ADMINISTRATIVE RECORD

RECORD OF DECISION

CLEAR CREEK/CENTRAL CITY SUPERFUND SITE
CLEAR CREEK AND GILPIN COUNTIES, COLORADO
OPERABLE UNIT NO. TWO
TAILINGS AND WASTE ROCK REMEDIATION

MARCH 31, 1988
DECLARATION
FOR THE
RECORD OF DECISION

SITE NAME AND LOCATION

Clear Creek/Central City Superfund Site
Clear Creek and Gilpin Counties, Colorado
Operable Unit No. Two
Tailings and Waste Rock Remediation

STATEMENT OF PURPOSE

This decision document represents the selected remedial action for Operable Unit No. Two (Tailings and Waste Rock Remediation) of the Clear Creek/Central City Superfund Site developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300).

The State of Colorado has been consulted on the Proposed Plan and has indicated that it will concur on the selected remedy for Operable Unit No. Two.

STATEMENT OF BASIS

This decision is based upon the Administrative Record for Operable Unit No. Two of the Clear Creek/Central City Superfund Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

DESCRIPTION OF SELECTED REMEDY

The Clear Creek/Central City Superfund Site is located approximately 30 miles west of Denver, Colorado and primarily consists of acid mine discharges and milling and mining wastes from five mines/tunnels in the Clear Creek and North Clear Creek drainages. These are the Argo Tunnel and Big Five Tunnel in the Clear Creek drainage; and the Gregory Incline, National Tunnel, and the Quartz Hill Tunnel in the North Clear Creek drainage. Conditions at the five tunnels and tailings and waste rock pile locations pose potential impacts to human health and the environment.
More specifically, potential impacts to human health and the environment resulting from the acid mine discharges include:

- degradation of downstream surface water quality resulting from dissolved and suspended metals in the discharges and resuspended metal laden sediments below the discharges; and

- reduction in aquatic habitat quality or productivity in Clear Creek and North Clear Creek resulting from contaminated surface water.

These impacts were addressed in the September 30, 1987 Record of Decision for the Discharge Treatment Operable Unit or Operable Unit No. One for the site.

Operable Unit No. Two for the site, the Tailings and Waste Rock Remediation Operable Unit, considers potential impacts to human health and the environment resulting from:

- degradation of downstream surface water quality due to collapse of the piles into either Clear Creek or North Clear Creek;

- degradation of downstream surface water quality due to runon and runoff from the tailings and waste rock piles; and

- human uptake of metals from the inhalation of dust or ingestion of material from the tailings and waste rock piles.

These impacts are addressed in this Record of Decision.

EPA is undertaking an additional feasibility study, Operable Unit No. Three or the Blowout/Discharge Control Operable Unit, to evaluate remedial action alternatives for remediating impacts to human health and the environment resulting from a potential blowout of the Argo Tunnel. In addition, the State of Colorado has submitted an application to EPA for monies to fund an investigation to identify other areas within the mining district which may be significantly impacting North Clear Creek and Clear Creek. The State will also investigate the quality of groundwater in the area. Depending upon the results of the State study, EPA may consider additional operable units.

The selected remedy for Operable Unit No. Two consists of slope stabilization at the Big Five Tunnel and Gregory Incline and runon control at all five tailings and waste rock piles. No action will be taken at this time to address potential impacts from inhalation and ingestion of material from the piles.
The unstable slopes at the Big Five Tunnel and Gregory Incline could collapse into Clear Creek and North Clear Creek, respectively, and the resulting metals loading into the creeks would adversely affect the water quality of the creeks. Slope stabilization at the Big Five Tunnel will consist of regrading portions of the piles to a stable configuration and placing large boulders at the base to minimize erosion. The current gabion wall at the Gregory Incline will be maintained until monitoring indicates remediation is necessary or until the tailings are removed for reprocessing. At that time, a permanent solution will be implemented.

Runon control will reduce the metals loading to Clear Creek and North Clear Creek resulting in an improvement of stream water quality. Runon control at all five locations will consist of installing diversion ditches on the upgradient sides of the piles.

No action will be taken at this time to address potential impacts from inhalation and ingestion of material from the piles because the Public Health Evaluation for the site indicated that current or episodic human health and environmental risks resulting from these exposure pathways were minor. Current use consists of periodic visits to the sites by local residents and visitors. The Public Health Evaluation indicated, however, that for a potential future residential scenario, risks resulting from the inhalation and ingestion exposure pathways are of some concern. Therefore, EPA will evaluate this No Action decision when the final remedy is selected for the site. EPA, in coordination with the State of Colorado and local officials, will evaluate the use of institutional measures which would control any human health or environmental threat that could be created by future development upon these tailings and waste rock piles and any other piles which the State identifies in its study. In addition, pursuant to SARA Section 121(c), EPA will review no less than every five years all properties where hazardous substances continue to remain onsite and, if necessary, will reconsider this No Action decision.

Estimated costs for slope stabilization at the Big Five Tunnel and Gregory Incline and runon control at all five sites is approximately $1.0 million.

The selected remedy for Operable Unit No. Two has been chosen to mitigate and minimize potential impacts resulting from the tailings and waste rock piles and to protect human health and the environment. The selected remedy for Operable Unit No. Two is an interim remedy because the net beneficial impact to Clear Creek and North Clear Creek will not be realized until the completion of remedial actions for the other operable units. The selected remedy therefore requires the exercise of the "interim remedy" waiver (SARA Section 121(d)(4)(A)) from contaminant-
specific ARARs listed in the Feasibility Study. The interim remedy waiver allows for the selection of a remedial action that does not attain ARARs if "the remedial action selected is only part of a total remediation action that will attain such level or standard of control when completed." The interim remedy is consistent with the final site remedy. Location- and action-specific ARARs will be met.

DECLARATION

The selected remedy for Operable Unit No. Two of the Clear Creek/Central City Superfund Site is a cost-effective remedy which is protective of human health and the environment. The selected remedy is an interim remedy which does not attain Federal and State public health and environmental requirements that are applicable or relevant and appropriate and therefore the SARA Section 121(d)(4)(A) interim remedy waiver is required.

The statutory preference for treatment is not satisfied because treatment was found to be impracticable at this time. However, EPA leaves open the opportunity for any future treatment or reprocessing which can be shown to be protective of human health and the environment and which attains Federal and State public health and environmental requirements that are applicable or relevant and appropriate.

James C. Scherer
Regional Administrator
Environmental Protection Agency
Region VIII

Date
March 31, 1988
SUMMARY FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Clear Creek/Central City Superfund Site
Clear Creek and Gilpin Counties, Colorado
Operable Unit No. Two
Tailings and Waste Rock Remediation

SITE DESCRIPTION

The Clear Creek/Central City Superfund site is located approximately 30 miles west of Denver, Colorado, and primarily consists of acid mine drainages and milling and mining wastes from five mines/tunnels in the Clear Creek and North Clear Creek drainages. The site encompasses the northeastern portion of Clear Creek County and southeastern portion of Gilpin County.

Specifically, the focus of the Remedial Investigation was five abandoned mines/tunnels proximal to the cities of Idaho Springs, Black Hawk, and Central City (Figure 1). The tunnels are the Argo Tunnel and Big Five Tunnel in the Clear Creek drainage and the National Tunnel, Gregory Incline, and the Quartz Hill Tunnel in the North Clear Creek drainage. The Argo portal is within the city limits of Idaho Springs. The Big Five portal borders the Idaho Springs city limits. The Gregory Incline is within the Black Hawk city limits. The National Tunnel is within a mile of the City of Black Hawk. The Quartz Hill Tunnel is within a mile of the City of Central City.

The waste rock/tailings piles considered in this Operable Unit were selected based on their location close to the acid mine discharges. Currently, the major impacts on the water quality of Clear Creek are the Big Five and Argo mine tunnel discharges. The water quality of North Clear Creek is affected by the National Tunnel discharge and seepage from the Gregory Incline and the Quartz Hill Tunnel. The discharges from the five sites were addressed in Operable Unit No. One.

In addition to direct discharge from the mine tunnels, contaminated water may enter the creeks during overland sheet flow. Overland runoff occurs during rapid snow melt and thunderstorms. The resulting surface flow across the tailings and waste rock piles dissolves soluble minerals and transports particulate tailings and waste rock material into the creeks. These mechanisms result in elevated creek acidity and metal loads. The introduction of tailings and waste rock into the...
creeks could also occur due to catastrophic collapse of tailings and waste rock piles during a flash flood or as a result of undercutting of the base of the pile under any flow regime.

SITE HISTORY

The Clear Creek/Central City hard rock mining district is historically one of the most mined areas in Colorado. At one time, gold mining accounted for 85 percent of the activity, silver for 10 percent and other minerals, (e.g., copper, lead, and zinc) the remaining 5 percent. The area includes over 800 abandoned mine workings and tunnels. Recent data indicate that up to twenty-five mines and six milling operations are currently operating in Gilpin and Clear Creek counties. The intensity of mining operations has varied in recent years, due largely to fluctuating market prices for precious metals.

Mining activity in the Central City/Black Hawk area commenced in 1859. Placer gold was found at the mouth of Chicago Creek, near Idaho Springs, in January of 1859 and, in May of the same year, the first lode discovery in the Rockies was made in Gregory Gulch between Central City and Black Hawk. Initially, mining was concentrated in the Gregory Gulch area, including the Gregory Incline. Exploration via adits and shafts rapidly expanded to the south and west of Central City. Excavation of the Quartz Hill Tunnel was begun in 1860, largely for the purpose of transporting ore from the overlying surface Glory Hole Mine to mills in Central City. The tunnel is over a mile long. National Tunnel construction was initiated in 1905 and continued to 1937. The tunnel is believed to be over 3,100 feet in length.

The Argo Tunnel was constructed from 1893 to 1904. The tunnel was built for the dual purpose of mine drainage and ore transport. The total tunnel length is 4.16 miles, extending from the portal in Idaho Springs in a northward direction to beneath the headwaters of Gregory Gulch, west of Central City.

In July, 1982, the Clear Creek/Central City site was ranked as Site No. 174 on the Interim Priorities List of 400 sites. The site was added to the final National Priorities List (NPL) in September, 1983. EPA began the Remedial Investigation (RI) of the site in July, 1985. The RI Report was issued in June, 1987 and reported results from the study period of July, 1985 through December, 1986. An addendum to the RI was issued in January, 1988 to report results from additional studies conducted in April and May, 1987.

A removal action was conducted by EPA's Emergency Response Branch at the Gregory Incline in March, 1987 to protect human health and the environment from hazards associated with the collapse of a retaining crib wall. A collapse would have allowed
the tailings to slide into North Clear Creek and EPA was concerned that a large load of metals-laden tailings would wash downstream into Clear Creek and contaminate the municipal water supply of the City of Golden, Colorado. EPA removed an old deteriorated crib retaining wall and decreased the slope of the tailings pile to stabilize it. EPA then constructed a gabion-basket retaining wall.

SCOPE AND ROLE OF THE OPERABLE UNIT

During the course of the RI, EPA determined, in accordance with 40 CFR Section 300.68(c), that the Feasibility Study (FS) should be divided into Operable Units in order to remediate site-specific problems.

The Operable Units include:

Operable Unit No. One - Mine Tunnel Discharge Treatment
   (Record of Decision signed in September, 1987)
Operable Unit No. Two - Tailings and Waste Rock Remediation
Operable Unit No. Three - Blowout/Discharge Control

In addition, the State of Colorado has submitted an application to EPA for monies to fund an investigation to identify other areas within the mining district which may be significantly impacting North Clear Creek and Clear Creek. The State will also investigate the quality of the groundwater in the area. Depending upon the results of the State study, EPA may consider additional operable units.

SITE CHARACTERISTICS

A public health evaluation was conducted to identify compounds which could pose a significant threat to human health and the environment. Based on sampling of environmental media and consideration of toxicity, twelve contaminants of concern were identified and potential exposure pathways were analyzed. Impacts on human health and the environment were assessed for exposures due to inhalation and ingestion of material from the piles and due to runoff from the piles and catastrophic slope failure of the piles into the streams.

As stated, twelve contaminants were identified during the public health evaluation as contaminants of concern in the Clear Creek/Central City study area. Contaminants of concern were chosen separately for human receptors and aquatic organisms. Arsenic, chromium (VI), and nickel are present in relatively high concentrations in the tailings and waste rock and have been rated by EPA as Group A human carcinogens by the inhalation pathway. Cadmium is a Group B1 carcinogen by inhalation and is a potent...
kidney toxin when ingested. Lead and silver are toxic noncancerogens and are present in relatively high concentrations in the tailings and waste rock.

Contaminants of concern for aquatic life were chosen based on their concentration in water, published criteria values (e.g., Ambient Water Quality Criteria (AWQC)), and supplemental data for chemicals that lacked criteria. Contaminants include aluminum, arsenic, cadmium, chromium, copper, fluoride, lead, manganese, nickel, silver, and zinc.

Exposure to metals in tailings or waste rock can potentially occur through inhalation of dust by people at or near the sites. Two mechanisms for dust generation were considered in the evaluation: (1) dust resulting from wind entrainment of tailings or soil particles; and (2) dust generated from human activities (in particular, riding of dirt bikes on the tailings piles). The Gregory tailings pile is readily accessible and in some areas is quite compacted or has a surface crust. Dirt-bike riding is known to occur at the Gregory tailings pile. The Argo tailings are also readily accessible and are less compacted and more friable than the Gregory tailings. The Argo tailings are not used extensively by dirt-bike riders due to their steepness. Currently, however, waste rock at Argo is being removed for use in constructing roads. This activity, which involves operation of dump trucks and front-end loaders, increases dust emissions from this area.

In addition to inhalation, exposure to metals in soil or tailings can also occur by incidental ingestion. Tourists visiting the mines may contact the tailings, although the potential for significant exposure is low. Older children living in the area, particularly those from ages 6 to 16 who have less parental supervision than younger children, may play or ride dirt bikes at the tailings piles especially during the summer months when school is out.

Future use of the sites may include residential development. Under this scenario, potential exposure pathways would include incidental ingestion of contaminated material by the residents over their life time. This potential future use residential exposure scenario was also evaluated.

In summary, the major potential impacts at the site due to tailings and waste rock are:

- Degradation of surface water quality caused by runoff from the piles;
Degradation of surface water quality caused by collapse of the piles into the creeks; and,

Human uptake of metals through inhalation or ingestion.

Exposure to humans

Under both current land use conditions and potential future use scenarios, the principal potential pathways by which human receptors could be exposed to site contaminants from the tailings and waste rock piles is through inhalation or ingestion of material from the piles. Impacts resulting from ingestion of surface water were evaluated as part of Operable Unit No. One.

Exposure scenarios for average and maximum plausible cases were developed for both the inhalation and ingestion potential exposure pathways. Based on estimates of exposure and a quantitative description of each contaminant's toxicity, human health risks were then assessed. The major conclusions of this assessment are presented in Table 1 and can be summarized as follows:

- Inhalation of wind-entrained dust from the Gregory Tailings pile results in upperbound lifetime excess cancer risks of $7 \times 10^{-6}$ and $3 \times 10^{-5}$ for the average and maximum plausible cases, respectively, primarily from exposure to arsenic. Inhalation of wind-entrained dust from the Argo Tailing pile results in upperbound lifetime excess cancer risks of $2 \times 10^{-5}$ and $3 \times 10^{-5}$, for the average and maximum plausible cases, respectively. Generation of dust by dirt bikes ridden at the Gregory Tailings piles results in upperbound risks of $5 \times 10^{-6}$ and $1 \times 10^{-5}$, for the average and maximum plausible cases, respectively. Risks from inhalation of dust from the other tailings and waste rock piles are similar.

- Ingestion of arsenic-contaminated material from the tailings and waste rock piles under current use, or the episodic exposure scenario, poses an upperbound lifetime excess cancer risk of $2 \times 10^{-5}$ for the average case and $1 \times 10^{-4}$ under maximum plausible conditions.

- Ingestion of arsenic-contaminated material from the tailings and waste rock piles under the potential future use residential scenario poses an upperbound lifetime excess cancer risk of $9 \times 10^{-4}$ under average conditions and $9 \times 10^{-4}$ under maximum plausible conditions.

The risks for individual sites are provided in Table 1 and a more detailed discussion of these exposure pathways and the resulting risks can be found in the Public Health Evaluation,
<table>
<thead>
<tr>
<th>Exposure Pathway</th>
<th>Average Case</th>
<th>Maximum Plausible Case</th>
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</thead>
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<tr>
<td><strong>Inhalation of Dust Entrained by Wind</strong></td>
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<tr>
<td>Gregory</td>
<td>7x10^{-6}</td>
<td>3x10^{-5}</td>
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<tr>
<td>Argo</td>
<td>2x10^{-5}</td>
<td>3x10^{-5}</td>
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<tr>
<td><strong>Inhalation of Dust Generated by Motorcycles</strong></td>
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<tr>
<td>Gregory</td>
<td>5x10^{-6}</td>
<td>1x10^{-4}</td>
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<tr>
<td><strong>Incidental Ingestion of Soil and Tailings</strong></td>
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<tr>
<td>Episodic Exposure</td>
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<tr>
<td>Gregory</td>
<td>2x10^{-5}</td>
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<td>Argo</td>
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<td>Big Five</td>
<td>1x10^{-5}</td>
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<tr>
<td>National</td>
<td>2x10^{-5}</td>
<td>1x10^{-4}</td>
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<tr>
<td>Quartz Hill</td>
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<tr>
<td><strong>Incidental Ingestion of Soil and Tailings</strong></td>
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<td>Residential Exposure</td>
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<tr>
<td>Gregory</td>
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</tr>
<tr>
<td>Quartz Hill</td>
<td>1x10^{-4}</td>
<td>6x10^{-4}</td>
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Section 10 of the Remedial Investigation Report. Impacts on aquatic life due to catastrophic slope failure and runoff during storm events are discussed in the following paragraphs.

**Exposures to Aquatic Life**

The exposure of aquatic life in Clear Creek and North Clear Creek were considered. The principal potential pathways by which the tailings and waste rock piles impact aquatic life are:

- Degradation of surface water quality caused by collapse of the piles into the creeks; and
- Degradation of surface water quality caused by runoff from the piles.

**Catastrophic Slope Failure:**

The failure of a slope results in movement of a mass of waste rock and/or tailings into the adjacent creek. If these materials are reactive or toxic and are introduced into a water or air stream, where exposure to environmental or human receptors can occur, then a hazard exists. The potential for catastrophic slope failure was assessed for each site.

**Argo Tunnel:** A geotechnical evaluation was performed on the waste rock/tailings pile at the Argo Tunnel and Mill. The evaluation concluded that the toe of the slope behind the commercial buildings had been cut away and the slope was marginally stable and increased weakness could result from further activities or disturbance. A slope failure would impact the buildings but materials would probably not reach Clear Creek. The volume of such a failure was estimated at 11,200 cubic yards (cy).

**Big Five Tunnel:** A geotechnical engineering evaluation was conducted on two mine waste rock piles (one on the north side of Clear Creek and one on the south side) created from material excavated from the Big Five Tunnel. The conclusions of these evaluations included:

- The eastern portion of the waste rock pile on the north side of Clear Creek and the western portion of the waste rock pile on the south side of Clear Creek are marginally stable to unstable;
- A 100-year flood could erode the toe of existing slopes back seven to ten feet and decrease slope stability. A 500-year flood could erode the slope back an additional two feet; and,
- All slopes are subject to erosion if left exposed.
Based on the results of the geotechnical investigations, volumes of marginally stable and unstable mine waste rock have been calculated to be 2000 and 6200 cy for the north and south banks, respectively. In addition, the volumes of waste rock which could become marginally stable or unstable after seven to ten feet erosion back from the toe of the existing waste piles due to a 100-year flood were also determined. The volume was calculated to be 7200 and 7900 cy for the north and south banks, respectively.

Quartz Hill and National Tunnel: The waste rock pile adjacent to the National Tunnel is considered stable. Some slopes near the Quartz Hill Tunnel are marginally stable and some minor recontouring is recommended.

Gregory Incline: In 1987, the tailings pile at the Gregory Incline was recontoured to a 2:1 (horizontal to vertical) slope and a gabion-basket retaining wall was constructed. The gabion-basket wall is partially immersed in creek water and is exposed to acid drainage. Without maintenance, the wall has an estimated life of five years. The wall is supporting an estimated 1,100 cubic yards of tailings which would otherwise collapse into North Clear Creek.

More details on the geotechnical evaluations conducted at the Clear Creek/Central City Superfund Site can be found in Section 8 of the Remedial Investigation Report and Section 5 of the Addendum to the Remedial Investigation Report.

Estimated Impact Due to Catastrophic Collapse:

A computer model was used to predict water quality in Clear Creek and North Clear Creek in the assessment of human health and environmental impacts resulting from the catastrophic failure of the Big Five Tunnel and Gregory Incline waste rock and tailings piles. The collapse of the Big Five waste rock piles was modeled under realistic, worst case conditions. In particular, a total of 8,200 cubic yards of material (both north and south banks collapse) was instantaneously introduced into Clear Creek during normal low flow (40 cubic feet per second (cfs)). The 8,200 cubic yards is the quantity of material currently unstable and which could collapse into Clear Creek at any time, including during low flow conditions. Zinc and aluminum were selected to represent the variety of geochemical behavior expected from the twelve identified contaminants of concern. Arsenic was not modeled because measured concentrations in the streams and leachates were below detection limits. Lead and copper were not modeled because leachate concentrations were low.

A collapse of the Big Five pile into Clear Creek would result in a peak dissolved concentration of 1,000 ug/L of aluminum at the point of collapse. After one day, the
contamination would reach Golden where a maximum concentration of 730 ug/L of aluminum is predicted. The aluminum concentration at Golden under ambient conditions is 200 ug/L. A collapse of the Big Five pile would result in a maximum dissolved concentration of 1,100 ug/L of zinc at the collapse point, an increase from 400 ug/L of zinc under ambient conditions. This translates into a maximum concentration of 960 ug/L of zinc at Golden after two days which would gradually decrease to 400 ug/L after eight days. The zinc concentration at Golden under ambient conditions is about 300 ug/L. The modeling results indicate that maximum concentrations of aluminum and zinc would exceed AWQC in all stream segments down to Golden. At Golden, the AWQC would be exceeded by a factor of 24 and 89, respectively for aluminum and zinc. Based on the modeling of zinc and aluminum, it is estimated that concentrations of selected parameters in Clear Creek at Golden would also exceed maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The results of the model clearly indicate an adverse impact on Clear Creek due to collapse of the waste rock piles at the Big Five Tunnel.

Similar analyses of collapse of the Gregory Tailings into North Clear Creek have been performed. Results from this effort indicate that both AWQC and MCL values would be exceeded in Clear Creek at Golden as a result of a collapse.

Impact Due to Runoff:

In addition to collapse of the tailings and waste rock piles, materials will also enter the stream due to runoff from the piles during snow melt and storm events. The results of the analyses of samples taken on Clear Creek and North Clear Creek during storm events indicate that the average total aluminum and zinc concentrations exceeded AWQC values by factors of 69 and 15 times, respectively. The results indicate potential impact on aquatic life due to runoff during storm events. Impacts on human health due to runoff from the sites are minimal because the storm events are of limited duration.

Summary of Exposures to Aquatic Life:

The major conclusions of the assessment of exposure to aquatic life can be summarized as follows:

- Several of the chemicals of concern are at concentrations that exceed the ambient water quality criteria for the protection of freshwater aquatic life (AWQC). In particular, concentrations of zinc, copper, and aluminum consistently exceed the acute and chronic AWQC. In addition, concentrations of manganese in the water exceed the lowest observed effect level in rainbow trout. Because aquatic organisms are exposed to a mixture and not
individual chemicals, toxic effects may be even greater than indicated by comparison to the AWQC. Although some fish may tolerate the chemicals in the creeks, it is highly unlikely that the populations of fish found in these creeks are free of toxic effects.

A more detailed discussion of these exposure pathways and the resulting risks can be found in the Public Health Evaluation, Section 10 of the Remedial Investigation Report. It is clear that a release or substantial threat of release of a hazardous substance or pollutant or contaminant into the environment has occurred at the Clear Creek/Central City Superfund site and that remedial action is justified.

COMMUNITY PARTICIPATION

On October 26, 27, and 28, 1987, announcements for the public comment period and the public meeting to be held concerning the Operable Unit No. Two Feasibility Study (FS) were published in the Weekly Register Call, the Golden Transcript, and the Clear Creek Courant. The ads announced the November 9 through December 8, 1987 public comment period and the November 24 public meeting, gave a brief description of the remedial action alternatives, and stated the rationale for the Proposed Plan. The press release, along with the Proposed Plan, was mailed to the approximately 300 names on the EPA-compiled Clear Creek/Central City Superfund Site mailing list.

The press release notified the public of the availability of the Administrative Record for the site and informed them of location of the information repositories which had previously been established for the site. Those information repositories are located at the EPA library in Denver, the Gilpin County Court House in Central City, the Idaho Springs Public Library and the Idaho Springs City Hall in Idaho Springs, and the Golden Public Library in Golden, Colorado. The Administrative Record is located at the Gilpin County Courthouse and the EPA Library. An index of the Administrative Record is located at each information repository and is also attached to this Record of Decision.

On November 24, 1987, EPA held a public meeting concerning the Operable Unit No. Two FS and the Proposed Plan. Approximately 50 people attended. Major concerns raised were how EPA's presence in the area was affecting the economy of the area, the perceived large amounts of money which EPA is spending on studying the site, and whether remedial action at the site is warranted. At the request of several who attended the public meeting, EPA extended the public comment period on the Operable Unit No. Two FS to December 18, 1987 and assured concerned individuals that late comments would be accepted up until the decision was made (late March).
The Operable Unit No. Two Responsiveness Summary contains the official transcript of the public meeting, describes in more detail the nature and level of the community's concern, and includes EPA's responses to all comments received during the public review of the Operable Unit No. Two FS.

ENFORCEMENT

A responsible party search for the Clear Creek/Central City Superfund Site has been initiated. The search has revealed information on ownership of the mine tailings and waste rock piles. At this time, however, this search has not been completed. EPA does not feel that response actions should be delayed pending finalization of the responsible party search. Upon finalization of the search, the status of responsible parties will be determined and evaluated and, if appropriate, EPA will formally notify them of the selected remedy for Operable Unit No. Two and will initiate negotiations for the implementation of the remedy. If the potentially responsible parties do not formally commit to performing the remedy in a timely manner, or if no potentially responsible parties are found, EPA will proceed with a Fund-financed remedial design and remedial action and will attempt to recover EPA's response costs from the responsible parties.

IDENTIFICATION AND SCREENING OF ALTERNATIVES

The EPA evaluated potential remedial action alternatives to abate the threat posed by contamination from the five mine tailing and waste rock piles by progressing through the series of analyses which are outlined in the National Contingency Plan (NCP), in particular, 40 CFR Section 300.68, the Interim Guidance on Superfund Selection of Remedy, December 24, 1986, (OSWER Directive No. 9355.0-19) and the Additional Interim Guidance for FY '87 Records of Decision, July 24, 1987, (OSWER Directive No. 9355.0-21). This process, in part, enables the EPA to address the SARA Section 121 requirements of selecting a remedial action that is protective of human health and the environment, that is cost-effective, that attains Federal and State requirements that are applicable or relevant and appropriate, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Additionally, SARA Section 121 and the guidance documents referenced above require that EPA give preference to remedies which employ treatment which permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances as their principal element.
The selection of remedy process begins by identifying certain site-specific information to be assessed in determining the types of response actions that will be considered for the site. A general list of site-specific information is contained in Section 300.68(e)(2) of the NCP. This list was used to identify specific site and waste characteristics for Operable Unit No. Two of the Clear Creek/Central City site. Based upon these site and waste characteristics, the EPA was able to reduce, from the universe of many possible response actions, a set of response actions and associated technologies to be considered for Operable Unit No. Two.

Section 121(b)(1) of SARA requires that an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant be conducted. The alternative treatment and resource recovery technologies considered included chemical fixation and reprocessing.

The next step of the selection of remedy process is assembling the technologies and/or disposal options into remedial action alternatives. Pursuant to OSWER Directive No. 9355.0-19, "Interim Guidance on Superfund Selection of Remedy", remedial action alternatives were considered ranging from those that would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce mobility, toxicity, or volume as their principal element. Remedial action alternatives developed in this way will vary mainly in the degree to which they rely on long-term site management. Further, a no action alternative was developed as required by Section 300.68(f)(1)(v) of the NCP.

The remedial action alternatives developed in the Feasibility Study for Operable Unit No. Two for the Clear Creek/Central City site are:

- No Action
- Slope Stabilization and Runon Control
- Capping
- Off-site Disposal
- Chemical Fixation
- Reprocessing

Alternatives were subjected to an initial screening to narrow the list of potential remedial actions for further detailed analyses using the criteria of cost, effectiveness, and implementability (acceptable engineering practices) as directed by 40 CFR Section 300.68(g). A description of each alternative follows along with the results of the initial screening analysis.
No Action Alternative

Under the No Action Alternative, there would be no monitoring activities and no new barriers would be constructed to restrict access to the tailings and waste rock piles. The analysis of the No Action Alternative was summarized earlier in this document in the section entitled "Site Characteristics". The evaluation indicated that potential human health and environmental impact could result from the tailings and waste rock piles. In particular, catastrophic failure and runoff could affect aquatic life and downstream water users. In addition, ingestion of tailings or waste rock may have some effects on human health under the future residential use scenario. The No Action Alternative serves as a baseline and was retained for further analysis and consideration as required by Section 300.68(f)(1)(v) of the NCP.

Slope Stabilization and Runon Control Alternative

Slope stabilization measures eliminate or reduce contamination of surface water resulting from collapse of tailings and waste rock piles into the stream. Slope stabilization measures can include excavation, grouting and construction of retaining walls. In addition, contamination of surface water resulting from sheet flow over the piles can be reduced by providing runon control to the piles. Runon control can include diversion ditches around the piles or culverts through the piles.

Initial assessments indicated that slope stabilization and runon controls are effective and can be implemented. Therefore, these alternatives were considered further in the detailed screening of remedial action alternatives. The initial screening of stabilization alternatives identified the following alternatives by site for further study:

Gregory Incline
- Concrete Crib Wall
- Timber Crib Wall
- Box Culvert
- Runon Control

Big Five
- Excavation and Slope Layback
- Erosion Protection at Toe
- Runon Control

National, Argo, and Quartz Hill
- Runon Control
The initial screening evaluation indicated that grouting and retaining walls at the Big Five were not technically feasible. These alternatives were eliminated and not considered in the detailed screening.

Capping Alternative

Surface control measures will eliminate contamination of surface water due to runoff from the mine tailings and waste rock sites and prevent human exposure through inhalation and ingestion. Such measures could include regrading the site to stabilize existing slopes and control surface water runoff, providing a containing cap over the tailings and waste rock material, or revegetation of the site.

Six types of caps were evaluated for each site including synthetic liners, bituminous pavement, soil cement layers, soil cover, clay barrier/soil cover, and a modified Resource Conservation and Recovery Act (RCRA) cap - a frost-resistant clay barrier/soil cover).

The capping analysis indicated that containment is effective, technically feasible and can be implemented. Therefore, these alternatives were considered further in the detailed screening of remedial action alternatives. The initial screening resulted in the following capping alternatives for further evaluation:

National Tunnel
- Synthetic liner
- Soil cement cover

Argo Tunnel
- Synthetic liner
- Soil cement cover

Gregory Incline
- Synthetic liner or soil cement cover

Quartz Hill Tunnel
- Pavement of parking lots
- Synthetic liner or soil cement cover
**Big Five Tunnel**

- South Side of Clear Creek - Remove to north side of creek or off-site disposal.
- North Side of Clear Creek - Synthetic liner or soil cement cover.

Various caps were eliminated during the initial screening. Those caps screened out included soil cover, clay barrier/soil cover, bituminous cover and modified RCRA cap. Most of these covers could not be implemented on the steep slopes. More details concerning the screening evaluation can be found in Section 2 of the Feasibility Study Report.

**Off-Site Disposal Alternative**

The off-site disposal alternative considers the option of transporting the mine tailings and waste rock material to either a local municipal landfill or to a RCRA permitted landfill.

The most likely municipal landfill would be a facility operated by Browning Ferris Incorporated (BFI) near 88th and Tower Road northeast of Denver. This is a relatively new facility which replaces a BFI facility along Colorado State Highway 93 between Golden and Boulder, which has now been closed. The primary concern with this alternative, however, would be whether or not the appropriate regulatory agencies or the operator would allow disposal of materials from a CERCLA site at a municipal landfill even if it was not a RCRA characteristic waste. A second concern would be the impact of such a large volume of material on a landfill designed primarily for municipal use.

The second alternative for disposal of the material is landfill at a permitted RCRA landfill. Three sites were investigated, including the new Last Chance site, operated by BFI near Limon, Colorado; the U.S. Ecology disposal site near Beatty, Nevada; and the USPCI disposal site at Grassy Mountain, Utah. Construction of the BFI site has not yet begun, but will probably commence within the next year. The BFI site is scheduled to provide cells of approximately 158,000 cubic yard capacity. Several of these cells could be dedicated to disposal of the Clear Creek mining waste. The U.S. Ecology and USPCI sites are presently in operation.

The off-site disposal analysis indicated that off-site disposal is a technically feasible alternative that is effective and can be implemented. Therefore, this alternative was considered further in the detailed analysis of remedial action alternatives.
Chemical Fixation Alternatives

Modifying the chemical environment within the Clear Creek/Central City tailings and waste rock piles is a means of reducing the mobility of metals in the piles. By changing the chemical environment of the tailings through the addition of neutralizing materials, the generation of acid and the subsequent dissolution of metals can be eliminated. Such changes also would limit dust generation and could potentially reduce the impact of direct ingestion.

Several methods exist for the modification of the chemical environment in the piles. The effects on the metal-specific species present will vary according to the technique chosen for modification. The addition of materials with large neutralization (basic) capacity, such as kiln dust, is a common method available for raising the pH of an acidic material with the accompanying "fixation" of metals as metallic hydroxides. This is a cost-effective option but its total effectiveness is limited by the fact that some metals may remain slightly leachable by this method.

Another approach is fixation of contaminant metals by chemical binding with an accompanying physical encapsulation. This is accomplished by the addition of fixation and solidification agents that make the contaminants unavailable to oxidation and leaching. Metals that cannot be fixed by simple pH adjustment respond to this technique. Pozzolans and cements constitute the major portion of these fixation agents. Their addition to an acidic material also causes an increase in pH.

Approximately thirty different fixation agents were evaluated during the screening process. These materials were screened for effectiveness as shown by actual leach results, implementability and cost per unit neutralization capacity. The details of this evaluation are provided in Section 2 of the Feasibility Study. Based on the screening evaluation, fixation appears to be a technically feasible containment option and was, therefore, further investigated in the detailed analysis of remedial action alternatives. In particular, the following techniques/fixation agents were considered:

- Kiln dust
- Three proprietary fixation agents

Each of these fixation agents were subject to bench scale tests. The resulting fixed materials were also tested for effectiveness by using leaching tests. The results of these tests are summarized in the Detailed Analysis Section.
Reprocessing Alternatives

There are many processes that have been developed to remove metals from ores and these processes could potentially be applied to remove toxic metals from the five waste piles. The processes fall into two categories: pyrometallurgical - processes using heat; and hydrometallurgical - processes using water solutions. Facilities using these processes exist in several parts of the country and could potentially reprocess materials from the Clear Creek/Central City site. These processes could also potentially be used at a facility constructed in the Clear Creek/Central City site area.

The screening of technologies for reprocessing of tailings and waste rock piles indicated that flotation as a reprocessing alternative is technically feasible and can be implemented. In addition, reprocessing of Gregory Tailings by gravity separation to recover pyrite is technically feasible. To determine the effectiveness and cost of reprocessing, laboratory bench scale studies were conducted. The results are summarized in the detailed analysis of remedial action alternatives.

Summary of Initial Screening

The following alternatives were considered for remediation of the tailings and waste rock piles:

- No Action
- Slope Stabilization and Runon Control
- Capping (with soil cement or synthetic liners)
- Off-site disposal
- Chemical Fixation (with kiln dust and three proprietary agents)
- Reprocessing (flotation or gravity concentration)

Various options under each alternative were evaluated for effectiveness, implementability and cost. Based on this screening evaluation, options were selected for detailed analyses. The results of the detailed analyses are provided in the next section.

DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

Consistent with Section 300.68(h) of the NCP, the Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.0-19, and OSWER Directive No. 9355.0-21, the remedial action
alternatives remaining after initial screening were further refined and then subjected to detailed analysis. Detailed analysis of each remedial action alternative entailed evaluation based on the criteria derived from the NCP and SARA. These criteria relate directly to factors mandated by SARA in Section 121, in particular Section 121(b)(1)(A-G). The criteria follow:

- Protection of human health and the environment
- Compliance with legally applicable and/or relevant and appropriate requirements
- Reduction of mobility, toxicity, or volume
- Short-term effectiveness
- Long-term effectiveness and permanence
- Implementability
- Cost
- Community acceptance
- State acceptance

The evaluation of alternatives reflects the mandate to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, as specified in Section 121 of SARA.

Description of Alternatives

No Action Alternative: The No Action alternative assumes that there will be no remediation of tailings and waste rock piles. The potential impacts on human health and the environment include:

- Collapse of tailings and waste rock piles into Clear Creek and North Clear Creek;
- Runoff from the waste rock and tailings piles contaminating Clear Creek and North Clear Creek; and
- Inhalation or ingestion of material from the piles.

The impact due to potential collapse of the Big Five and Gregory Incline waste rock/tailings piles were evaluated in the section entitled "Site Characteristics". As discussed in that
section, both AWQC and MCLs would be exceeded in Clear Creek and North Clear Creek.

The Site Characteristics section also summarized the effects of runoff during storm events. Actual data indicate that AWQC are exceeded in Clear Creek and North Clear Creek.

In addition to potential impacts due to runoff and collapse, the adverse effects of inhalation of ingestion of material from the piles were evaluated and summarized in the Site Characteristics section (Table 1). Under current (episodic exposure) worst case conditions, the risk for ingestion of soil was $1 \times 10^{-4}$ (one excess cancer death in 10,000 people over a lifetime). Under average conditions, the risk was $2 \times 10^{-5}$. Inhalation of dust under average and worst cases indicated risks of $5 \times 10^{-6}$ to $1 \times 10^{-4}$. Under a potential future use residential scenario, the risk of ingestion under average conditions ranged from $8 \times 10^{-5}$ to $1 \times 10^{-4}$. Under maximum plausible exposure conditions the risk ranged from $4 \times 10^{-4}$ to $9 \times 10^{-4}$.

Slope Stabilization and Runon Control Alternative: Based on the detailed evaluation of criteria cited previously, slope stabilization at the Big Five waste rock piles would be accomplished by excavation, slope cutback and toe rip-rap to prevent erosion and tailings collapse into Clear Creek. Based on detailed evaluation at the Gregory Incline, the current gabion wall would be maintained until monitoring indicates remediation is necessary or until the tailings are removed for reprocessing. At that time, a permanent solution will be implemented. Runon controls such as diversion ditches or culverts would be placed on the upgradient side of all sites.

Slope stabilization would be a permanent solution that eliminates collapse of the tailings and waste rock piles. The potential for catastrophic contamination of Clear Creek and North Clear Creek would be eliminated. The runoff would also be reduced by eliminating runon at the upgradient sides of the piles. No reduction in impact due to dust or ingestion would be achieved.

Capping Alternatives: Results of the screening analysis indicated that because of the steep slopes only two technically feasible capping alternatives exist for waste piles at the National Tunnel and Argo Tunnel: synthetic liners or soil cement covers. Because of the steep slopes at both sites, a soil cover would not remain on a synthetic liner. A bare liner would be extremely susceptible to damage and/or vandalism with frequent replacement required. The soil cement cover retains the natural color of the tailings and waste rock material and is probably preferred by the Colorado Historical Society and local residents over a liner. Thus, a soil cement cover is the preferable
capping alternative which could be implemented at the National Tunnel and Argo Tunnel waste piles.

Before the Gregory Incline can be capped, the temporary gabion wall would be replaced. A timber crib wall is priced comparably with other alternatives and would probably be preferred by the Colorado Historical Society. Alternatives evaluated for capping were a synthetic liner and soil cement cover. The soil cement cover is a permanent cover and is probably preferred by the Colorado Historical Society over other capping alternatives.

The Big Five waste rock pile provides a technical challenge for capping and protection against flood erosion. Physical constraints imposed by the original topography and the location of Clear Creek along one side of the piles dictate that piles would be regraded and rip-rap would be placed for flood protection. The regraded piles would then be covered by a soil cement cap. A synthetic liner could be placed, but no soil cover could be put on the liner.

Capping of the Quartz Hill waste rock pile was evaluated for three areas: parking lots with adjoining side slopes, an area near the tunnel entrance, and all remaining areas from the parking lots to the tunnel portal. The screening analysis indicated that soil cement covers were more feasible than synthetic liners for non-auto traffic areas. Selection of soil cement covers would also probably be preferred by the Colorado Historical Society over a liner. The most feasible capping alternative for the parking lots is paving.

In all cases discussed above, runon and runoff control would be provided. This would consist of ditches upgradient of the capped area to divert water and ditches or culverts below the sites to divert runoff. Capping of the tailings and waste rock piles would be a permanent solution that removes exposure to human health and the environment.

Off-Site Disposal: Under the off-site disposal alternative, tailings and waste rock piles would be excavated and transported for disposal at a municipal landfill site such as the landfill operated by BFI at 88th and Tower Road northwest of Denver. Leachate tests indicate that the tailings and waste rock are not RCRA characteristic waste and therefore do not have to be sent to a RCRA landfill.

Removal of the tailings and waste rock piles is a permanent solution that removes exposure to human health and the environment. Dust control measures must be implemented during excavation and trucks would have to be lined and covered during transportation.
Chemical Fixation: In the initial screening process, kiln dust and three proprietary materials were selected for detailed evaluation. Waste rock/tailings from Gregory and Argo were treated with each of the four selected fixation agents. The resultant fixed materials were then subjected to a series of leaching tests to document the effectiveness of the treatment. In all cases, the fixation agents tested were effective in reducing leachate concentrations. In some cases, leachate concentrations were below AWQC for zinc. However, in one case, the leachate contained extremely high values for aluminum (27,700 ug/L). Because of this result, this fixation agent was eliminated from evaluation. Kiln dust and two proprietary agents were all considered further. Based on cost and leachate quality, kiln dust is the most cost-effective. Kiln dust would be applied at an application rate of approximately 0.58 tons per cubic yard of available tailings and waste rock material. Approximately 9 inches of kiln dust would be mixed in with the top 9 inches of tailings and waste rock material and then compacted.

Fixation of the tailings and waste rock piles is a permanent solution that removes exposure to human health and the environment.

Reprocessing Alternative: The reprocessing alternative considers the tailings and waste rock piles as an economic resource and recovers the inherent monetary value while generating a waste which may not be detrimental to the environment. In order to evaluate this option, a three-phase characterization task was undertaken:

- Evaluating the parameters necessary to process the waste rock/tailings;
- Determining if the resultant waste is a hazardous waste; and
- Performing a cost analysis of all options.

The reprocessing studies were conducted on a bench scale level by International Process Research Corporation of Golden, Colorado. Two options were evaluated, namely:

- Reprocessing of all materials; and
- Reprocessing of all materials less than two inches with disposal of coarse fraction as a waste rock.
The results of these types of tests were evaluated to determine if the tailings and waste rock could be reprocessed. These tests included:

- Tests on characterizing the waste rock with respect to particle size distribution and selected contaminant concentrations (copper, zinc, lead, chromium, and arsenic), total sulfur, and precious metals (silver and gold) in different size fractions;
- Froth flotation tests for recovery of an economic product; and
- Leaching tests on waste rock and new tailings to determine potential environmental impacts.

Results of the tests indicate that the quantities of contaminants remaining in the new waste tailings were significantly reduced. However, leachate concentrations were greater than AWQC for selected contaminants such as zinc.

Reprocessing would be a permanent solution that eliminated collapse of the tailings and waste rock piles. A new waste tailings is produced. Leaching tests show that the new tailings can be disposed in a municipal landfill.

Comparison of Alternatives

Listed in Table 2, in matrix format, are the key criteria considered in evaluating and comparing alternatives. These criteria are specified in J. Winston Porter's memorandum "Additional Interim Guidance for FY '87 Records of Decision," dated July 21, 1987 and include:

- Protection of human health and the environment
- Compliance with legally applicable and/or relevant and appropriate requirements
- Reduction of mobility, toxicity or volume
- Short-term effectiveness
- Long-term effectiveness and permanence
- Implementability
- Cost
- Community acceptance
- State acceptance
Table 2 summarizes the data developed in the Detailed Analysis of Remedial Action Alternatives and provides a comparison for selecting a preferred alternative for each location. The following paragraphs summarize the evaluation criteria for all sites.

**No Action:** As previously indicated, collapse would result in degradation of stream quality below AWQC and MCLs. Runoff also does not meet AWQC. No action would not reduce the mobility, toxicity or volume of the contaminants.

**Stabilization and Runon Controls:** Degradation of stream quality due to collapse will be eliminated. Runoff quality will not meet AWQC; however, the volume of runoff will be reduced as a result of runon control. As a result, contamination to the stream will be reduced. Overall mobility of contaminants are reduced. Relative to other alternatives (except no action), this option has the lowest cost. The remediation is not a permanent solution for all contamination and does not eliminate all risks to human health and the environment.

**Capping:** Runoff quality will meet AWQC. Capping reduces mobility of contaminants. Risks to human health due to inhalation of dust and ingestion of materials are eliminated. Capping is a permanent remediation that removes exposure to human health and the environment.

**Off-Site Disposal:** Off-site disposal reduces the mobility and toxicity of contaminants on the site. However, the materials are placed in another location and the ultimate volume and toxicity is not reduced. Existing risks to human health and the environment are eliminated. Off-site disposal is a permanent remedy. The cost for off-site disposal is the second highest of the six alternatives evaluated.

**Chemical Fixation:** Runoff quality will meet AWQC for most parameters. Fixation reduces mobility and possibly toxicity of the contaminants. However, the volume of contaminated material is increased. Fixation is a permanent remedy and eliminates existing risks to human health and substantially reduces risk to the environment.

**Reprocessing:** Reprocessing will result in new tailings that are not RCRA wastes. However, potential leachates from the waste will exceed AWQC. Reprocessing reduces mobility, toxicity and volume of the contaminants. This alternative is the only option that reduces volume. Reprocessing reduces existing risk to human health and the environment. This option is the most expensive of the six alternatives evaluated even considering the value of the minerals extracted (See Table 2). Overall, reprocessing is a permanent solution that reduces exposure to human health and the environment.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>No Action</th>
<th>Stabilization/Runoff Control</th>
<th>Capping</th>
<th>Off-Site Disposal</th>
<th>Chemical Fixation</th>
<th>Reprocessing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argo Tunnel</td>
<td>Runoff does not meet ARARs.</td>
<td>Runoff will not meet ARARs.</td>
<td>Runoff will meet ARARs.</td>
<td>Risks are removed.</td>
<td>Runoff will meet most ARARs.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed ARARs.</td>
</tr>
<tr>
<td>1. Compliance with ARARs</td>
<td>Runoff does not meet ARARs.</td>
<td>Runoff will not meet ARARs.</td>
<td>Runoff will meet ARARs.</td>
<td>Risks are removed.</td>
<td>Runoff will meet most ARARs.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed ARARs.</td>
</tr>
<tr>
<td>2. Reduction of mobility, toxicity or volume</td>
<td>No reduction of M.T.V.</td>
<td>Reduces mobility</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces mobility and toxicity on-site materials are placed in another location.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces M.T and V.</td>
</tr>
<tr>
<td>3. Short Term Effectiveness</td>
<td>No reduction of existing risks from catastrophic collapse of piles and from runoff or ingestion.</td>
<td>Eliminates some contamination to stream. Can be completed in 6 mo.</td>
<td>Eliminates existing risk to human health and the environment. Capping can be completed in 12-18 months.</td>
<td>Existing risk to human health and the environment are eliminated. Fixation can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Reprocessing can be completed in 5 to 9 years.</td>
<td></td>
</tr>
<tr>
<td>4. Long Term Effectiveness</td>
<td>Does not present a permanent solution to remediating risks from the tailings and waste rock piles.</td>
<td>Does not present a permanent solution to all risks.</td>
<td>Capping is a permanent remedy that eliminates the need for long term site management.</td>
<td>Off-site disposal is a permanent remedy that eliminates the need for long term site management.</td>
<td>Fixation is a permanent remedy that eliminates the need for long term site management.</td>
<td>Reprocessing is a permanent remedy that eliminates the need for long term site management.</td>
</tr>
<tr>
<td>5. Implementability</td>
<td>Constructed with available equipment</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Local mills can be used but are currently inoperable.</td>
<td></td>
</tr>
<tr>
<td>6. Cost ($)</td>
<td>0</td>
<td>40,000</td>
<td>1,969,800</td>
<td>7,347,800</td>
<td>1,461,800</td>
<td>8,5-12,126,000</td>
</tr>
<tr>
<td>- Capital</td>
<td>0</td>
<td>40,000</td>
<td>1,969,800</td>
<td>7,347,800</td>
<td>1,461,800</td>
<td>8,5-12,126,000</td>
</tr>
<tr>
<td>- Present Worth 10%</td>
<td>0</td>
<td>80,000</td>
<td>1,969,800</td>
<td>7,347,800</td>
<td>1,461,800</td>
<td>8,5-12,126,000</td>
</tr>
<tr>
<td>7. Community Acceptance</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td></td>
</tr>
<tr>
<td>8. State Acceptance</td>
<td>No action is acceptable as an interim solution only.</td>
<td>State's preferred alternative.</td>
<td>Capping should be considered in future studies.</td>
<td>Costs are the major concern.</td>
<td>May be considered in future studies.</td>
<td>State would encourage reprocessing if economically feasible.</td>
</tr>
<tr>
<td>9. Overall Protection of Human Health and the Environment</td>
<td>Runoff control eliminates some of the risk to the environment.</td>
<td>Capping is a permanent solution that removes exposure to human health and the environment.</td>
<td>Off-site disposal is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Fixation is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Reprocessing is a permanent solution that reduces exposure to human health and the environment.</td>
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<tr>
<td><strong>Big Five Tunnel</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Compliance with ARARs</td>
<td>Runoff does not meet AWQC. Collapse would result in degradation below MCL and AWQC.</td>
<td>Runoff will not meet AWQC.</td>
<td>Runoff will meet AWQC’s.</td>
<td>Risks are removed. Disposal will meet RCRA.</td>
<td>Runoff will meet most AWQC’s.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed AWQC’s.</td>
</tr>
<tr>
<td>2. Reduction of mobility, toxicity or volume</td>
<td>No reduction of M.T.V.</td>
<td>Reduces mobility and volume (if reprocessed).</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces mobility and toxicity on-site materials are placed in another location.</td>
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<td>Reduces M.T and V.</td>
</tr>
<tr>
<td>3. Short Term Effectiveness</td>
<td>No reduction of existing risks from catastrophic collapse of piles and from runoff or ingestion.</td>
<td>Eliminates collapse potential and most contaminants in the stream; can be completed in 6 mo.</td>
<td>Eliminates existing risk to human health and the environment. Capping can be completed in 12-18 months.</td>
<td>Existing risk to human health and the environment are eliminated. Off-site disposal can be completed in 2 years.</td>
<td>Eliminates existing risk to human health and the environment. Fixation can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Reprocessing can be completed in 5 to 9 years.</td>
</tr>
<tr>
<td>4. Long Term Effectiveness</td>
<td>Does not present a permanent solution to remediating risks from the tailings and waste rock piles.</td>
<td>Provides a permanent solution to collapse; eliminates most of long term site management.</td>
<td>Capping is a permanent remedy that eliminates the need for long term site management.</td>
<td>Off-site disposal is a permanent remedy that eliminates the need for long term site management.</td>
<td>Fixation is a permanent remedy that eliminates the need for long term site management.</td>
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<td>5. Implementability</td>
<td>—</td>
<td>Constructed with available equipment.</td>
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<td>Constructed with available construction equipment.</td>
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<td>6. Cost ($)</td>
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<td>562,100</td>
<td>825,700</td>
<td>5,654,000</td>
<td>693,800</td>
<td>4,2-6,855,000</td>
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<td>- Capital</td>
<td>0</td>
<td>641,100</td>
<td>825,700</td>
<td>5,654,000</td>
<td>693,800</td>
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<td>No Action is acceptable as an interim solution only.</td>
<td>State’s preferred alternative.</td>
<td>Capping should be considered in future studies.</td>
<td>Costs are the major concern.</td>
<td>May be considered in future studies.</td>
<td>State would encourage reprocessing if economically feasible.</td>
</tr>
<tr>
<td>9. Overall Protection of Human Health and the Environment</td>
<td>May result in adverse effects due to runoff and collapse of waste rock/tailings piles and direct contact with piles.</td>
<td>Stabilization is a permanent solution that eliminates collapse and reduced potential human and environmental exposure.</td>
<td>Capping is a permanent solution that removes exposure to human health and the environment.</td>
<td>Off-site disposal is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Fixation is a permanent solution that reduces exposure to human health and the environment.</td>
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<tr>
<td><strong>Gregory Incline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Compliance with ARABS</td>
<td>Runoff does not meet AWQC. Collapse would result in degradation below MCLs and AWQC.</td>
<td>Runoff will not meet AWQC.</td>
<td>Runoff will meet AWQC's.</td>
<td>Risks are removed. Disposal will meet RCRA.</td>
<td>Runoff will meet most AWQC's.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed AWQC.</td>
</tr>
<tr>
<td>2. Reduction of mobility, toxicity or volume</td>
<td>No reduction of M.T.V.</td>
<td>Reduces mobility</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces mobility and toxicity on-site materials are placed in another location.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces M,T and V.</td>
</tr>
<tr>
<td>3. Short Term Effectiveness</td>
<td>No reduction of existing risks from catastrophic collapse of piles and from runoff or ingestion.</td>
<td>Eliminates collapse potential and most contaminants in the stream; can be completed in 6 mo. (processing in 2 yr).</td>
<td>Eliminates existing risk to human health and the environment. Capping can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Existing risk to human health and the environment are eliminated. Off-site disposal can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Reprocessing can be completed in 5 to 9 years.</td>
<td></td>
</tr>
<tr>
<td>4. Long Term Effectiveness</td>
<td>Does not present a permanent solution to remediating risks from the tailings and waste rock piles.</td>
<td>Provides a permanent solution to collapse; eliminates most of long term site management.</td>
<td>Capping is a permanent remedy that eliminates the need for long term site management.</td>
<td>Off-site disposal is a permanent remedy that eliminates the need for long term site management.</td>
<td>Fixation is a permanent remedy that eliminates the need for long term site management.</td>
<td>Reprocessing is a permanent remedy that eliminates the need for long term site management.</td>
</tr>
<tr>
<td>5. Implementability</td>
<td>Constructed with available equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Local mills can be used but are currently inoperable.</td>
</tr>
<tr>
<td>6. Cost ($)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Capital</td>
<td>0</td>
<td>32,500</td>
<td>498,300</td>
<td>876,400</td>
<td>395,800</td>
<td>3-3,480,000</td>
</tr>
<tr>
<td>- Present Worth 10%</td>
<td>0</td>
<td>50,700</td>
<td>498,300</td>
<td>876,400</td>
<td>395,800</td>
<td>3-3,480,000</td>
</tr>
<tr>
<td>7. Community Acceptance</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
</tr>
<tr>
<td>8. State Acceptance</td>
<td>No Action is acceptable as an interim solution only.</td>
<td>State's preferred alternative.</td>
<td>Capping should be considered in future studies.</td>
<td>Costs are the major concern.</td>
<td>May be considered in future studies.</td>
<td>State would encourage reprocessing if economically feasible.</td>
</tr>
<tr>
<td>9. Overall Protection of Human Health and the Environment</td>
<td>May result in adverse effects due to runoff and collapse of waste rock/tailings piles and direct contact with piles.</td>
<td>Stabilization is a permanent solution that eliminates collapse and reduces potential human and environmental exposure.</td>
<td>Capping is a permanent solution that removes exposure to human health and the environment.</td>
<td>Off-site disposal is a permanent solution that removes exposure to human health and the environment.</td>
<td>Fixation is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Reprocessing is a permanent solution that reduces exposure to human health and the environment.</td>
</tr>
<tr>
<td>Criteria</td>
<td>No Action</td>
<td>Stabilization/Runoff Control</td>
<td>Capping</td>
<td>Off-Site Disposal</td>
<td>Chemical Fixation</td>
<td>Reprocessing</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>National Tunnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Compliance with ARARs</td>
<td>Runoff does not meet AMQC. Collapse would result in degradation below MCLs and AMQC.</td>
<td>Runoff will not meet AMQC.</td>
<td>Runoff will not meet AMQC.</td>
<td>Risks are removed. Disposal will meet RCRA.</td>
<td>Runoff will meet most AMQCs.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed AMQCs.</td>
</tr>
<tr>
<td>2. Reduction of mobility, toxicity or volume</td>
<td>No reduction of M.T.V.</td>
<td>Reduced mobility.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces mobility and toxicity on-site materials are placed in another location.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces M.T and V.</td>
</tr>
<tr>
<td>3. Short Term Effectiveness</td>
<td>No reduction of existing risks from catastrophic collapse of piles and from runoff or ingestion.</td>
<td>Eliminates existing contamination to stream; can be completed in 6 mo.</td>
<td>Eliminates existing risk to human health and the environment. Capping can be completed in 12-18 months.</td>
<td>Existing risk to human health and the environment are eliminated. Off-site disposal can be completed in 2 years.</td>
<td>Eliminates existing risk to human health and the environment. Fixation can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Reprocessing can be completed in 5 to 9 years.</td>
</tr>
<tr>
<td>4. Long Term Effectiveness</td>
<td>Does not present a permanent solution to remediating risks from the tailings and waste rock piles.</td>
<td>Does not present a permanent solution to all risks.</td>
<td>Capping is a permanent remedy that eliminates the need for long term site management.</td>
<td>Off-site disposal is a permanent remedy that eliminates the need for long term site management.</td>
<td>Fixation is a permanent remedy that removes exposure to human health and this environment.</td>
<td>Reprocessing is a permanent remedy that eliminates the need for long term site management.</td>
</tr>
<tr>
<td>5. Implementability</td>
<td>Constructed with available equipment.</td>
<td>Constructed with available equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Local mills can be used but are currently inoperable.</td>
</tr>
<tr>
<td>6. Cost ($)</td>
<td>0</td>
<td>25,200</td>
<td>275,100</td>
<td>1,809,300</td>
<td>230,400</td>
<td>1,9-3,190,000</td>
</tr>
<tr>
<td>- Capital</td>
<td>0</td>
<td>43,400</td>
<td>275,100</td>
<td>1,809,300</td>
<td>230,400</td>
<td>1,9-3,190,000</td>
</tr>
<tr>
<td>- Present Worth</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Community Acceptance</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
</tr>
<tr>
<td>8. State Acceptance</td>
<td>No Action is acceptable as an interim solution only.</td>
<td>State's preferred alternative.</td>
<td>Capping should be considered in future studies.</td>
<td>Costs are the major concern.</td>
<td>May be considered in future studies.</td>
<td>State would encourage reprocessing if economically feasible.</td>
</tr>
<tr>
<td>9. Overall Protection of Human Health and the Environment</td>
<td>May result in adverse effects due to runoff and direct contact with piles.</td>
<td>Reunion control eliminates some of the risk to the environment.</td>
<td>Capping is a permanent solution that removes exposure to human health and this environment.</td>
<td>Off-site disposal is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Fixation is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Reprocessing is a permanent solution that reduces exposure to human health and the environment.</td>
</tr>
<tr>
<td>Criteria</td>
<td>No Action</td>
<td>Stabilization/Runon Control</td>
<td>Capping</td>
<td>Off-Site Disposal</td>
<td>Chemical Fixation</td>
<td>Reprocessing</td>
</tr>
<tr>
<td>----------------------------------------------</td>
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<td>-----------------------------</td>
<td>---------</td>
<td>------------------</td>
<td>-------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Quartz Hill Tunnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Compliance with ARARs</td>
<td>Runoff does not meet AQMC. Collapse would result in degradation below MCLs and AQMC.</td>
<td>Runoff will not meet AQMC.</td>
<td>Runoff will meet AQMC.</td>
<td>Risks are removed. Disposal will meet RCRA.</td>
<td>Runoff will meet most AQMCs.</td>
<td>Risks are removed. Reprocessed tailings are not RCRA wastes. Leachates will exceed AQMCs.</td>
</tr>
<tr>
<td>2. Reduction of mobility, toxicity or volume</td>
<td>No reduction of M,T,V.</td>
<td>Reduces mobility.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces mobility and toxicity on-site materials are placed in another location.</td>
<td>Reduces mobility of contaminants of concern.</td>
<td>Reduces M,T and V.</td>
</tr>
<tr>
<td>3. Short Term Effectiveness</td>
<td>No reduction of existing risks from catastrophic collapse of piles and from runoff or ingestion.</td>
<td>Eliminates some contamination to stream; can be completed in 6 mo.</td>
<td>Eliminates existing risk to human health and the environment. Capping can be completed in 12-18 months.</td>
<td>Existing risk to human health and the environment are eliminated. Off-site disposal can be completed in two years.</td>
<td>Eliminates existing risk to human health and the environment. Fixation can be completed in 12-18 months.</td>
<td>Eliminates existing risk to human health and the environment. Reprocessing can be completed in 5 to 9 years.</td>
</tr>
<tr>
<td>4. Long Term Effectiveness</td>
<td>Does not present a permanent solution to remediating risks from the tailings and waste rock piles.</td>
<td>Does not present a permanent solution to all risks.</td>
<td>Capping is a permanent remedy that eliminates the need for long term site management.</td>
<td>Off-site disposal is a permanent remedy that eliminates the need for long term site management.</td>
<td>Fixation is a permanent remedy that eliminates the need for long term site management.</td>
<td>Reprocessing is a permanent remedy that eliminates the need for long term site management.</td>
</tr>
<tr>
<td>5. Implementability</td>
<td>Constructed with available equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Constructed with available construction equipment.</td>
<td>Local mills can be used but are currently inoperable.</td>
</tr>
<tr>
<td>6. Cost ($)</td>
<td>0</td>
<td>197,500</td>
<td>665,900</td>
<td>565,400</td>
<td>305,000</td>
<td>857,000 - 1,379,000</td>
</tr>
<tr>
<td>- Capital</td>
<td>0</td>
<td>219,000</td>
<td>882,300</td>
<td>565,400</td>
<td>521,400</td>
<td>857,000 - 1,379,000</td>
</tr>
<tr>
<td>- Present Worth 10%</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Community Acceptance</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
<td>No Action is preferred alternative.</td>
</tr>
<tr>
<td>8. State Acceptance</td>
<td>No Action is acceptable as an interim solution only.</td>
<td>State's preferred alternative.</td>
<td>Capping should be considered in future studies.</td>
<td>Costs are the major concern.</td>
<td>May be considered in future studies.</td>
<td>State would encourage reprocessing if economically feasible.</td>
</tr>
<tr>
<td>9. Overall Protection of Human Health and the Environment</td>
<td>May result in adverse effects due to runoff and direct contact with piles.</td>
<td>Runon control eliminates some of the risk to the environment.</td>
<td>Capping is a permanent solution that removes exposure to human health and this environment.</td>
<td>Off-site disposal is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Fixation is a permanent solution that reduces exposure to human health and the environment.</td>
<td>Reprocessing is a permanent solution that reduces exposure to human health and the environment.</td>
</tr>
</tbody>
</table>
SELECTED REMEDY

Description of Selected Remedy

The selected remedy for Operable Unit Two of the Clear Creek/Central City site consists of slope stabilization and runon control.

The Remedial Investigation identified four potential exposure pathways by which the tailings and waste rock piles could impact human health and the environment. These potential pathways are:

- Collapse of tailings and waste rock piles into streams;
- Runoff from tailings and waste rock piles into streams;
- Inhalation of dust from the piles; and
- Ingestion of material from the piles.

Two sites were identified that had tailings and waste rock piles that had the potential to collapse into Clear Creek or North Clear Creek because of unstable slopes. The two sites are the Big Five Tunnel and the Gregory Incline. The Argo Tunnel tailings and waste rock pile was also identified as being unstable because of being undercut. If the Argo waste rock pile fails, the structures below it would be affected, however, the waste rock would not reach Clear Creek. Based on the effects on human health and the environment from the potential collapse of the Big Five waste rock pile into Clear Creek, it is recommended that the slopes on both sides of the creek be regraded and stabilized and rock rip-rap be placed on the toe to protect the slope from eroding and collapsing into Clear Creek. Based on the effects on human health and the environment from the potential collapse of the tailings and waste rock pile at the Gregory Incline, it is recommended that the gabion-basket wall be maintained until monitoring indicates remediation is necessary or until the tailings are removed for reprocessing. At that time, a permanent solution will be implemented. Specific details concerning the stabilization remedial actions will be developed during Remedial Design. The cost of this remediation is provided in Table 3.

The second exposure pathway is contaminated water from both runoff and runon over the tailings and waste rock piles. Runoff can be controlled by alternatives such as: capping, chemical fixation, reprocessing, and off-site disposal. Because of the high cost to control runoff and the fact that the quantity of runoff, as opposed to runon, from the five sites is small when compared to the total runoff from the mining district (less than 0.01 percent of the total during storm events), no large-scale
TABLE 3
SUMMARY OF COST FOR PREFERRED OPTION

<table>
<thead>
<tr>
<th>Cost</th>
<th>Slope Stabilization</th>
<th>Runon Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gregory Incline</td>
<td>$ 0</td>
<td>$ 25,300</td>
</tr>
<tr>
<td>National Tunnel</td>
<td>$ 0</td>
<td>19,700</td>
</tr>
<tr>
<td>Quartz Hill</td>
<td>-</td>
<td>154,300</td>
</tr>
<tr>
<td>Argo Tunnel</td>
<td>-</td>
<td>31,900</td>
</tr>
<tr>
<td>Big Five</td>
<td>207,800</td>
<td>231,400</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$207,800</strong></td>
<td><strong>$462,600</strong></td>
</tr>
<tr>
<td>Engineering, Management and Contingency</td>
<td>$ 58,200</td>
<td>129,500</td>
</tr>
<tr>
<td><strong>Total Capital</strong></td>
<td><strong>$266,000</strong></td>
<td><strong>$592,100</strong></td>
</tr>
</tbody>
</table>

OPERATIONS AND MAINTENANCE

<table>
<thead>
<tr>
<th></th>
<th>Slope Stabilization</th>
<th>Runon Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five Year Evaluation</td>
<td>$ 10,000</td>
<td>$ 10,000</td>
</tr>
<tr>
<td>Annual Repair</td>
<td>9,000</td>
<td>25,000$^a$</td>
</tr>
<tr>
<td>Annual Total</td>
<td>10,800</td>
<td>30,000</td>
</tr>
<tr>
<td>(including 20% contingency)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five Year Recurring Total</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>(including 20% contingency)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PRESENT WORTH COST

(Inflation = 4% and Interest = 10%)

|                              | $330,900            | 718,700       |

TOTAL BOTH OPTIONS           | $1,049,600

$^a$ Includes repair of five percent of the total length each year.
remediation to eliminate runoff is proposed. However, runon
controls (upgradient ditches) have been incorporated into the
proposed remediation. The costs for runon control are shown for
all five sites in Table 3. Runon controls will substantially
reduce the quantity of water flowing over the waste rock and
tailings piles. A detailed evaluation of these quantities is
provided in the Operable Unit No. Two FS (Appendix J). Based on
the benefit achieved by providing runon control and the
relatively small cost of these measures, runon controls are
recommended.

When final designs are completed to treat acid mine drainage
under Operable Unit No. One, collection and treatment of runoff
from tailings and waste rock piles at the treatment facilities
will be evaluated.

The third and fourth exposure pathways of concern are
ingestion and dust inhalation. As previously discussed,
acceptable risks are present for tourists and the occasional site
visitors (episodic exposure), therefore, no remedial actions are
currently recommended to alleviate ingestion and dust inhalation.
However, the Public Health Evaluation for the site indicated
that, for a residential scenario, risks resulting from the
inhalation and ingestion exposure pathways are of some concern.
Therefore, EPA will evaluate this No Action decision when the
final remedy is selected for the site. EPA, in coordination with
the State of Colorado and local officials, will evaluate the use
of institutional measures which would control any human health or
environmental threat that could be created by future development
upon these tailings and waste rock piles and any other piles
which the State identifies in its study. In addition, pursuant
to SARA Section 121(c), EPA will review no less than every five
years all properties where hazardous substances continue to
remain onsite and, if necessary, will reconsider this No Action
decision.

Documentation of Significant Changes

EPA identified the Slope Stabilization and Runon Control
Alternative as the preferred alternative in the Proposed Plan
which was released to the public on November 9, 1987. The key
elements of this alternative as stated in the Proposed Plan were
runon control on all five tailings and waste rock piles and slope
stabilization of the Big Five and the Gregory Incline.

At the time of the release of the Proposed Plan, EPA was
proposing to remove the gabion-basket wall at the Gregory Incline
and replace it with a crib wall. EPA intended to take the
property owner's desire to reprocess tailings at the Gregory
Incline into account when replacing the gabion-basket wall. Since
that time, EPA has received extensive comment on this portion of
the Proposed Plan and has modified the selected remedy to address
these concerns. The primary difference between the preferred remedy as presented in the Proposed Plan and the selected remedy as presented in this Record of Decision is that EPA no longer plans to immediately replace the gabion-basket wall, but will instead maintain the wall until monitoring indicates that the wall needs to be replaced or until the tailings are removed for reprocessing. The EPA will still take the owner's reprocessing concerns into account while monitoring and maintaining the wall.

The selected remedy is a logical outgrowth of the remedy identified in the Proposed Plan and other alternatives developed and evaluated in the Operable Unit No. Two FS. The components of the selected remedy were conceptually evaluated in the FS and the selected remedy is well within the range of alternatives the public could have reasonably anticipated EPA to be considering.

STATUTORY DETERMINATIONS

Protectiveness:

The Public Health Evaluation for the Clear Creek/Central City Superfund Site clearly shows that Clear Creek and North Clear Creek are being impacted by the acid mine discharges and the tailings and waste rock piles which are associated with the site. These impacts include:

- degradation of downstream surface water quality resulting from dissolved and suspended metals in the discharges and resuspended metal laden sediments below the discharges;

- degradation of downstream surface water quality due to potential collapse of the tailings and waste rock piles into either Clear Creek or North Clear Creek; and

- degradation of downstream surface water quality due to runon and runoff from the tailings and waste rock piles.

These impacts pose no immediate danger to public health because the cities of Idaho Springs, Blackhawk, Central City, and Golden have municipal water supply systems that meet MCLs. However, these impacts result in severely degraded water quality affecting aquatic life and productivity and reduced or destroyed aquatic habitat in Clear Creek and North Clear Creek.

The first impact mentioned above is associated with the acid mine discharges and was addressed under Operable Unit No. One. The other two impacts are associated with the tailings and waste rock piles and are addressed in this Operable Unit.

The selected remedy for this Operable Unit includes slope stabilization which will reduce the potential for a collapse of
unstable tailings and waste rock piles into the creeks and runon control measures which will divert water around the piles thereby eliminating the impact due to runon. This portion of the selected remedy is therefore protective and will result in an improvement of the water quality in Clear Creek and North Clear Creek.

The Public Health Evaluation also considered impacts to human health resulting from inhalation or ingestion of material from the tailings and waste rock piles. However, as discussed earlier in this document and as shown in Table 1, there are no current impacts to human health from these exposure pathways. For this reason, the selected remedy for this portion of the Operable Unit, No Action, is protective of human health.

Under the potential future residential use scenario the risk from ingestion of soil is of some concern. For this reason, EPA, when selecting the final remedy, will consider institutional measures to control future development upon the tailings piles.

Consistency With Other Laws:

Pursuant to SARA Section 121(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release which at a minimum assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate Federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a State environmental or facility siting law that is more stringent than any Federal standard (ARARs).

On December 23, 1986 EPA requested that the State of Colorado provide a list of applicable or relevant State requirements, standards, criteria and limitations for the Clear Creek/Central City Site. The State responded on May 14, 1987 with a list of requirements pertaining to Operable Unit No. One. The State did not formally submit a list of requirements for Operable Unit No. Two. Subsequently, however, probable State requirements were identified by State and EPA staff through informal discussions. These informally identified requirements were taken into account during the development of alternatives for tailings and waste rock remediation.

EPA classified all Federal and State public health and environmental requirements applicable or relevant and appropriate to the tailings and waste rock remediation into three categories: contaminant-specific ARARs, action-specific ARARs, and location-specific ARARs. A description of each of these categories is
provided in Section 2 of the Operable Unit No. Two FS. Tables 2-1 and 2-2 in the FS contain a brief description of each potential Federal and State public health and environmental requirement identified and EPA's analysis of each requirement's applicability or relevance and appropriateness to the operable unit.

EPA has determined that the contaminant-specific ARARs for Operable Unit No. Two are the Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act, Ambient Water Quality Criteria (AWQCs) established under the Clean Water Act and State Water Quality Standards. There are currently no identified contaminant-specific ARARs for metals in soils so EPA relied on action-levels established through the risk assessment. These action levels are contained in Table 2-3 of the Operable Unit No. Two FS.

The selected remedy for Operable Unit No. Two is an interim remedy which is consistent with the final remedy and which, pursuant to SARA Section 121(d)(4)(A), requires the exercise of the "interim remedy" waiver from the contaminant-specific ARARs mentioned in the previous paragraph, that is, the selected remedy is only part of a total remediation that will attain such a level or standard of control when completed. Location- and action-specific ARARs will be met.

In accordance with SARA Section 121(d)(2)(A)(ii), EPA intends that the final remedy will at least attain water quality criteria established under the Acts mentioned above. However, additional data collection and use attainability analyses are necessary for EPA to determine if such criteria are appropriate under the circumstances of the release or whether site-specific modification to the criteria would more appropriately establish clean-up goals for the site. EPA will make this determination as part of the final remedy selection.

**Cost-effectiveness and Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable:**

The Slope Stabilization and Runon Control Alternative is a cost-effective remedial action alternative which effectively mitigates and minimizes threats to and provides adequate protection of public health and the environment. Other than the No Action Alternative, this is the least expensive alternative of those considered. (See Table 2.) The estimated total cost for the selected remedy is anticipated to be $1,049,600. This cost includes operation and maintenance activities and the cost of the five-year evaluation.
The selected remedy does not satisfy the statutory preference for treatment as a principal element because treatment was found to be impracticable at this time. However, EPA leaves open the opportunity for any future treatment or reprocessing which can be shown to be protective of human health and the environment and which attains Federal and State public health and environmental requirements that are applicable or relevant and appropriate.