Isolation/Diversion Components		
Nonconventional Access-Alpine Locations		
Rock Borrow, ECY:	340	*Rounded to the nearest tens*
Rock Borrow, LCY:	380	*Rounded to the nearest tens*
Rock Borrow, BCY:	320	*Rounded to the nearest tens*

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Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Nonconventional Access-Subalpine Locations		
Rock Borrow, ECY:	400	*Rounded to the nearest tens*
Rock Borrow, LCY:	450	*Rounded to the nearest tens*
Rock Borrow, BCY:	380	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Rock Borrow, ECY:	120	*Rounded to the nearest tens*
Rock Borrow, LCY:	130	*Rounded to the nearest tens*
Rock Borrow, BCY:	110	*Rounded to the nearest tens*
Total Quantities for Borrow		
Total Borrow Soil, BCY:	**220**	
Total Borrow Soil, LCY:	**260**	
Borrow Rock, BCY:	**3,220**	
Borrow Rock, LCY:	**3,800**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**1,610**	
Rock Ripping, BCY:	**1,610**	
Total Soil and Rock Borrow, BCY:	**3,440**	
Total Soil and Rock Borrow, LCY:	**4,060**	
Reclamation of Borrow Area		
Assumed Area for Borrow Reclamation, AC:	5	
Assumed Area for Borrow Reclamation, SF:	217,800	
Seed Mix, LB/AC:	20	
Grading, SF:	**217,800**	
Seeding, AC:	**5**	*Rounded up to the nearest whole number*
Seeding, LB:	**100**	
Erosion Control Blanket, SF:	217,800	
Erosion Control Blanket, SY:	**8,070**	*Rounded to the nearest tens*
Transportation of Borrow Materials		
Haul Distance, MI:	13	
Hauling - Rock Borrow for Access Roads, LCY:	**2,580**	
Hauling - Borrow for Nonconventional Access-Alpine Locations, LCY:	**500**	
Hauling - Borrow for Nonconventional Access-Subalpine Locations, LCY:	**560**	
Hauling - Borrow for Conventional Access-Subalpine Locations, LCY:	**160**	
Total Borrow Material, LCY:	**3,800**	

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Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Volume Transported per Truckload - Nonconventional Access-Alpine, LCY/EA:	5	
Volume Transported per Truckload - Nonconventional Access-Subalpine & Access Roads, LCY/EA:	8	
Volume Transported per Truckload - Conventional Access-Subalpine, LCY/EA:	16	
Total Amount of Truckloads, EA:	503	

Dust Control

Assumes water-based dust suppression during implementation of remedial work, including borrow development and access road improvements.

Borrow Area Development

Assumed Excavation Productivity (Borrow Materials), BCY/HR:	117.9	
Total Borrow Volume, BCY:	3,440	
Estimated Borrow Excavation Time, HR:	29	*Rounded up to nearest whole number*
Estimated Borrow Dust Control Time, HR:	29	*Assumes water truck on hand for all excavation*

Access Road Improvements

Estimated Access Road Improvements Time, HR:	200	*Assumed*
Subtotal of Dust Control Time, HR:	229	
Additonal Time for Returning and Refilling Water Truck, %:	30%	*Assumed*
Total Dust Control Time, HR:	**298**	

Erosion Control and Reclamation of Areas Disturbed during Construction

Erosion Control Installation

No. of Mining-Related Sources, EA:	11	*See B2 Quantities*
Silt Fencing per Mining-Related Source, LF/EA:	300	*Assume 300 LF per mining-related source.*
Total Silt Fencing, LF:	**3,300**	*Rounded up to the nearest tens*
Crane Mats, EA:	**10**	*Assumed*

Reclamation of Nonconventional Access-Alpine Locations

Seed Mix, LB/AC:	20	
Reclamation of Area per Alpine Location, SF:	1,000	
No. of Alpine Mining-Related Sources, EA:	6	*See B2 Quantities*
Seeding, AC:	1	*Rounded up to the nearest whole number*
Seeding, LB:	**20**	
Erosion Control Blanket, SF:	6,000	
Erosion Control Blanket, SY:	**230**	*Rounded to the nearest tens*

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Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Annual O&M Costs

Inspection of Remedial Components

Total Days for Inspection, DY:	4	
Project Engineer, HR:	**32**	
Field Engineer, HR:	**32**	
Truck Rental, DY:	**4**	
Per Diem, DY:	**8**	*Assumes two inspectors*

Surface Water Monitoring

Surface Water Monitoring Events per Year, EA/YR:	2	
Number of Crew Members per Crew, EA/EA:	3	
Number of Crews, EA:	2	
Assumed Samples Collected per Day (per Crew), EA/DY:	12	
Assumed Hours per Workday, HR/DY:	8	
Number of Mining-Related Sources for Monitoring, EA:	11	*Assumes all mining-related sources identified for this issue will require monitoring*
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	
Total Number of Sample Locations, EA:	33	
Estimated Sampling Hours per Monitoring Event, HR:	11	*Rounded up to nearest whole number*
Mobilization/Demobilization Time per Monitoring Event, HR:	8	*Assumes 4 hours each way*
Total Hours per Monitoring Event (per Crew Member), HR:	19	*Hours per crew member*
Total Days per Monitoring Event (per Crew Member), DY:	3	*Days per crew member, rounded up to nearest whole number*

Analysis

Sample Locations, EA:	33	
Assumed Duplicate Frequency, EA/EA:	10	*One duplicate per 10 samples*
Assumed Field Blank Frequency, EA/EA:	20	*One field blank per 20 samples*

	Per Event	Total (Per Year)	
Total Samples for Analysis, EA:	39	78	*Includes QC samples*
TAL Metals (Total), EA:	39	**78**	
TAL Metals (Dissolved), EA:	39	**78**	
Anions, EA:	78	**156**	*Chloride and Fluoride*
Sulfate, EA:	39	**78**	
Alkalinity, EA:	39	**78**	
Hardness, EA:	39	**78**	
Overnight Sample Shipment, EA:	10	**20**	*Assumes 4 samples per shipment, rounded up to whole number*

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Equipment

	Per Event	Total (Per Year)	
Field Meter Rental, DY:	6	**12**	*1 field meter per sampling crew for each event*
Stream Gauge Rental, DY:	6	**12**	*1 stream gauge per sampling crew for each event*
Field Filters, EA:	39	**78**	
Miscellaneous Sampling Supplies, LS:	1	**2**	*Includes disposable gloves, ice, etc.*

Labor

	Per Event	Total (Per Year)	
Field Engineer, HR:	114	**228**	
Per Diem (Travel Days), DY:	12	**24**	
Per Diem (Full Days), DY:	6	**12**	
Truck Rental, DY:	6	**12**	*Assumes 1 truck per crew*

Reporting

	Per Event	Total (Per Year)	
Project Manager, HR:	-	**16**	*Assumes 1 annual report summarizing all monitoring events in a given year*
Environmental Engineer, HR:	-	**60**	
Environmental Scientist, HR:	-	**20**	
CAD Drafter, HR:		**12**	
Admin Clerk, HR:	-	**8**	

Periodic O&M Costs

Post-Construction Maintenance

Diversion/Isolation Component Maintenance

Percentage of Geotextile for Channels to be Replaced, %:	5%	
Percentage of Riprap for Channels to be Replaced, %:	5%	
Percentage of Soil for Berms to be Replaced, %:	5%	
Mob/Demob - Small Equipment, EA:	**2**	

Culverts for Maintenance

Total Culvert Lengths for Maintenance, LF:	**60**	*Summation of newly installed and previously existing*

Surface Diversion/Isolation for Maintenance (Diversion Channel, Piping, and Berms)

Total Length of Previously Installed Surface Diversion/Isolation Components, LF:	**4,270**	*Summation of newly installed and previously existing*

Geotextile for Channel Maintenance

Geotextile Placed During Initial Installation, SF:	48,125	*Summation of installed geotextile*
Geotextile Placed During Initial Installation - Remote Locations, SF:	3,510	*Summation of installed geotextile*

Description: Calculations and assumptions for the development of quantities for Alternative B2 - Stormwater Diversion/Isolation for Mining Related Source/Stormwater Interactions cost estimate.

Geotextile Placement per Maintenance Event, SF:	**2,410**	*Rounded up to nearest tens*
Geotextile Placement per Maintenance Event - Remote Locations, SF:	**180**	*Rounded up to nearest tens*
Riprap for Channel Maintenance		
Riprap Placed During Initial Installation, LCY:	794	
Riprap Volume Placement per Maintenance Event, LCY:	40	*Rounded up to nearest whole number*
Riprap Volume Placement per Maintenance Event, BCY:	34	*Rounded up to nearest whole number*
Soil for Berm Maintenance		
Soil Placed During Initial Installation, ECY:	192	
Soil Volume Placement per Maintenance Event, ECY:	10	*Rounded up to nearest whole number*
Soil Volume Placement per Maintenance Event, LCY:	14	
Soil Volume Placement per Maintenance Event, BCY:	9	*Rounded up to nearest whole number*
Borrow Development and Transportation for Maintenance		
Total Soil Borrow per Maintenance Event, BCY:	**9**	
Total Soil Borrow per Maintenance Event, LCY:	**14**	
Total Rock Borrow per Maintenance Event, BCY:	**34**	
Total Rock Borrow per Maintenance Event, LCY:	**40**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**17**	
Rock Ripping, BCY:	**17**	
Total Soil and Rock Borrow, BCY:	**43**	
Total Soil and Rock Borrow, LCY:	**54**	
Haul Distance, MI:	13	
Hauling - Borrow for Nonconventional Access-Alpine Locations, LCY:	**18**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Nonconventional Access-Subalpine Locations, LCY:	**18**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Conventional Access-Subalpine Locations, LCY:	**18**	*Assumes 1/3 of borrow materials*

CDM Smith

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	3/8/2018	DATE CHECKED:	3/12/2018
CLIENT:	USACE			WRKSHT NO.:	C2 Quantities

Description: Estimated quantites for mine portal pond sediment at mine locations.

Mine Portal Pond Sediment Quantities									
Site Category	Number of Mining-Related Sources Identified	Number of Ponds	Area of Ponds	Estimate of Depth of Sediment in Pond	Volume of Sediment	Volume of Sediment	Length of Moderate Road Improvements	Length of Minor Road Improvements	Number of Access Road Improvements
	EA	ea	sq ft	ft	cubic ft	cubic yd	ft	ft	EA
Nonconventional Access-Alpine	**1**	**5**	**8,400**	**4**	**33,600**	**1,244**	**3,100**	**-**	**1**
Conventional Access-Alpine	**0**	**0**	**0**	**-**	**0**	**0**	**-**	**0**	**0**
Nonconventional Access-Subalpine	**3**	**5**	**28,400**	**4**	**113,600**	**4,207**	**-**	**1,500**	**1**
Conventional Access-Subalpine	**4**	**4**	**32,000**	**4**	**128,000**	**4,741**	**200**	**-**	**1**
Total	**8**	**14**	**68,800**	**-**	**275,200**	**10,200**	**3,300**	**1,500**	**3**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources and number of ponds)

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

General Assumptions		
Estimated Sediment Density, LB/CY:	3,100	*Source: Caterpillar Performance Handbook, edition 3.1 (Assumes Sand - Wet)*
Estimated Sediment Density, TN/CY:	1.55	
Soil Bulking factor:	1.2	*Conversion from BCY to LCY*
Soil Compaction Factor:	0.9	*Conversion from BCY to ECY*
Soil Compaction Factor:	0.75	*Conversion from LCY to ECY*
Rock / Mine Waste Bulking factor:	1.2	*Conversion from BCY to LCY*
Rock / Mine Waste Compaction Factor:	1.08	*Conversion from BCY to ECY*
Rock / Mine Waste Compaction Factor:	0.9	*Conversion from LCY to ECY*
Density of Riprap, TN/CY:	1.5	*Means Handbook, Fig 2.5, Pg.47 (Granite, Loose)*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of Gravel, TN/CY:	1.39	*Means Handbook, Gravel, Dry*
Capital Costs		
Institutional Controls		
Project Manager, HR:	16	
Lawyer, HR:	32	
Paralegal, HR:	64	
Admin (Clerks, Typists), HR:	8	
Mobilization/Demobilization		
Nonconventional Access-Alpine Locations		
No. of Locations, EA:	1	*See C2 Quantities*
Mob/Demob - Small Equipment (Nonconventional Locations), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Locations), EA:	**0**	
Nonconventional Access-Subalpine Locations		
No. of Locations, EA:	3	*See C2 Quantities*
Mob/Demob - Small/Med Equipment (Nonconventional Locations), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Locations), EA:	**2**	
Conventional Access-Subalpine Locations		
No. of Locations, EA:	4	*See C2 Quantities*
Mob/Demob - Medium Equipment (Conventional Locations), EA:	**2**	
Mob/Demob - Between Prop. (Conventional Locations), EA:	**3**	

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Borrow Development/Access Roads		
Borrow Development		
Mobilization/Demoblization - Large Equipment, EA:	**2**	
Access Road Improvements		
Mob/Demob - Between Access Road Locations, EA:	3	*See C2 Quantities*
Mobilization/Demoblization - Medium Equipment, EA:	**3**	
Mob/Demob - Between Access Road Locations, EA:	**2**	
Pond Draining		
Nonconventional Access-Alpine Locations		
Total Ponds for Draining, EA:	5	*See C2 Quantities*
Total Area for Pond Draining, SF:	8,400	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	1	
Total Volume of Pond Water, CF:	8,400	
Total Volume of Pond Water, GAL:	**62,800**	
Nonconventional Access-Subalpine Locations		
Total Ponds for Draining, EA:	5	See C2 Quantities
Total Area for Pond Draining, SF:	28,400	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	1	
Total Volume of Pond Water, CF:	28,400	
Total Volume of Pond Water, GAL:	**212,400**	
Since one of the nonconventional access-subalpine location mine has only 1 pond, a berm will be constructed divert water while each side of the pond is drained.		
Top Berm Width, FT:	3	
Bottom Berm Width, FT:	5	
Berm Height, FT:	6	
Length of Berm, LF:	20	*Estimated from Google Earth*
Volume of Berm Material, ECF:	480	
Volume of Berm Material, ECY:	**18**	*Rounded up to the nearest whole number*
Conventional Access-Subalpine Locations		
Total Ponds for Draining, EA:	4	*See C2 Quantities*
Total Area for Pond Draining, SF:	32,000	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	1	
Total Volume of Pond Water, CF:	32,000	
Total Volume of Pond Water, GAL:	**239,400**	
Since two of the conventional access-subalpine location mine has only 1 pond, a berm will be constructed divert water while each side of the pond is drained.		
Top Berm Width, FT:	3	
Bottom Berm Width, FT:	5	
Berm Height, FT:	6	
Length of Berm, LF:	150	*Estimated from Google Earth*
Volume of Berm Material, ECF:	3600	
Volume of Berm Material, ECY:	**134**	*Rounded up to the nearest whole number*

CDM Smith	PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY : JN	CHECKED BY: EW		
	JOB NO.: 219758.6460.DK4.WAD3.043	DATE : 5/7/2018	DATE CHECKED: 5/8/2018		
	CLIENT: USACE		WRKSHT NO.: CALC-C2		

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Repair of Pond Berms		
Includes repair of existing berms at the ponds		
Assumed Berm Repair - Width, FT:	5	
Assumed Berm Repair - Height, FT:	2	
Assumed Length of Berm Repair - Per Pond, FT:	30	
Total Ponds (Nonconventional Access-Alpine), EA:	5	*See C2 Quantities*
Total Ponds (Nonconventional Access-Subalpine), EA:	5	*See C2 Quantities*
Total Ponds (Conventional Access-Subalpine), EA:	4	*See C2 Quantities*
Volume of Berm Material (Nonconventional Access-Alpine), ECY:	56	*Rounded up to the nearest whole number*
Volume of Berm Material (Nonconventional Access-Subalpine), ECY:	56	*Rounded up to the nearest whole number*
Volume of Berm Material (Total Nonconventional Access), ECY:	**112**	
Volume of Berm Material (Conventional Access), ECY:	**45**	*Rounded up to the nearest whole number*
Excavation of Sediment from Ponds		
Nonconventional Access-Alpine Locations		
Sediment Excavation Volume, BCY:	**1,244**	*See C2 Quantities*
Sediment Excavation Volume, LCY:	**1,500**	*Rounded to nearest tens*
Nonconventional Access-Subalpine Locations		
Sediment Excavation Volume, BCY:	**4,207**	*See C2 Quantities*
Sediment Excavation Volume, LCY:	**5,050**	*Rounded to nearest tens*
Conventional Access-Subalpine Locations		
Sediment Excavation Volume, BCY:	**4,741**	*See C2 Quantities*
Sediment Excavation Volume, LCY:	**5,690**	*Rounded to nearest tens*
Total Excavation of Sediment		
Total Sediment Excavation Volume, BCY:	10,192	
Total Sediment Excavation Volume, LCY:	12,240	
Geotechnical Characterization - Sampling Mine Portal Pond Sediment		
No. of Samples Required, EA/EA	1	
Frequency of Sampling, LCY/EA:	250	
Sediment Volume, LCY:	12,240	
Geotechnical Analysis, EA:	**49**	*Rounded up to the nearest whole number*
No. of Samples Collected per Hour, EA/HR:	1.5	
Travel Time Between Sampling Locations, HR/EA:	1.0	
Mobilizing between Sampling Locations, EA:	7	
Time Required for Field Engineer, HR:	**40**	*Rounded up to the nearest whole number*
Equipment, Supplies, and Shipping, per Sample, EA:	**49**	

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CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Placement and Dewatering of Sediment at Interim Storage Locations		
Movement of Mine Waste to Dewatering Area		
Short Haul (Nonconventional Access), LCY:	**6,550**	
Short Haul (Conventional Access), LCY:	**5,690**	
Diatomaceous Earth (D.E.) Amendment to Aid Dewatering		
Percentage of Sediment Amended, %:	10%	
Volume of Mine Waste Amended (Nonconventional Access), LCY:	660	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Conventional Access), LCY:	570	
Mine Waste Amended (Nonconventional Access), TN:	1,020	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Conventional Access), TN:	880	
D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Nonconventional Access), TN:	102	*Rounded to the nearest whole number*
Weight of D.E. (Conventional Access), TN:	88	
Total Weight of D.E., TN:	**190**	
Volume of D.E. (Nonconventional Access), LCY:	280	*Rounded to the nearest tens*
Volume of D.E. (Conventional Access), LCY:	240	
Mixing D.E. (Nonconventional Access), LCY:	**940**	*Includes volume of mine waste and diatomaceous earth*
Mixing D.E. (Conventional Access), LCY:	**810**	*Includes volume of mine waste and diatomaceous earth*
Movement of Mine Waste to Local Interim Management Areas		
Short Haul (Nonconventional Access), LCY:	**6,830**	
Short Haul (Conventional Access), LCY:	**5,930**	
Perimeter of Trapezoidal Berm		
Nonconventional Access-Alpine Locations		
Total Area for Nonconventional Access-Alpine Locations, SF:	8,400	*See C2 Quantities*
Side Length of Interim Storage Area, LF:	92	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	375	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	**1,124**	
Volume of Berm Material, ECF:	1,500	*Rounded to the nearest tens*
Volume of Berm Material, ECY:	**60**	*Rounded to the nearest tens*

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CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Nonconventional Access-Subalpine Locations		
Total Area for Nonconventional Access-Subalpine Locations, SF:	28,400	*See C2 Quantities*
Side Length of Interim Storage Area, LF:	169	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	684	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	**2,052**	
Volume of Berm Material, ECF:	2,740	*Rounded to the nearest tens*
Volume of Berm Material, ECY:	100	*Rounded to the nearest tens*
Volume of Berm Material (Nonconventional Access), ECY:	**160**	
Conventional Access-Subalpine Locations		
Total Area for Conventional Access-Subalpine Locations, SF:	32,000	*See C2 Quantities*
Side Length of Interim Storage Area, LF:	179	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	724	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	**2,172**	
Volume of Berm Material, ECF:	2,900	*Rounded to the nearest tens*
Volume of Berm Material, ECY:	**110**	*Rounded to the nearest tens*
Total Volume of Berm Material, ECY:	270	
Access Road Improvements		
Minor Improvements for Access Road		
Estimated Length of Road for Minor Improvements, LF:	**1,500**	*See C2 Quantities*
Assumed Width of Access Road, FT:	16	
Rough Grading, SF:	24,000	
Minor Road Improvements, LF:	1,500	
Moderate Improvements for Access Road		
Estimated Length of Road for Moderate Improvements, LF:	**3,300**	*See C2 Quantities*
Assumed Width of Access Road, FT:	16	
Assumed Depth of Gravel for Access Road, IN:	12	
Area for Clearing and Grubbing, AC:	**0.7**	*Assumes 50% of area will need to be cleared*
Rough Grading, SF:	52,800	

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Volume of Gravel for Access Roads, ECY:	1,956	
Volume of Gravel for Access Roads, LCY:	2,302	
Volume of Gravel for Access Roads, TON:	3,200	
Removal of Acess Road following Remedial Action		
Volume of Gravel for Access Roads, LCY:	**2,302**	
Volume of Gravel for Access Roads, BCY:	**1,956**	
Development of Borrow Materials		
Assumes gravel and soil borrow materials are developed onsite.		
Access Roads		
Gravel Borrow Volume Required, ECY:	1,960	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	**2,300**	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	2,050	*Rounded to the nearest tens*
Soil for Berm Material - Nonconventional Access-Alpine Location Mine Pond		
Borrow Soil, ECY:	60	*Rounded to the nearest tens*
Borrow Soil, LCY:	80	*Rounded to the nearest tens*
Borrow Soil, BCY:	70	*Rounded to the nearest tens*
Soil for Berm Material - Nonconventional Access-Subalpine Location Mine Pond		
Borrow Soil, ECY:	70	*Rounded to the nearest tens*
Borrow Soil, LCY:	90	*Rounded to the nearest tens*
Borrow Soil, BCY:	80	*Rounded to the nearest tens*
Soil for Berm Material - Conventional Access-Subalpine Location Mine Pond		
Borrow Soil, ECY:	180	*Rounded to the nearest tens*
Borrow Soil, LCY:	240	*Rounded to the nearest tens*
Borrow Soil, BCY:	200	*Rounded to the nearest tens*
Soil for Berm Material - Perimeter of Interim Material Storage		
Nonconventional Access-Alpine Locations		
Borrow Soil, ECY:	60	*Rounded to the nearest tens*
Borrow Soil, LCY:	80	*Rounded to the nearest tens*
Borrow Soil, BCY:	70	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Borrow Soil, ECY:	100	*Rounded to the nearest tens*
Borrow Soil, LCY:	130	*Rounded to the nearest tens*
Borrow Soil, BCY:	110	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Borrow Soil, ECY:	110	*Rounded to the nearest tens*
Borrow Soil, LCY:	150	*Rounded to the nearest tens*
Borrow Soil, BCY:	130	*Rounded to the nearest tens*
Total Quantities for Borrow		
Total Borrow Soil, BCY:	**660**	
Total Borrow Soil, LCY:	**770**	
Borrow Rock, BCY:	**2,050**	
Borrow Rock, LCY:	**2,300**	

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**1,025**	
Rock Ripping, BCY:	**1,025**	
Total Soil and Rock Borrow, BCY:	**2,710**	
Total Soil and Rock Borrow, LCY:	**3,070**	
Reclamation of Borrow Area		
Assumed Area for Borrow Reclamation, AC:	5	
Assumed Area for Borrow Reclamation, SF:	217,800	
Seed Mix, LB/AC:	20	
Grading, SF:	**217,800**	
Seeding, AC:	**5**	*Rounded up to the nearest whole number*
Seeding, LB:	**100**	
Erosion Control Blanket, SF:	217,800	
Erosion Control Blanket, SY:	**8,070**	*Rounded to the nearest tens*
Transportation of Borrow Materials		
Haul Distance, MI:	13	
Hauling - Rock Borrow for Access Roads, LCY:	**2,300**	
Hauling - Soil Borrow for Nonconventional Access-Alpine Locations, LCY:	**160**	
Hauling - Soil Borrow for Nonconventional Access-Subalpine Locations, LCY:	**220**	
Hauling - Soil Borrow for Conventional Access-Subalpine Locations, LCY:	**390**	
Total Borrow Material, LCY:	**3,070**	
Volume Transported per Truckload - Nonconventional Access-Alpine, LCY/EA:	5	
Volume Transported per Truckload - Nonconventional Access-Subalpine & Access Roads, LCY/EA:	8	
Volume Transported per Truckload - Conventional Access-Subalpine, LCY/EA:	16	
Total Amount of Truckloads, EA:	371	

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
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CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Dust Control		
Assumes water-based dust suppression during implementation of remedial work, including borrow development and access road improvements.		
Borrow Area Development		
Assumed Excavation Productivity (Borrow Materials), BCY/HR:	117.9	
Total Borrow Volume, BCY:	2,710	
Estimated Borrow Excavation Time, HR:	23	*Rounded up to nearest whole number*
Estimated Borrow Dust Control Time, HR:	23	*Assumes water truck on hand for all excavation*
Access Road Improvements		
Estimated Access Road Improvements Time, HR:	200	*Assumed*
Subtotal of Dust Control Time, HR:	223	
Additonal Time for Returning and Refilling Water Truck, %:	30%	*Assumed*
Total Dust Control Time, HR:	**290**	
Erosion Control and Reclamation of Areas Disturbed during Construction		
Erosion Control Installation		
No. of Mining-Related Sources, EA:	8	*See C2 Quantities*
Silt Fencing per Mining-Related Source, LF/EA:	300	*Assume 300 LF per mining-related source.*
Total Silt Fencing, LF:	**2,400**	*Rounded up to the nearest tens*
Crane Mats, EA:	**10**	*Assumed*
Reclamation of Nonconventional Access-Alpine Locations		
Seed Mix, LB/AC:	20	
Reclamation of Area per Alpine Location, SF:	1,000	
No. of Alpine Mining-Related Sources, EA:	1	*See C2 Quantities*
Seeding, AC:	1	*Rounded up to the nearest whole number*
Seeding, LB:	**20**	
Erosion Control Blanket, SF:	1,000	
Erosion Control Blanket, SY:	**40**	*Rounded to the nearest tens*
Annual O&M Costs		
Inspection of Remedial Components		
Total Days for Inspection, DY:	3	
Project Engineer, HR:	**24**	
Field Engineer, HR:	**24**	
Truck Rental, DY:	**3**	
Per Diem, DY:	**6**	*Assumes two inspectors*

CDM Smith

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-C2

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Surface Water Monitoring

Surface Water Monitoring Events per Year, EA/YR:	2	
Number of Crew Members per Crew, EA/EA:	3	
Number of Crews, EA:	1	
Assumed Samples Collected per Day (per Crew), EA/DY:	12	
Assumed Hours per Workday, HR/DY:	8	
Number of Mining-Related Sources for Monitoring, EA:	8	*Assumes all mining-related sources identified for this issue will require monitoring*
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	4	
Total Number of Sample Locations, EA:	32	
Estimated Sampling Hours per Monitoring Event, HR:	22	*Rounded up to nearest whole number*
Mobilization/Demobilization Time per Monitoring Event, HR:	8	*Assumes 4 hours each way*
Total Hours per Monitoring Event (per Crew Member), HR:	30	*Hours per crew member*
Total Days per Monitoring Event (per Crew Member), DY:	4	*Days per crew member, rounded up to nearest whole number*

Analysis

Sample Locations, EA:	32	
Assumed Duplicate Frequency, EA/EA:	10	*One duplicate per 10 samples*
Assumed Field Blank Frequency, EA/EA:	20	*One field blank per 20 samples*

	Per Event	Total (Per Year)	
Total Samples for Analysis, EA:	38	76	*Includes QC samples*
TAL Metals (Total), EA:	38	**76**	
TAL Metals (Dissolved), EA:	38	**76**	
Anions, EA:	76	**152**	*Chloride and Fluoride*
Sulfate, EA:	38	**76**	
Alkalinity, EA:	38	**76**	
Hardness, EA:	38	**76**	
Overnight Sample Shipment, EA:	10	**20**	*Assumes 4 samples per shipment, rounded up to whole number*

Equipment

	Per Event	Total (Per Year)	
Field Meter Rental, DY:	4	**8**	*1 field meter per sampling crew for each event*
Stream Gauge Rental, DY:	4	**8**	*1 stream gauge per sampling crew for each event*
Field Filters, EA:	38	**76**	
Miscellaneous Sampling Supplies, LS:	1	**2**	*Includes disposable gloves, ice, etc.*

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Labor			
	Per Event	Total (Per Year)	
Field Engineer, HR:	90	**180**	
Per Diem (Travel Days), DY:	6	**12**	
Per Diem (Full Days), DY:	6	**12**	
Truck Rental, DY:	4	**8**	*Assumes 1 truck per crew*
Reporting			
	Per Event	Total (Per Year)	
Project Manager, HR:	-	**16**	*Assumes 1 annual report summarizing all monitoring events in a given year*
Environmental Engineer, HR:	-	**60**	
Environmental Scientist, HR:	-	**20**	
CAD Drafter, HR:		**12**	
Admin Clerk, HR:	-	**8**	

Periodic O&M Costs

Post-Construction Maintenance

Interim Local Management Areas Maintenance

Maintenance Crew, DY:	3	
Maintenance Allowance for Local Interim Management Areas, LS:	1	

Periodic Mine Portal Pond Sediment Removal

Assumes periodic mine portal pond sediment would occur when ponds are 50% full

Nonconventional Access-Alpine Locations

Total Area for Pond Draining, SF:	8,400	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Assumed Sediment Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Pond Draining		
Total Volume of Pond Water, GAL:	**157,100**	*Rounded up to the nearest hundreds*
Sediment Excavation		
Sediment Excavation Volume, BCY:	**780**	*Rounded up to the nearest tens*
Sediment Excavation Volume, LCY:	940	*Rounded up to the nearest tens*
Placement and Dewatering of Sediment at Interim Storage Locations		
Short Haul (Nonconventional Access), LCY:	**940**	*Rounded up to the nearest tens*
Percentage of Sediment Amended, %:	10%	
Volume of Mine Waste Amended (Nonconventional Access), LCY:	90	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Nonconventional Access), TN:	140	*Rounded to the nearest tens*

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Nonconventional Access), TN:	14	*Rounded to the nearest whole number*
Total Weight of D.E., TN:	**14**	
Volume of D.E. (Nonconventional Access), LCY:	40	*Rounded to the nearest tens*
Mixing D.E. (Nonconventional Access), LCY:	**130**	*Includes volume of mine waste and diatomaceous earth*
Short Haul (Nonconventional Access), LCY:	**980**	
Material Spreading (Nonconventional Access), LCY:	**980**	*In Interim Local Management Areas*
Nonconventional Access-Subalpine Locations		
Total Area for Pond Draining, SF:	28,400	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Assumed Sediment Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Pond Draining		
Total Volume of Pond Water, GAL:	**531,100**	*Rounded up to the nearest hundreds*
Sediment Excavation		
Sediment Excavation Volume, BCY:	**2,630**	*Rounded up to the nearest tens*
Sediment Excavation Volume, LCY:	3,160	*Rounded up to the nearest tens*
Placement and Dewatering of Sediment at Interim Storage Locations		
Short Haul (Nonconventional Access), LCY:	**3,160**	*Rounded up to the nearest tens*
Percentage of Sediment Amended, %:	10%	
Volume of Mine Waste Amended (Nonconventional Access), LCY:	320	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Nonconventional Access), TN:	500	*Rounded to the nearest tens*
D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Nonconventional Access), TN:	50	*Rounded to the nearest whole number*
Total Weight of D.E., TN:	**50**	
Volume of D.E. (Nonconventional Access), LCY:	140	*Rounded to the nearest tens*

Description: Calculations and assumptions for the development of quantities for Alternative C2 - Excavation and Interim Local Waste Mangement cost estimate.

Mixing D.E. (Nonconventional Access), LCY:	**460**	*Includes volume of mine waste and diatomaceous earth*
Short Haul (Nonconventional Access), LCY:	**3,300**	
Material Spreading (Nonconventional Access), LCY:	**3,300**	*In Interim Local Management Areas*
Conventional Access-Subalpine Locations		
Total Area for Pond Draining, SF:	32,000	*See C2 Quantities, rounded up to the nearest hundreds*
Assumed Pond Water Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Assumed Sediment Depth, FT:	2.5	*Assumes removal when ponds are 50% full*
Pond Draining		
Total Volume of Pond Water, GAL:	**598,400**	*Rounded up to the nearest hundreds*
Sediment Excavation		
Sediment Excavation Volume, BCY:	**2,960**	*Rounded up to the nearest tens*
Sediment Excavation Volume, LCY:	3,560	*Rounded up to the nearest tens*
Placement and Dewatering of Sediment at Interim Storage Locations		
Short Haul (Conventional Access), LCY:	**3,560**	*Rounded up to the nearest tens*
Percentage of Sediment Amended, %:	10%	
Volume of Mine Waste Amended (Conventional Access), LCY:	360	
Volume of Mine Waste Amended (Conventional Access), TN:	560	
D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Conventional Access), TN:	56	
Total Weight of D.E., TN:	**56**	
Volume of D.E. (Conventional Access), LCY:	160	
Mixing D.E. (Conventional Access), LCY:	**520**	*Includes volume of mine waste and diatomaceous earth*
Short Haul (Conventional Access), LCY:	**3,720**	
Material Spreading (Conventional Access), LCY:	**3,720**	*In Interim Local Management Areas*

CDM Smith

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	3/8/2018	DATE CHECKED:	3/12/2018
CLIENT:	USACE			WRKSHT NO.:	D2 Quantities

Description: Estimated quantites for in-stream mine waste

In-Stream Mine Waste Quantities

Site Category	Number of Mining-Related Sources Identified	Area of Impacted Solid Media	Depth of Impacted Solid Media	Volume of Impacted Solid Media	Volume of Impacted Solid Media	Length of Moderate Road Improvements	Length of Minor Road Improvements	Number of Access Road Improvements
	EA	sq ft	ft	cubic ft	cubic yd	ft	ft	EA
Nonconventional Access-Alpine	**2**	**8,900**	**3**	**26,700**	**989**	**-**	**900**	**2**
Conventional Access-Alpine	**0**	**0**	**-**	**0**	**0**	**-**	**-**	**0**
Nonconventional Access-Subalpine	**0**	**0**	**-**	**0**	**0**	**-**	**-**	**0**
Conventional Access-Subalpine	**0**	**0**		**0**	**0**	**-**	**-**	**0**
Total	**2**	**8,900**	**-**	**26,700**	**990**	**0**	**900**	**2**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources)

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-D2

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

General Assumptions		
Estimated Sediment Density, LB/CY:	3,100	*Source: Caterpillar Performance Handbook, edition 3.1 (Assumes Sand - Wet)*
Estimated Sediment Density, TN/CY:	1.55	
Soil Bulking factor:	1.2	*Conversion from BCY to LCY*
Soil Compaction Factor:	0.9	*Conversion from BCY to ECY*
Soil Compaction Factor:	0.75	*Conversion from LCY to ECY*
Rock / Mine Waste Bulking factor:	1.2	*Conversion from BCY to LCY*
Rock / Mine Waste Compaction Factor:	1.08	*Conversion from BCY to ECY*
Rock / Mine Waste Compaction Factor:	0.9	*Conversion from LCY to ECY*
Density of Riprap, TN/CY:	1.5	*Means Handbook, Fig 2.5, Pg.47 (Granite, Loose)*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of Gravel, TN/CY:	1.39	*Means Handbook, Gravel, Dry*
Capital Costs		
Institutional Controls		
Project Manager, HR:	16	
Lawyer, HR:	32	
Paralegal, HR:	64	
Admin (Clerks, Typists), HR:	8	
Mobilization/Demobilization		
Nonconventional Access-Alpine Locations		
No. of Locations, EA:	2	*See D2 Quantities*
Mob/Demob - Small Equipment (Nonconventional Access), EA:	**2**	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**1**	
Nonconventional Access-Subalpine Locations		
No. of Locations, EA:	0	
Mob/Demob - Small/Med Equipment (Nonconventional Access), EA:	2	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**0**	
Conventional Access-Subalpine Locations		
No. of Locations, EA:	0	
Mob/Demob - Medium Equipment (Conventional Access), EA:	2	
Mob/Demob - Between Prop. (Conventional Access), EA:	**0**	

CDM Smith	PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY : JN	CHECKED BY: EW
	JOB NO.: 219758.6460.DK4.WAD3.043	DATE : 5/7/2018	DATE CHECKED: 5/8/2018
	CLIENT: USACE		WRKSHT NO.: CALC-D2

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Borrow Development/Access Roads		
Borrow Development		
Mobilization/Demoblization - Large Equipment, EA:	**2**	
Access Road Improvements		
No. of Access Road Improvements, EA:	2	*See D2 Quantities*
Mobilization/Demoblization - Medium Equipment, EA:	**3**	
Mob/Demob - Between Access Road Locations, EA:	**1**	
Excavation of Mine Waste from Stream Location		
Nonconventional Access-Alpine Locations		
Mine Waste Excavation Volume, BCY:	**989**	*See D2 Quantities*
Mine Waste Excavation Volume, LCY:	**1,190**	*Rounded to nearest tens*
Nonconventional Access-Subalpine Locations		
Mine Waste Excavation Volume, BCY:	**0**	*See D2 Quantities*
Mine Waste Excavation Volume, LCY:	**0**	*Rounded to nearest tens*
Conventional Access-Subalpine Locations		
Mine Waste Excavation Volume, BCY:	**0**	*See D2 Quantities*
Mine Waste Excavation Volume, LCY:	**0**	*Rounded to nearest tens*
Total Excavation of Mine Waste		
Total Mine Waste Excavation Volume, BCY:	989	
Total Mine Waste Excavation Volume, LCY:	1,190	
Geotechnical Characterization - Sampling In-Stream Mine Waste		
No. of Samples Required, EA/EA	1	
Frequency of Sampling, LCY/EA:	250	
Mine Waste Volume, LCY:	1,190	
Geotechnical Analysis, EA:	**5**	*Rounded up to the nearest whole number*
No. of Samples Collected per Hour, EA/HR:	1.5	
Travel Time Between Sampling Locations, HR/EA:	1.0	
Mobilizing between Sampling Locations, EA:	1	
Time Required for Field Engineer, HR:	**5**	*Rounded up to the nearest whole number*
Equipment, Supplies, and Shipping, per Sample, EA:	**5**	
Placement of Mine Waste at Interim Storage Locations		
Movement of Mine Waste to Dewatering Area		
Short Haul to Dewatering Area (Nonconventional Access), LCY:	**1,190**	
Short Haul to Dewatering Area (Conventional Access), LCY:	**0**	

CDM Smith

PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY : JN	CHECKED BY: EW	
JOB NO.: 219758.6460.DK4.WAD3.043	DATE : 5/7/2018	DATE CHECKED: 5/8/2018	
CLIENT: USACE		WRKSHT NO.: CALC-D2	

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Diatomaceous Earth (D.E.) Amendment to Aid Dewatering		
Percentage of Mine Waste Amended, %:	10%	
Volume of Mine Waste Amended (Nonconventional Access), LCY:	120	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Conventional Access), LCY:	0	
Volume of Mine Waste Amended (Nonconventional Access), TN:	190	*Rounded to the nearest tens*
Volume of Mine Waste Amended (Conventional Access), TN:	0	
D.E. Density, LB/CF:	27	*Source: EP Minerals LLC*
D.E. Density, TON/CY:	0.36	
Assumed D.E. Amendment Rate, %:	10%	*Based on amendment rate from recent project*
Weight of D.E. (Nonconventional Access), TN:	19	*Rounded to the nearest whole number*
Weight of D.E. (Conventional Access), TN:	0	
Total Weight of D.E., TN:	**19**	
Volume of D.E. (Nonconventional Access), LCY:	50	*Rounded to the nearest tens*
Volume of D.E. (Conventional Access), LCY:	0	
Mixing D.E. (Nonconventional Access), LCY:	**170**	*Includes volume of mine waste and diatomaceous earth*
Mixing D.E. (Conventional Access), LCY:	**0**	*Includes volume of mine waste and diatomaceous earth*
Movement of Mine Waste to Local Interim Management Areas		
Short Haul (Nonconventional Access), LCY:	**1,240**	
Short Haul (Conventional Access), LCY:	**0**	
Perimeter of Trapezoidal Berm		
Nonconventional Access-Alpine Locations		
Area of Mine Waste, SF:	8,900	*See D2 Quantities*
Side Length of Interim Storage Area, LF:	94	*Assume square storage piles*
Area of Grand Mogul Mine, SF:	0	*See D2 Quantities*
Side Length of Interim Storage Area, LF:	0	*Assume square storage piles*
Top Berm Width, FT:	1	
Bottom Berm Width, FT:	3	
Berm Height, FT:	2	
Combined Perimeter of Interim Storage Areas, LF:	393	*Assume additional 1 ft beyond base of storage pile*
Grading, SF:	**1,180**	
Volume of Berm Material, ECF:	1,573	
Volume of Berm Material, ECY:	**58**	

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Access Road Improvements		
Minor Improvements for Access Roads		
Estimated Length of Road for Minor Improvements, LF:	**900**	*See D2 Quantities*
Assumed Width of Access Road, FT:	16	
Rough Grading, SF:	14,400	
Minor Road Improvements, LF:	900	
Moderate Improvements for Access Roads		
Estimated Length of Road for Moderate Improvements, LF:	**0**	*See D2 Quantities*
Assumed Width of Access Road, FT:	16	
Assumed Depth of Gravel for Access Road, IN:	12	
Area for Clearing and Grubbing, AC:	**0.0**	*Assumes 50% of area will need to be cleared*
Rough Grading, SF:	0	
Volume of Gravel for Access Roads, ECY:	0	
Volume of Gravel for Access Roads, LCY:	0	
Volume of Gravel for Access Roads, TON:	0	
Removal of Acess Road following Remedial Action		
Volume of Gravel for Access Roads, LCY:	0	
Volume of Gravel for Access Roads, BCY:	**0**	
Development of Borrow Materials		
Assumes gravel and soil borrow materials are developed onsite.		
Access Roads		
Gravel Borrow Volume Required, ECY:	0	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	**0**	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	0	*Rounded to the nearest tens*
Soil for Berm Material - Perimeter of Interim Material Storage		
Nonconventional Access-Alpine Locations		
Borrow Soil, ECY:	60	*Rounded to the nearest tens*
Borrow Soil, LCY:	80	*Rounded to the nearest tens*
Borrow Soil, BCY:	70	*Rounded to the nearest tens*
Rock for Minimal Stream Rehabilitation		
Nonconventional Access-Alpine Locations		
Borrow Rock, ECY:	110	*Rounded to the nearest tens*
Borrow Rock, LCY:	130	*Rounded to the nearest tens*
Borrow Rock, BCY:	110	*Rounded to the nearest tens*

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-D2

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Total Quantities for Borrow		
Borrow Soil, BCY:	**70**	
Borrow Soil, LCY:	**80**	
Borrow Rock, BCY:	**110**	
Borrow Rock, LCY:	**130**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**55**	
Rock Ripping, BCY:	**55**	
Total Soil and Rock Borrow, BCY:	**180**	
Total Soil and Rock Borrow, LCY:	**210**	
Reclamation of Borrow Area		
Assumed Area for Borrow Reclamation, AC:	0.5	
Assumed Area for Borrow Reclamation, SF:	21,780	
Seed Mix, LB/AC:	20	
Grading, SF:	**21,780**	
Seeding, AC:	**0.5**	
Seeding, LB:	**10**	
Erosion Control Blanket, SF:	21,780	
Erosion Control Blanket, SY:	**810**	*Rounded to the nearest tens*
Transportation of Borrow Materials		
Haul Distance, MI:	13	
Hauling - Total Borrow for Access Roads, LCY:	**130**	
Hauling - Total Borrow for Nonconventional Access-Alpine Locations, LCY:	**210**	
Total Borrow Volume, LCY:	**340**	
Volume Transported per Truckload - Nonconventional Access-Alpine, LCY/EA:	5	
Volume Transported per Truckload - Access Roads, LCY/EA:	8	
Total Amount of Truckloads, EA:	58	

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
CLIENT:	USACE			WRKSHT NO.:	CALC-D2

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Dust Control		
Assumes water-based dust suppression during implementation of remedial work, including borrow development and access road improvements.		
Borrow Area Development		
Assumed Excavation Productivity (Borrow Materials), BCY/HR:	117.9	
Total Borrow Volume, BCY:	180	
Estimated Borrow Excavation Time, HR:	2	*Rounded up to nearest whole number*
Estimated Borrow Dust Control Time, HR:	2	*Assumes water truck on hand for all excavation*
Access Road Improvements		
Estimated Access Road Improvements Time, HR:	200	*Assumed*
Subtotal of Dust Control Time, HR:	200	
Additonal Time for Returning and Refilling Water Truck, %:	30%	*Assumed*
Total Dust Control Time, HR:	**260**	
Erosion Control and Reclamation of Areas Disturbed during Construction		
Erosion Control Installation		
No. of Mining-Related Sources, EA:	2	*See D2 Quantities*
Silt Fencing per Mining-Related Source, LF/EA:	300	*Assume 300 LF per mining-related source.*
Total Silt Fencing, LF:	**600**	*Rounded up to the nearest tens*
Crane Mats, EA:	**10**	*Assumed*
Minimal Stream Rehabilitation		
No. of Mining-Related Sources, EA:	2	*See D2 Quantities*
Stream Rehab per Mining-Related Source, SF/EA:	1,500	*Assume 300 LF per mining-related source.*
Assumed Rock Depth for Stream Rehab, IN:	12	
Grading, SF:	**3,000**	
Rock Placement, ECY:	112	*Rounded up to the nearest whole number*
Rock Placement, LCY:	**125**	*Rounded up to the nearest whole number*
Reclamation of Nonconventional Access-Alpine Locations		
Seed Mix, LB/AC:	20	
Reclamation of Area per Alpine Location, SF:	1,000	
No. of Alpine Mining-Related Sources, EA:	2	*See D2 Quantities*
Seeding, AC:	1	*Rounded up to the nearest whole number*
Seeding, LB:	**20**	
Erosion Control Blanket, SF:	2,000	
Erosion Control Blanket, SY:	**80**	*Rounded to the nearest tens*

CDM Smith	PROJECT: Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
	JOB NO.: 219758.6460.DK4.WAD3.043	DATE :	5/7/2018	DATE CHECKED:	5/8/2018
	CLIENT: USACE			WRKSHT NO.:	CALC-D2

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

Annual O&M Costs

Inspection of Remedial Components

Total Days for Inspection, DY:	2	
Total Hours for Inspection, HR:	16	
Project Engineer, HR:	**16**	
Field Engineer, HR:	**16**	
Truck Rental, DY:	**2**	
Per Diem, DY:	**4**	*Assumes two inspectors*

Surface Water Monitoring

Surface Water Monitoring Events per Year, EA/YR:	2	
Number of Crew Members per Crew, EA/EA:	3	
Number of Crews, EA:	1	
Assumed Samples Collected per Day (per Crew), EA/DY:	12	
Assumed Hours per Workday, HR/DY:	8	
Number of Mining-Related Sources for Monitoring, EA:	2	*Assumes all mining-related sources identified for this issue will require monitoring*
Assumed Number of Surface Water Samples per Mining-Related Source, EA/EA:	3	
Total Number of Sample Locations, EA:	6	
Estimated Sampling Hours per Monitoring Event, HR:	4	*Rounded up to nearest whole number*
Mobilization/Demobilization Time per Monitoring Event, HR:	8	*Assumes 4 hours each way*
Total Hours per Monitoring Event (per Crew Member), HR:	12	*Hours per crew member*
Total Days per Monitoring Event (per Crew Member), DY:	2	*Days per crew member, rounded up to nearest whole number*

Analysis

Sample Locations, EA:	6	
Assumed Duplicate Frequency, EA/EA:	10	*One duplicate per 10 samples*
Assumed Field Blank Frequency, EA/EA:	20	*One field blank per 20 samples*

Description: Calculations and assumptions for the development of quantities for Alternative D2 - Excavation of In-Stream Mine Wastes and Interim Local Waste Management cost estimate.

	Per Event	Total (Per Year)	
Total Samples for Analysis, EA:	8	16	*Includes QC samples*
TAL Metals (Total), EA:	8	**16**	
TAL Metals (Dissolved), EA:	8	**16**	
Anions, EA:	16	**32**	*Chloride and Fluoride*
Sulfate, EA:	8	**16**	
Alkalinity, EA:	8	**16**	
Hardness, EA:	8	**16**	
Overnight Sample Shipment, EA:	2	**4**	*Assumes 4 samples per shipment, rounded up to whole number*
Equipment			
	Per Event	Total (Per Year)	
Field Meter Rental, DY:	2	**4**	*1 field meter per sampling crew for each event*
Stream Gauge Rental, DY:	2	**4**	*1 stream gauge per sampling crew for each event*
Field Filters, EA:	8	**16**	
Miscellaneous Sampling Supplies, LS:	1	**2**	*Includes disposable gloves, ice, etc.*
Labor			
	Per Event	Total (Per Year)	
Field Engineer, HR:	36	**72**	
Per Diem (Travel Days), DY:	6	**12**	
Per Diem (Full Days), DY:	0	**0**	
Truck Rental, DY:	2	**4**	*Assumes 1 truck per crew*
Reporting			
	Per Event	Total (Per Year)	
Project Manager, HR:	-	**8**	*Assumes 1 annual report summarizing all monitoring events in a given year*
Environmental Engineer, HR:	-	**24**	
Environmental Scientist, HR:	-	**10**	
CAD Drafter, HR:		**6**	
Admin Clerk, HR:	-	**8**	

Periodic O&M Costs

Post-Construction Maintenance

Interim Local Management Areas Maintenance

Maintenance Crew, DY:	2
Maintenance Allowance for Local Interim Management Areas, LS:	1

CDM Smith

PROJECT:	Bonita Peak Mining District Superfund Site	COMPUTED BY :	JN	CHECKED BY:	EW
JOB NO.:	219758.6460.DK4.WAD3.043	DATE :	3/8/2018	DATE CHECKED:	3/12/2018
CLIENT:	USACE			WRKSHT NO.:	E2 Quantities

Description: Estimated quantites for mining-impacted recreation staging areas

Mining-Impacted Recreation Staging Areas Quantities

Site Category	Number of Mining-Related Sources Identified	Area of Impacted Solid Media	Depth of Impacted Solid Media	Volume of Impacted Solid Media	Volume of Impacted Solid Media	Length of Moderate Road Improvements	Length of Minor Road Improvements	Number of Access Road Improvements
	ea	sq ft	ft	cubic ft	cubic yd	ft	ft	EA
Nonconventional Access-Alpine	**0**	**0**	**-**	**0**	**0**	**-**	**-**	**0**
Conventional Access-Alpine	**0**	**0**	**-**	**0**	**0**	**-**	**-**	**0**
Nonconventional Access-Subalpine	**1**	**58,000**	**2**	**116,000**	**4,300**	**-**	**-**	**0**
Conventional Access-Subalpine	**4**	**329,000**	**2**	**658,000**	**25,300**	**-**	**-**	**0**
Total	**5**	**387,000**	**-**	**774,000**	**29,600**	**0**	**0**	**0**

Note:
All quantities in the 'Total' row are rounded up to nearest tens (except number of mining-related sources)

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

General Assumptions		
Estimated Sediment Density, LB/CY:	3,100	*Source: Caterpillar Performance Handbook, edition 3.1 (Assumes Sand - Wet)*
Estimated Sediment Density, TN/CY:	1.55	
Soil Bulking factor:	1.2	*Conversion from BCY to LCY*
Soil Compaction Factor:	0.9	*Conversion from BCY to ECY*
Soil Compaction Factor:	0.75	*Conversion from LCY to ECY*
Rock / Mine Waste Bulking factor:	1.2	*Conversion from BCY to LCY*
Rock / Mine Waste Compaction Factor:	1.08	*Conversion from BCY to ECY*
Rock / Mine Waste Compaction Factor:	0.9	*Conversion from LCY to ECY*
Density of Riprap, TN/CY:	1.5	*Means Handbook, Fig 2.5, Pg.47 (Granite, Loose)*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of Gravel, TN/CY:	1.39	*Means Handbook, Gravel, Dry*
Capital Costs		
Institutional Controls		
Project Manager, HR:	16	
Lawyer, HR:	32	
Paralegal, HR:	64	
Admin (Clerks, Typists), HR:	8	
Mobilization/Demobilization		
Nonconventional Access-Alpine Locations		
No. of Nonconventional Access-Alpine Locations, EA:	0	
Mob/Demob - Small Equipment (Nonconventional Access), EA:	0	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**0**	
Nonconventional Access-Subalpine Locations		
No. of Nonconventional Access-Subalpine Locations, EA:	1	*See E2 Quantities*
Mob/Demob - Small/Med Equipment (Nonconventional Access), EA:	**3**	
Mob/Demob - Between Prop. (Nonconventional Access), EA:	**0**	
Conventional Access-Subalpine Locations		
No. of Conventional Access-Subalpine Locations, EA:	4	*See E2 Quantities*
Mob/Demob - Medium Equipment (Conventional Access), EA:	**3**	
Mob/Demob - Between Prop. (Conventional Access), EA:	**3**	

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Borrow Development

Mobilization/Demoblization - Large Equipment, EA: **2**

In Place Cover of Mine Waste

Assumes an 18" cover consisting of either a gravel cap or an earthen cap of subsoil and growth media.

Gravel Cover

Assumed Gravel Depth for Cover, IN: 18

Soil Cover (Subsoil and Growth Media)

Assumed Subsoil Depth for Cover, IN: 12

Assumed Surface Layer Depth for Cover, IN: 6

Breakdown of Cover Assumptions

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	
Assumed Percentage of Covers addressed with Gravel Covers, %:	NA	10%	25%	*Assumed for high traffic areas or near riverbanks*
Assumed Percentage of Covers addressed with Soil Covers, %:	NA	90%	75%	*Assumed for low traffic areas*
Estimated Total Cover Area, SF:	0	58,000	329,000	*See E2 Quantities*
Estimated Area for Gravel Cover, SF:	0	5,800	82,300	*Rounded to hundreds*
Estimated Area for Soil Cover, SF:	0	52,200	246,800	*Rounded to hundreds*

Placement of Gravel Covers

Grading

Assumes grading of existing mine waste prior to cover placement

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total
Grading, SF:	0	5,800	82,300	88,100

Placement of Gravel

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total	
Gravel Cover Volume, ECY:	0	330	4,580	4,910	*Rounded to tens*
Gravel Cover Volume, LCY:	0	400	5,400	5,800	*Rounded to tens*

Placement of Soil Covers

Grading

Assumes grading of existing mine waste prior to cover placement

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total
Grading, SF:	0	52,200	246,800	299,000

Placement of Soil

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total	
Subsoil Cover Volume, ECY:	0	1,940	9,150	11,090	*Rounded to tens*
Subsoil Cover Volume, LCY:	0	2,600	12,200	14,800	*Rounded to tens*

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Growth Media Cover Volume, ECY:	0	970	4,580	5,550	*Rounded to tens*
Growth Media Cover Volume, LCY:	0	1,300	6,200	7,500	*Rounded to tens*
Total Soil Placement, ECY:	0	2,910	13,730	16,640	*Rounded to tens*
Total Soil Placement, LCY:	0	3,900	18,400	22,300	*Rounded to tens*
Total Soil Compaction, ECY:	0	1,940	9,150	11,090	*Assumes compaction of subsoil only*
Total Soil Compaction, LCY:	0	2,600	12,200	14,800	

Lime and Organic Material for Surface Amendment

Assumes lime and organic amendment for all areas with growth media as the surface layer.

Lime for Parent Surface Amendment, TON/AC-FT:	40
Lime for Parent Surface Amendment, TON/LCY:	0.025
Compost for Growth Media Amendment, TON/AC-FT:	40
Compost for Growth Media Amendment, TON/LCY:	0.025
Compost Density, TON/CY:	0.5

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total	
Estimated Extent of Soil Covers, SF:	0	52,200	246,800	299,000	
Estimated Extent of Soil Covers, AC:	0.0	1.2	5.7	6.9	*Rounded to tenths*
Growth Media Volume, ECY:	0	970	4,580	5,550	
Growth Media Volume, LCY:	0	1,300	6,200	7,500	
Lime Amendment, AC:	0.0	1.2	5.7	6.9	
Lime Amendment, TON:	0	33	155	188	
Compost Amendment, AC:	0.0	1.2	5.7	6.9	
Compost Amendment, TON:	0	33	155	188	
Compost Amendment, CY:	0	66	310	376	

Revegetation

Assumes seeding of soil covers with growth media as the surface layer

Seed Mix, LB/AC:	20
Hydromulch, LB/AC:	3,000
Fertilizer, LB/AC:	135

	Nonconventional Access-Alpine	Nonconventional Access-Subalpine	Conconventional Access-Subalpine	Total
Seeding, AC:	0.0	1.2	5.7	6.9
Seed Mix, LB:	0	24	114	138
Hydromulch, LB:	0	3,600	17,100	20,700
Fertilizer, LB:	0	162	770	932

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Development of Borrow Materials

Assumes gravel and soil borrow materials are developed onsite.

Gravel for Gravel Cover

Nonconventional Access-Alpine Locations		
Gravel Borrow Volume Required, ECY:	0	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	0	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	0	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Gravel Borrow Volume Required, ECY:	330	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	400	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	360	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Gravel Borrow Volume Required, ECY:	4,580	*Rounded to the nearest tens*
Gravel Borrow Volume Required, LCY:	5,400	*Rounded to the nearest tens*
Gravel Borrow Volume Required, BCY:	4,820	*Rounded to the nearest tens*

Soil for Soil Covers

Nonconventional Access-Alpine Locations		
Borrow Soil, ECY:	0	*Rounded to the nearest tens*
Borrow Soil, LCY:	0	*Rounded to the nearest tens*
Borrow Soil, BCY:	0	*Rounded to the nearest tens*
Nonconventional Access-Subalpine Locations		
Borrow Soil, ECY:	2,910	*Rounded to the nearest tens*
Borrow Soil, LCY:	3,900	*Rounded to the nearest tens*
Borrow Soil, BCY:	3,250	*Rounded to the nearest tens*
Conventional Access-Subalpine Locations		
Borrow Soil, ECY:	9,150	*Rounded to the nearest tens*
Borrow Soil, LCY:	12,200	*Rounded to the nearest tens*
Borrow Soil, BCY:	10,170	*Rounded to the nearest tens*

Total Quantities for Borrow

Borrow Soil, BCY:	**13,420**	
Borrow Soil, LCY:	**16,100**	
Borrow Rock, BCY:	**5,180**	
Borrow Rock, LCY:	**5,800**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**2,590**	
Rock Ripping, BCY:	**2,590**	
Total Soil and Rock Borrow, BCY:	**18,600**	
Total Soil and Rock Borrow, LCY:	**21,900**	

Reclamation of Borrow Area

Assumed Area for Borrow Reclamation, AC:	10
Assumed Area for Borrow Reclamation, SF:	435,600

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Seed Mix, LB/AC:	20	
Grading, SF:	**435,600**	
Seeding, AC:	**10**	*Rounded up to the nearest whole number*
Seeding, LB:	**200**	
Erosion Control Blanket, SF:	435,600	
Erosion Control Blanket, SY:	**16,140**	*Rounded to the nearest tens*
Transportation of Borrow Materials		
Haul Distance, MI:	13	
Hauling - Total Borrow for Access Roads, LCY:	**0**	
Hauling - Total Borrow for Nonconventional Access-Alpine Locations, LCY:	**0**	
Hauling - Total Borrow for Nonconventional Access-Subalpine Locations, LCY:	**4,300**	
Hauling - Total Borrow for Conventional Access-Subalpine Locations, LCY:	**17,600**	
Total Borrow Material, LCY:	**21,900**	
Volume Transported per Truckload - Nonconventional Access-Alpine, LCY/EA:	5	
Volume Transported per Truckload - Nonconventional Access-Subalpine & Access Roads, LCY/EA:	8	
Volume Transported per Truckload - Conventional Access-Subalpine, LCY/EA:	16	
Total Amount of Truckloads, EA:	1,638	
Dust Control		
Assumes water-based dust suppression during implementation of remedial work, including borrow development and access road improvements.		
Borrow Area Development		
Assumed Excavation Productivity (Borrow Materials), BCY/HR:	117.9	
Total Borrow Volume, BCY:	18,600	
Estimated Borrow Excavation Time, HR:	158	*Rounded up to nearest whole number*
Estimated Borrow Dust Control Time, HR:	158	*Assumes water truck on hand for all excavation*
Access Road Improvements		
Estimated Access Road Improvements Time, HR:	200	*Assumed*
Subtotal of Dust Control Time, HR:	358	
Additonal Time for Returning and Refilling Water Truck, %:	30%	*Assumed*
Total Dust Control Time, HR:	**466**	

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Erosion Control and Reclamation of Areas Disturbed during Construction		
Erosion Control Installation		
No. of Mining-Related Sources, EA:	5	*See E2 Quantities*
Silt Fencing per Mining-Related Source, LF/EA:	300	*Assume 300 LF per mining-related source.*
Total Silt Fencing, LF:	**1,500**	*Rounded up to the nearest tens*
Crane Mats, EA:	**10**	*Assumed*
Annual O&M Costs		
Inspection of Remedial Components		
Total Days for Inspection, DY:	4	
Project Engineer, HR:	**32**	
Field Engineer, HR:	**32**	
Truck Rental, DY:	**4**	
Per Diem, DY:	**8**	*Assumes two inspectors*
Periodic O&M Costs		
Post-Construction Maintenance		
Cover Maintenance		
Percentage of Gravel for Covers to be Replaced, %:	5%	
Percentage of Soil for Covers to be Replaced, %:	5%	
Percentage of Seeding for Covers to be Replaced, %:	10%	
Mob/Demob - Small Equipment, EA:	**2**	
Maintenance Crew, DY:	4	
Gravel for Cover Maintenance		
Gravel Placed During Initial Installation, LCY:	5,800	
Gravel Volume Placement per Maintenance Event, LCY:	290	*Rounded up to nearest whole number*
Gravel Volume Placement per Maintenance Event, BCY:	260	*Rounded up to nearest whole number*
Soil for Cover Maintenance		
Soil Placed During Initial Installation, ECY:	16,640	

Description: Calculations and assumptions for the development of quantities for Alternative E2 - Containment/Isolation cost estimate.

Soil Volume Placement per Maintenance Event, ECY:	840	*Rounded up to nearest whole number*
Soil Volume Placement per Maintenance Event, LCY:	1,120	
Soil Volume Placement per Maintenance Event, BCY:	700	*Rounded up to nearest whole number*
Borrow Development and Transportation for Maintenance		
Total Soil Borrow per Maintenance Event, BCY:	**700**	
Total Soil Borrow per Maintenance Event, LCY:	**1,120**	
Total Rock Borrow per Maintenance Event, BCY:	**260**	
Total Rock Borrow per Maintenance Event, LCY:	**290**	
Rock Borrow by Quarrying, %:	50%	*Assumed*
Rock Borrow by Ripping, %:	50%	*Assumed*
Rock Quarrying, BCY:	**130**	
Rock Ripping, BCY:	**130**	
Total Soil and Rock Borrow, BCY:	**960**	
Total Soil and Rock Borrow, LCY:	**1,410**	
Haul Distance, MI:	13	
Hauling - Borrow for Nonconventional Access-Alpine Locations, LCY:	**470**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Nonconventional Access-Subalpine Locations, LCY:	**470**	*Assumes 1/3 of borrow materials*
Hauling - Borrow for Conventional Access-Subalpine Locations, LCY:	**470**	*Assumes 1/3 of borrow materials*
Seeding for Cover Maintenance		
Seeding During Initial Installation, AC:	6.9	
Seed Mix During Initial Installation, LB:	138	
Seeding per Maintenance Event, AC:	1	*Rounded up to nearest whole number*
Seed Mix per Maintenance Event, LB:	14	*Rounded up to nearest whole number*

Cost Estimate Backup

TABLE PV-ADRFT

PRESENT VALUE ANALYSIS

Annual Discount Rate Factors Table

Site: Bonita Peak Mining District Superfund Site
Location: San Juan County, Colorado
Phase: Focused Feasibility Study
Base Year: 2018

Discount Rate (Percent): 7.0

Year	Discount Factor[1,2]	Year	Discount Factor[1,2]
0	1.0000	26	0.1722
1	0.9346	27	0.1609
2	0.8734	28	0.1504
3	0.8163	29	0.1406
4	0.7629	30	0.1314
5	0.7130	31	0.1228
6	0.6663	32	0.1147
7	0.6227	33	0.1072
8	0.5820	34	0.1002
9	0.5439	35	0.0937
10	0.5083		
11	0.4751		
12	0.4440		
13	0.4150		
14	0.3878		
15	0.3624		
16	0.3387		
17	0.3166		
18	0.2959		
19	0.2765		
20	0.2584		
21	0.2415		
22	0.2257		
23	0.2109		
24	0.1971		
25	0.1842		

Notes:

1 Annual discount factors were calculated using the formulas and guidance presented in Section 4.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

2 The real discount rate of 7.0% was obtained from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, Page 4-5.

COST INDICES FOR ESCALATION

Base Year for Work: **2018**

Year	Cost Index[1]
2000	497.07
2001	503.52
2002	517.46
2003	529.95
2004	571.29
2005	608.36
2006	641.91
2007	673.52
2008	716.54
2009	703.00
2010	724.17
2011	756.48
2012	773.75
2013	787.64
2014	804.05
2015	804.97
2016	810.92
2017	833.78
2018	852.98
2019	870.04
2020	887.44
2021	905.19
2022	923.29
2023	941.76
2024	960.59
2025	979.80

1 Yearly composite cost index (weighted average) from the U.S. Army Corps of Engineers Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304, 31 March 2017. Revised as of 30 Sept 2017.

FLC Data Center

Base Year: 2018

COST CODES FOR LABOR AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
L1	Admin (Clerks, Typists)	HR	$17.32	$0.00	$0.00	$0.00	2018	1	1	$17.32	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L2	Engineers, Civil	HR	$36.54	$0.00	$0.00	$0.00	2018	1	1	$36.54	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L3	Engineers, Project	HR	$42.06	$0.00	$0.00	$0.00	2018	1	1	$42.06	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L4	Environmental Engineer	HR	$36.33	$0.00	$0.00	$0.00	2018	1	1	$36.33	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L5	CAD Drafter	HR	$25.25	$0.00	$0.00	$0.00	2018	1	1	$25.25	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L6	Field Engineer	HR	$28.56	$0.00	$0.00	$0.00	2018	1	1	$28.56	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L7	General Superintendents (P.M.)	HR	$44.73	$0.00	$0.00	$0.00	2018	1	1	$44.73	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L8	Hydrogeologist/Geologist	HR	$38.90	$0.00	$0.00	$0.00	2018	1	1	$38.90	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L9	Project Managers	HR	$58.53	$0.00	$0.00	$0.00	2018	1	1	$58.53	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L10	Quality Control Engineer	HR	$52.48	$0.00	$0.00	$0.00	2018	1	1	$52.48	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L11	Safety Engineers	HR	$47.83	$0.00	$0.00	$0.00	2018	1	1	$47.83	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L12	Surveyors	HR	$23.76	$0.00	$0.00	$0.00	2018	1	1	$23.76	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L13	Surveyors, Chief	HR	$29.26	$0.00	$0.00	$0.00	2018	1	1	$29.26	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L14	Environmental Scientist	HR	$43.20	$0.00	$0.00	$0.00	2018	1	1	$43.20	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L15	Environmental Lawyer	HR	$40.44	$0.00	$0.00	$0.00	2018	1	1	$40.44	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	
L16	Paralegal	HR	$24.61	$0.00	$0.00	$0.00	2018	1	1	$24.61	$0.00	$0.00	$0.00	100%	9%	FLC	FLC Datacenter	

Base Year: 2018

COST CODES FOR MATERIAL AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
MA1	Shutdown and Mothballing Allowance	LS	$0.00	$0.00	$0.00	$15,000.00	2016	1.06	1	$0.00	$0.00	$0.00	$15,900.00	0%	0%	A	Allowance	Per Estimator
MA2	Geomembrane Liner	SF	$0.00	$0.00	$0.30	$0.00	2016	1.06	1	$0.00	$0.00	$0.32	$0.00	0%	0%	V	Vendor Quote	Source: GSE, 2016
MA3	Riprap	TON	$0.00	$0.00	$0.00	$0.00	2017	1.03	1	$0.00	$0.00	$0.00	$0.00	0%	0%	V	Vendor Quote	Source: C&J Gravel, 2017
MA4	Piping and Culvert Allowance	LS	$0.00	$0.00	$0.00	$5,000.00	2018	1	1	$0.00	$0.00	$0.00	$5,000.00	0%	0%	A	Allowance	Per Estimator. Includes costs for piping, culverts, or other materials required for maintenance/repair
MA5																		
MA6																		
MA7	Geocomposite	ACR	$0.00	$0.00	$25,771.00	$21,562.20	2017	1.03	1	$0.00	$0.00	$26,544.13	$22,209.07	8%	9%	V	Vendor Quote	Source: Agru America, 2014 (delivered cost). Installation Cost: Geo-Synthetics, 2014.
MA8	Seed Mix	LB	$0.00	$0.00	$8.80	$0.00	2017	1.03	1	$0.00	$0.00	$9.06	$0.00	8%	9%	V	Vendor Quote	Source: Southwest Seed, 2017
MA9	Fertilizer (N2 and P2O5)	LB	$0.00	$0.00	$0.80	$0.00	2018	1	1	$0.00	$0.00	$0.80	$0.00	8%	9%	CW	CostWorks	Source: 32 92 1914 7025. Assume materials only
MA10	Hydromulch	LB	$0.00	$0.00	$0.30	$0.00	2018	1	1	$0.00	$0.00	$0.30	$0.00	8%	9%	V	Vendor Quote	Source: Ewing Irrigation Supply, 2018
MA11	Per Diem	DY	$0.00	$0.00	$0.00	$144.00	2018	1	1	$0.00	$0.00	$0.00	$144.00	0%	0%	V	www.gsa.gov	
MA11A	Per Diem (Travel Days)	DY	$0.00	$0.00	$0.00	$131.25	2018	1	1	$0.00	$0.00	$0.00	$131.25	0%	0%	V	www.gsa.gov	Assumes 75% M&IE on travel days
MA12	Copy and Shipping Allowance	LS	$0.00	$0.00	$0.00	$2,000.00	2018	1	1	$0.00	$0.00	$0.00	$2,000.00	0%	0%	V	Allowance	
MA13	Sign	EA	$0.00	$0.00	$165.75	$0.00	2016	1.06	1	$0.00	$0.00	$175.70	$0.00	8%	9%	V	Vendor Quote	Source: Allstate Sign & Plaque, 2016.
MA14	Chainlink Fencing w/Gates	LF	$0.00	$0.00	$0.00	$7.83	2016	1.06	1	$0.00	$0.00	$0.00	$8.30	8%	9%	V	Vendor Quote	Source: FenceCenter, 2016. Assumes 6' chainlink fencing with 2 gate openings
MA15	Lime, Material Amendment	TON	$0.00	$0.00	$0.00	$59.00	2017	1.03	1	$0.00	$0.00	$0.00	$60.77	8%	9%	V	Vendor Quote	Source: Colorado Lime Company, 2017.
MA16	Diatomaceous Earth for Dewatering	TON	$0.00	$0.00	$375.00	$129.50	2017	1.03	1	$0.00	$0.00	$386.25	$133.39	8%	9%	V	Vendor Quote	Source: EP Minerals, LLC. Freight included, 21 tons per truckload.
MA17A	Maintenance Allowance for Interim Management Area	LS	$0.00	$0.00	$0.00	$5,000.00	2018	1	1	$0.00	$0.00	$0.00	$5,000.00	0%	0%	A	Allowance	
MA17B	Maintenance Allowance for Covers	LS	$0.00	$0.00	$0.00	$10,000.00	2018	1	1	$0.00	$0.00	$0.00	$10,000.00	0%	0%	A	Allowance	
MA17C	Repair/Maintenance Allowance for Existing Diversion/Isolatio	LS	$0.00	$0.00	$0.00	$20,000.00	2018	1	1	$0.00	$0.00	$0.00	$20,000.00	0%	0%	A	Allowance	
MA18	Portland Cement	TON	$0.00	$0.00	$125.00	$0.00	2017	1.03	1	$0.00	$0.00	$128.75	$0.00	8%	9%	P	Previous Work	
MA19	Equipment, Supplies, and Shipping, per Sample	EA	$0.00	$0.00	$25.00	$0.00	2018	1	1	$0.00	$0.00	$25.00	$0.00	0%	0%	A	Allowance	
MA20	Compost	LCY	$0.00	$0.00	$35.00	$21.00	2017	1.03	1	$0.00	$0.00	$36.05	$21.63	8%	9%	V	Vendor Quote	Source: Beaver Lakes Nursery & Landscape Supply , 2017. Includes delivery
MA21	Culvert - 12" Material Cost	LF	$0.00	$0.00	$9.20	$0.00	2018	1	1	$0.00	$0.00	$9.20	$0.00	8%	9%	CW	CostWorks	Source: 33 42 1140 2560
MA22	Culvert - 18" Material Cost	LF	$0.00	$0.00	$13.95	$0.00	2018	1	1	$0.00	$0.00	$13.95	$0.00	8%	9%	CW	CostWorks	Source: 33 42 1140 2600

Base Year: 2018

COST CODES FOR MATERIAL AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
MA23	Culvert - 24" Material Cost	LF	$0.00	$0.00	$21.50	$0.00	2018	1	1	$0.00	$0.00	$21.50	$0.00	8%	9%	CW	CostWorks	Source: 33 42 1140 2620
MA24A	4" HDPE Pipe - Material Cost	LF	$0.00	$0.00	$5.13	$0.00	2018	1	1	$0.00	$0.00	$5.13	$0.00	8%	9%	V	Vendor Quote	Source: HDPE Supply, 2018
MA24B	6" HDPE Perforated Pipe - Material Cost	LF	$0.00	$0.00	$10.69	$0.00	2018	1	1	$0.00	$0.00	$10.69	$0.00	8%	9%	V	Vendor Quote	Source: HDPE Supply, 2018
MA25A	HDPE Weld Machine Rental (3" to 4"Diameter)	DY	$0.00	$0.00	$0.00	$42.50	2018	1	1	$0.00	$0.00	$0.00	$42.50	8%	9%	CW	CostWorks	Source: 22 11 1378 4360
MA25B	HDPE Weld Machine Rental (6" to 8"Diameter)	DY	$0.00	$0.00	$0.00	$95.50	2018	1	1	$0.00	$0.00	$0.00	$95.50	8%	9%	CW	CostWorks	Source: 22 11 1378 4370

Base Year: 2018

COST CODES FOR MATERIAL AND UNIT COSTS

Cost Code	Description	Units	Unit Labor Cost	Unit Equipment Cost	Unit Material Cost	Unit Other Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Labor Cost	Adjusted Equipment Cost	Adjusted Material Cost	Adjusted Other Cost	PC OH	PC PF	Cost Source		Comments
																Source	Source ID	
MA26	Steel Stakes	EA	$0.00	$0.00	$10.78	$0.00	2018	1	1	$0.00	$0.00	$10.78	$0.00	8%	9%	V	Vendor Quote	Source: Hogan, 2018
MA27	Tie Wire, 400 FT Roll	EA	$0.00	$0.00	$7.67	$0.00	2018	1	1	$0.00	$0.00	$7.67	$0.00	8%	9%	V	Vendor Quote	Source: Home Depot, 2018
MA28	Geotextile - Material Cost	SF	$0.00	$0.00	$0.17	$0.00	2017	1.03	1	$0.00	$0.00	$0.18	$0.00	8%	9%	V	Vendor Quote	Source: GSE, 2017
MA29	Silt Fence	LF	$0.00	$0.00	$0.72	$0.00	2018	1	1	$0.00	$0.00	$0.72	$0.00	8%	9%	CW	CostWorks	Source: 31 25 1416 1000
MA30	Erosion Control Blanket	SY	$0.00	$0.00	$2.47	$0.00	2018	1	1	$0.00	$0.00	$2.47	$0.00	8%	9%	V	Vendor Quote	Source: Home Depot, 2018
MA31	Geotechnical Analysis	EA	$0.00	$0.00	$0.00	$278.00	2018	1	1	$0.00	$0.00	$0.00	$278.00	8%	9%	CW	CostWorks	Source: 01 45 2350 5300. Includes shear strength analysis
MA32	Crane Mats	EA	$0.00	$0.00	$0.00	$525.00	2018	1	1	$0.00	$0.00	$0.00	$525.00	8%	9%	V	Vendor Quote	Source: Matrax, 2018
MA33	Allowance for Additional Road Improvements	LS	$0.00	$0.00	$0.00	$50,000.00	2018	1	1	$0.00	$0.00	$0.00	$50,000.00	0%	0%	A	Allowance	For improvements to roads, as necessary, including potential targeted improvements to county roads
MA34	TAL Metals (Total)	EA	$0.00	$0.00	$0.00	$85.64	2018	1	1	$0.00	$0.00	$0.00	$85.64	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA35	TAL Metals (Dissolved)	EA	$0.00	$0.00	$0.00	$85.64	2018	1	1	$0.00	$0.00	$0.00	$85.64	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA36	Anions	EA	$0.00	$0.00	$0.00	$22.16	2018	1	1	$0.00	$0.00	$0.00	$22.16	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018. Chloride and Fluoride
MA37	Sulfate	EA	$0.00	$0.00	$0.00	$11.08	2018	1	1	$0.00	$0.00	$0.00	$11.08	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA38	Alkalinity	EA	$0.00	$0.00	$0.00	$10.08	2018	1	1	$0.00	$0.00	$0.00	$10.08	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA39	Nitrate/Nitrite	EA	$0.00	$0.00	$0.00	$15.11	2018	1	1	$0.00	$0.00	$0.00	$15.11	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA40	Hardness	EA	$0.00	$0.00	$0.00	$10.08	2018	1	1	$0.00	$0.00	$0.00	$10.08	8%	9%	V	Vendor Quote	Source: TestAmerica, 2018
MA41	Cooler Sample Shipment	EA	$0.00	$0.00	$0.00	$100.00	2018	1	1	$0.00	$0.00	$0.00	$100.00	0%	0%	A	Allowance	Per Estimator
MA42	Field Meter Rental	DY	$0.00	$55.00	$0.00	$0.00	2018	1	1	$0.00	$55.00	$0.00	$0.00	8%	9%	V	Vendor Quote	Source: Field Environmental, 2018. YSI 556
MA43	Stream Gauge Rental	DY	$0.00	$75.00	$0.00	$0.00	2018	1	1	$0.00	$75.00	$0.00	$0.00	8%	9%	V	Vendor Quote	Source: Pine Environmental, 2018. SonTek FlowTracker
MA44	Field Filters	EA	$0.00	$0.77	$0.00	$0.00	2018	1	1	$0.00	$0.77	$0.00	$0.00	8%	9%	V	Vendor Quote	Source: Hach, 2018
MA45	Miscellaneous Sampling Supplies	LS	$0.00	$0.00	$0.00	$200.00	2018	1	1	$0.00	$0.00	$0.00	$200.00	0%	0%	A	Allowance	Per Estimator

Base Year: 2018

COST CODES FOR SUBCONTRACTORS AND UNIT COSTS

Cost Code	Work or Material Description	Description for Cost Workshee	Units	Unit Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted Unit Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
SU1	Snow Removal	Snow Removal	MO	$3,750.00	2016	1.06	1	$3,975.00	0%	0%	P	Previous Work	Snow removal services required for 6 months per year. Based on costs provided by the contractor for the Gladstone IWTP.
SU2	Pond Cleaning	Pond Cleaning	EA	$20,000.00	2016	1.06	1	$21,200.00	0%	0%	P	Previous Work	Pond cleaning with vac truck. Based on costs provided by the contractor for the Gladstone IWTP.
SU3	Sludge Removal and Liner Replacement	Sludge Removal and Liner Replacement	EA	$125,000.00	2016	1.06	1	$132,500.00	0%	0%	P	Previous Work	Occurs twice per year (once in the spring and once in the fall). Based on costs provided by the contractor for the Gladstone IWTP.
SU4	Weekly Operation (Typical)	Weekly Operation (Typical)	WK	$16,000.00	2016	1.06	1	$16,960.00	0%	0%	P	Previous Work	Typical non-peak operation costs. Based on costs provided by the contractor for the Gladstone IWTP.
SU5	Weekly Operation (Peak - High)	Weekly Operation (Peak - High)	WK	$34,000.00	2016	1.06	1	$36,040.00	0%	0%	P	Previous Work	Cost during high peak metal loads. Assumes 4 weeks per year of high peak metal loads. Based on costs provided by the contractor for the Gladstone IWTP.
SU6	Weekly Operation (Peak - Low)	Weekly Operation (Peak - Moderate)	WK	$26,000.00	2016	1.06	1	$27,560.00	0%	0%	P	Previous Work	Cost during low peak metal loads. Assumes 2 weeks per year of low peak metal loads. Based on costs provided by the contractor for the Gladstone IWTP.
SU7													
SU8													
SU9	Tipping Cost	Waste Disposal Fees	TON	18	2016	1.06	1	$19.08	0%	0%	P	Previous Work	
SU10	TCLP Analysis	TCLP Analysis	EA	80.6	2015	1.06	1	$85.44	0%	0%	GSA	Test America	
SU11	SPLP Analysis	SPLP Analysis	EA	80.6	2015	1.06	1	$85.44	0%	0%	GSA	Test America	
SU12	Geotechnical Analysis	Geotechnical Analysis	EA	42.08	2015	1.06	1	$44.60	0%	0%	GSA	Test America	Includes determination of water content of soil/rock and in-place density (bulk density)

Base Year: 2018

COST CODES FOR MII ASSEMBLIES AND UNIT COSTS

Cost Code	Work or Material Description	Description for Cost Worksheets	Units	MII Unit Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted MII Unit Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
AA1	Pickup Truck	Pickup Truck	DY	$100.83	2017	1.03	1	$103.85	8%	9%	MII	MII Assemblies	
AA2	Material Loading	Material Loading	LCY	$1.21	2017	1.03	1	$1.25	8%	9%	MII	MII Assemblies	
AA3A	Hauling to Existing Offsite Facility (Subtitle D)	Hauling Wastes to Existing Offsite Facility (Subtitle D)	LCY	$29.83	2018	1.00	1	$29.83	8%	9%	MII	MII Assemblies	
AA3C	Hauling - Lime to Site	Hauling - Lime to Site	TON	$21.31	2018	1.00	1	$21.31	8%	9%	MII	MII Assemblies	
AA3E	Hauling - Rock Borrow for Access Roads	Hauling - Rock Borrow for Access Roads	LCY	$21.12	2018	1.00	1	$21.12	8%	9%	MII	MII Assemblies	
AA3F	Hauling - Borrow (Nonconventional Access-Alpine)	Hauling - Borrow (Nonconventional Access-Alpine)	LCY	$62.80	2018	1.00	1	$62.80	8%	9%	MII	MII Assemblies	
AA3G	Hauling - Borrow (Nonconventional Access-Subalpine)	Hauling - Borrow (Nonconventional Access-Subalpine)	LCY	$21.94	2018	1.00	1	$21.94	8%	9%	MII	MII Assemblies	
AA3H	Hauling - Borrow (Conventional Access-Subalpine)	Hauling - Borrow (Conventional Access-Subalpine)	LCY	$10.73	2018	1.00	1	$10.73	8%	9%	MII	MII Assemblies	
AA3I	Hauling - Access Road Gravel to Borrow Location	Hauling - Access Road Gravel to Borrow Location	LCY	$21.12	2018	1.00	1	$21.12	8%	9%	MII	MII Assemblies	
AA4A	Material Spreading - Excavated Materials (Nonconventional Access)	Material Spreading - Excavated Materials (Nonconventional Access)	LCY	$2.42	2018	1.00	1	$2.42	8%	9%	MII	MII Assemblies	
AA4C	Material Spreading - Excavated Materials (Conventional Access)	Material Spreading - Excavated Materials (Conventional Access)	LCY	$1.41	2018	1.00	1	$1.41	8%	9%	MII	MII Assemblies	
AA5	Clearing and Grubbing	Clearing and Grubbing	ACR	$2,478.29	2018	1.00	1	$2,478.29	8%	9%	MII	MII Assemblies	
AA6A	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	Excavation - Sediment/In-Stream Mine Waste (Nonconventional Access)	BCY	$3.72	2018	1.00	1	$3.72	8%	9%	MII	MII Assemblies	
AA6C	Excavation - Sediment/In-Stream Mine Waste (Conventional Access)	Excavation - Sediment/In-Stream Mine Waste (Conventional Access)	BCY	$3.44	2018	1.00	1	$3.44	8%	9%	MII	MII Assemblies	
AA6D	Excavation - Soil/Rock (Nonconventional Access)	Excavation - Soil/Rock (Nonconventional Access)	BCY	$2.98	2018	1.00	1	$2.98	8%	9%	MII	MII Assemblies	
AA6F	Excavation - Soil/Rock (Conventional Access)	Excavation - Soil/Rock (Conventional Access)	BCY	$1.96	2018	1.00	1	$1.96	8%	9%	MII	MII Assemblies	
AA7	Rough Grading (Conventional Access)	Rough Grading (Conventional Access)	SF	$0.03	2018	1.00	1	$0.03	8%	9%	MII	MII Assemblies	
AA8	Compaction (Conventional Access)	Compaction (Conventional Access)	ECY	$1.56	2018	1.00	1	$1.56	8%	9%	MII	MII Assemblies	
AA9A	Movement of Waste - Short Haul (Nonconventional Access)	Movement of Waste - Short Haul (Nonconventional Access)	LCY	$4.68	2018	1.00	1	$4.68	8%	9%	MII	MII Assemblies	
AA9B	Movement of Waste - Short Haul (Conventional Access)	Movement of Waste - Short Haul (Conventional Access)	LCY	$2.62	2018	1.00	1	$2.62	8%	9%	MII	MII Assemblies	
AA10	Gravel/Riprap Placement (Conventional Access)	Gravel/Riprap Placement (Conventional Access)	LCY	$1.70	2018	1.00	1	$1.70	8%	9%	MII	MII Assemblies	
AA11	Geotextile Placement	Geotextile Placement	SF	$0.09	2018	1.00	1	$0.09	8%	9%	MII	MII Assemblies	
AA12	Geomembrane Liner Installation	Geomembrane Liner Installation	SF	$0.15	2018	1.00	1	$0.15	8%	9%	MII	MII Assemblies	
AA13A	Moderate Road Improvements	Moderate Road Improvements	LF	$21.03	2018	1.00	1	$21.03	8%	9%	MII	MII Assemblies	Assumes placement of gravel for road
AA13B	Minor Road Improvements	Minor Road Improvements	LF	$10.98	2018	1.00	1	$10.98	8%	9%	MII	MII Assemblies	
AA14	Rough Grading (Roads)	Rough Grading (Roads)	SF	$0.06	2018	1.00	1	$0.06	8%	9%	MII	MII Assemblies	
AA15A	Mob/Demob - Small Equipment (Nonconventional Access)	Mob/Demob - Small Equipment (Nonconventional Access)	EA	$606.70	2018	1.00	1	$606.70	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial mining-related source
AA15B	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	Mob/Demob - Small/Medium Equipment (Nonconventional Access)	EA	$1,081.51	2018	1.00	1	$1,081.51	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial mining-related source
AA15C	Mob/Demob - Small Equipment (Maintenance)	Mob/Demob - Small Equipment (Maintenance)	EA	$606.70	2018	1.00	1	$606.70	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial mining-related source
AA16	Mob/Demob - Medium Equipment (Conventional Access)	Mob/Demob - Medium Equipment (Conventional Access)	EA	$1,072.80	2018	1.00	1	$1,072.80	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial mining-related source
AA17	Mob/Demob - Large Equipment	Mob/Demob - Large Equipment	EA	$1,222.25	2018	1.00	1	$1,222.25	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial location
AA18					2017	1.03	1	$0.00	8%	9%	MII	MII Assemblies	
AA19A	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	Mob/Demob - Between Mining-Related Sources (Nonconventional Access)	EA	$1,257.67	2018	1.00	1	$1,257.67	8%	9%	MII	MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
AA19C	Mob/Demob - Between Mining-Related Sources (Conventional Access)	Mob/Demob - Between Mining-Related Sources (Conventional Access)	EA	$587.74	2018	1.00	1	$587.74	8%	9%	MII	MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
AA19D	Mob/Demob - Between Access Road Locations	Mob/Demob - Between Access Road Locations	EA	$600.83	2018	1.00	1	$600.83	8%	9%	MII	MII Assemblies	Includes moving equipment between mining-related sources after initial mobilization
AA20	Pilot Car w/ Driver	Pilot Car w/ Driver	EA	$313.23	2017	1.03	1	$322.63	8%	9%	MII	MII Assemblies	
AA21	Topsoil Placement	Topsoil Placement	LCY	$2.98	2017	1.03	1	$3.07	8%	9%	MII	MII Assemblies	
AA22	Soil Placement/Spreading (Conventional Access)	Soil Placement/Spreading (Conventional Access)	LCY	$1.41	2018	1.00	1	$1.41	8%	9%	MII	MII Assemblies	
AA23	Fine Grading	Fine Grading	SY	$1.71	2018	1.00	1	$1.71	8%	9%	MII	MII Assemblies	
AA24	Hydroseeding	Hydroseeding	ACR	$1,235.19	2018	1.00	1	$1,235.19	8%	9%	MII	MII Assemblies	
AA24B	Hydroseeding - Large Area	Hydroseeding - Large Area	ACR	$617.59	2018	1.00	1	$617.59	8%	9%	MII	MII Assemblies	
AA25	Erosion Control Blankets Installation	Erosion Control Blankets Installation	SY	$0.27	2018	1.00	1	$0.27	8%	9%	MII	MII Assemblies	
AA26	Planting, Trees, (Bagged and Burlapped)	Planting, Trees, (Bagged and Burlapped)	EA	$12.56	2018	1.00	1	$12.56	8%	9%	MII	MII Assemblies	

Base Year: **2018**

COST CODES FOR MII ASSEMBLIES AND UNIT COSTS

Cost Code	Work or Material Description	Description for Cost Worksheets	Units	MII Unit Cost	Year of Cost Source	Escalation Factor	Area Factor	Adjusted MII Unit Cost	PC OH	PC PF	Cost Source: Source	Cost Source: Source ID	Comments
AA27	Chain Link Fence Installation	Chain Link Fence Installation	LF	$3.12	2018	1.00	1	$3.12	8%	9%	MII	MII Assemblies	
AA28	Chain Link Fence - Gate Installation	Chain Link Fence - Gate Installation	EA	$234.16	2018	1.00	1	$234.16	8%	9%	MII	MII Assemblies	
AA29	Sign Installation	Sign Installation	EA	$11.08	2018	1.00	1	$11.08	8%	9%	MII	MII Assemblies	
AA30	Excavation of Soil	Excavation of Soil	BCY	$0.99	2017	1.03	1	$1.02	8%	9%	MII	MII Assemblies	
AA31	Soil Screening Plant - Soil Screening	Soil Screening Plant - Soil Screening	LCY	$0.90	2018	1.00	1	$0.90	8%	9%	MII	MII Assemblies	
AA32	Rock Crushing and Screening Plant - Jaw Crusher	Rock Crushing and Screening Plant - Jaw Crusher	LCY	$6.42	2018	1.00	1	$6.42	8%	9%	MII	MII Assemblies	
AA33	Rock Quarrying	Rock Quarrying	BCY	$5.67	2018	1.00	1	$5.67	8%	9%	MII	MII Assemblies	
AA34	Rock Ripping	Rock Ripping	BCY	$2.32	2018	1.00	1	$2.32	8%	9%	MII	MII Assemblies	
AA35	Blasting Rock	Blasting Rock	BCY	$1.34	2018	1.00	1	$1.34	8%	9%	MII	MII Assemblies	
AA36	Silt Fence Installation	Silt Fence Installation	LF	$0.43	2018	1.00	1	$0.43	8%	9%	MII	MII Assemblies	
AA37	Straw Bales Installation	Straw Bales Installation	LF	$0.43	2018	1.00	1	$0.43	8%	9%	MII	MII Assemblies	
AA38	Dust Control	Dust Control	HR	$137.94	2018	1.00	1	$137.94	8%	9%	MII	MII Assemblies	
AA39A	Survey Crew	Survey Crew	ACR	$587.29	2018	1.00	1	$587.29	8%	9%	MII	MII Assemblies	
AA39B	Survey Crew	Survey Crew	LF	$0.59	2018	1.00	1	$0.59	8%	9%	MII	MII Assemblies	
AA39C	Survey Crew	Survey Crew	DY	$587.29	2018	1.00	1	$587.29	8%	9%	MII	MII Assemblies	
AA40A	Draining Ponds	Draining Ponds	GAL	$0.05	2018	1.00	1	$0.05	8%	9%	MII	MII Assemblies	
AA40B	Draining Ponds	Draining Ponds	HR	$54.82	2018	1.00	1	$54.82	8%	9%	MII	MII Assemblies	
AA41A	Draining Ponds (to Water Truck)	Draining Ponds (to Water Truck)	GAL	$0.13	2018	1.00	1	$0.13	8%	9%	MII	MII Assemblies	
AA41B	Draining Ponds (to Water Truck)	Draining Ponds (to Water Truck)	HR	$129.72	2018	1.00	1	$129.72	8%	9%	MII	MII Assemblies	
AA42	Water Transportation	Water Transportation	GAL	$0.04	2018	1.00	1	$0.04	8%	9%	MII	MII Assemblies	
AA43	Organic and Lime Amendment and Processing - Ripping	Organic and Lime Amendment and Processing - Ripping	ACR	$1,336.31	2018	1.00	1	$1,336.31	8%	9%	MII	MII Assemblies	
AA44A	Mixing Diatomaceous Earth (Nonconventional Access)	Mixing Diatomaceous Earth (Nonconventional Access)	LCY	$4.14	2018	1.00	1	$4.14	8%	9%	MII	MII Assemblies	
AA44C	Mixing Diatomaceous Earth (Conventional Access)	Mixing Diatomaceous Earth (Conventional Access)	LCY	$2.35	2018	1.00	1	$2.35	8%	9%	MII	MII Assemblies	
AA45A	Soil Placement - Berm (Nonconventional Access)	Soil Placement - Berm (Nonconventional Access)	ECY	$9.75	2018	1.00	1	$9.75	8%	9%	MII	MII Assemblies	
AA45C	Soil Placement - Berm (Conventional Access)	Soil Placement - Berm (Conventional Access)	ECY	$6.22	2018	1.00	1	$6.22	8%	9%	MII	MII Assemblies	
AA45D	Soil Placement - Pond Berm (Nonconventional Access)	Soil Placement - Pond Berm (Nonconventional Access)	ECY	$9.75	2018	1.00	1	$9.75	8%	9%	MII	MII Assemblies	
AA45F	Soil Placement - Pond Berm (Conventional Access)	Soil Placement - Pond Berm (Conventional Access)	ECY	$6.22	2018	1.00	1	$6.22	8%	9%	MII	MII Assemblies	
AA46	Stabilization with Cement	Stabilization Wastes with Cement	LCY	$7.60	2018	1.00	1	$7.60	8%	9%	MII	MII Assemblies	
AA47	Ditch Excavation	Ditch Excavation	BCY	$0.98	2016	1.06	1	$1.04	8%	9%	MII	MII Assemblies	
AA48	Maintenance of Diversion/Isolation Components	Maintenance of Diversion/Isolation Components	LF	$1.38	2018	1.00	1	$1.38	8%	9%	MII	MII Assemblies	
AA49	Maintenance of Culverts	Maintenance of Culverts	LF	$3.93	2018	1.00	1	$3.93	8%	9%	MII	MII Assemblies	
AA50	Item Code Not Used	Item Code Not Used			2018	1.00	1	$0.00	8%	9%	MII	MII Assemblies	
AA53	Loading (Upper Locations)	Loading (Upper Locations)	LCY	$1.76	2018	1.00	1	$1.76	8%	9%	MII	MII Assemblies	
AA54	Soil Placement/Spreading (Nonconventional Access)	Soil Placement/Spreading (Nonconventional Access)	LCY	$2.42	2018	1.00	1	$2.42	8%	9%	MII	MII Assemblies	
AA55	Compaction (Nonconventional Access)	Compaction (Nonconventional Access)	ECY	$1.80	2018	1.00	1	$1.80	8%	9%	MII	MII Assemblies	
AA56	Short Haul (Nonconventional Access)	Short Haul (Nonconventional Access)	LCY	$4.68	2018	1.00	1	$4.68	8%	9%	MII	MII Assemblies	
AA57	Gravel/Riprap Placement (Nonconventional Access)	Gravel/Riprap Placement (Nonconventional Access)	LCY	$7.39	2018	1.00	1	$7.39	8%	9%	MII	MII Assemblies	
AA58	Rough Grading (Nonconventional Access)	Rough Grading (Nonconventional Access)	SF	$0.10	2018	1.00	1	$0.10	8%	9%	MII	MII Assemblies	
AA59	Item Code Not Used	Item Code Not Used				#N/A	1	#N/A	8%	9%	MII	MII Assemblies	
AA60A	Excavation - Removal of Gravel from Access Roads	Excavation - Removal of Gravel from Access Roads	BCY	$2.08	2018	1.00	1	$2.08	8%	9%	MII	MII Assemblies	
AA68	Mob/Demob - Medium Equipment	Mob/Demob - Medium Equipment	EA	$1,072.80	2018	1.00	1	$1,072.80	8%	9%	MII	MII Assemblies	Includes mobilization/demobilization of equipment from off-site to the initial location
AA69	Excavation - Hand Digging	Excavation - Hand Digging	BCY	$64.95	2018	1.00	1	$64.95	8%	9%	MII	MII Assemblies	
AA70	Spreading Soil/Gravel - By Hand	Spreading Soil/Gravel - By Hand	LCY	$35.43	2018	1.00	1	$35.43	8%	9%	MII	MII Assemblies	
AA71	Dust Control	Dust Control	HR	$137.94	2018	1.00	1	$137.94	8%	9%	MII	MII Assemblies	
AA72	Culvert Installation (Small Equip) - 12"	Culvert Installation (Small Equip) - 12"	LF	$5.17	2018	1.00	1	$5.17	8%	9%	MII	MII Assemblies	
AA73	Culvert Installation (Small Equip) - 18"	Culvert Installation (Small Equip) - 18"	LF	$5.54	2018	1.00	1	$5.54	8%	9%	MII	MII Assemblies	
AA74	Culvert Installation (Small Equip) - 24"	Culvert Installation (Small Equip) - 24"	LF	$6.49	2018	1.00	1	$6.49	8%	9%	MII	MII Assemblies	
AA75A	Installation of 4" HDPE Piping	Installation of 4" HDPE Piping	LF	$3.89	2018	1.00	1	$3.89	8%	9%	MII	MII Assemblies	
AA75B	Installation of 6" HDPE Piping	Installation of 6" HDPE Piping	LF	$4.09	2018	1.00	1	$4.09	8%	9%	MII	MII Assemblies	
AA76	HDPE Welding	HDPE Welding	EA	$18.92	2018	1.00	1	$18.92	8%	9%	MII	MII Assemblies	
AA77						#N/A	1	#N/A	8%	9%	MII	MII Assemblies	
AA78	Culvert Maintenance	Culvert Maintenance	LF	$4.21	2018	1.00	1	$4.21	8%	9%	MII	MII Assemblies	
AA79	Diversion/Isolation Maintenance	Diversion/Isolation Maintenance	LF	$2.13	2018	1.00	1	$2.13	8%	9%	MII	MII Assemblies	
AA80	Maintenance Crew	Maintenance Crew	DY	$853.84	2018	1.00	1	$853.84	8%	9%	MII	MII Assemblies	
AA81	Excavation - Mine Waste - Obstructive (Nonconventional Access)	Excavation - Mine Waste - Obstructive (Nonconventional Access)	BCY	$5.93	2018	1.00	1	$5.93	8%	9%	MII	MII Assemblies	
AA82	Excavation - Mine Waste/Rock - Obstructive (Conventional Access)	Excavation - Mine Waste/Rock - Obstructive (Conventional Access)	BCY	$7.84	2018	1.00	1	$7.84	8%	9%	MII	MII Assemblies	
AA83	Mobilization of Crew/Tools for Remote Locations	Mobilization of Crew/Tools for Remote Locations	EA	$1,235.69	2018	1.00	1	$1,235.69	8%	9%	MII	MII Assemblies	
AA84	Geotextile Placement - Remote Locations	Geotextile Placement - Remote Locations	SF	$0.22	2018	1.00	1	$0.22	8%	9%	MII	MII Assemblies	
AA85	Hand Placement of Rocks to Anchor Geotextile	Hand Placement of Rocks to Anchor Geotextile	HR	$97.43	2018	1.00	1	$97.43	8%	9%	MII	MII Assemblies	