489638

INTERIM RECORD OF DECISION

OPERABLE UNIT 2
INTERIM WATER
TREATMENT OPERATIONS

GILT EDGE MINE NPL SITE
LAWRENCE COUNTY,
SOUTH DAKOTA

November 2001

U.S. Environmental Protection Agency
999 18th Street, Suite 500
Denver, Colorado 80202

Final

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Acronyms

ARARs	applicable or relevant and appropriate requirements
ARD	acid rock drainage
BMC	Brohm Mining Corporation
BOR	U.S. Bureau of Reclamation
CDM Federal	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
COPC	chemicals of potential concern
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FEMA	Federal Emergency Management Agency
FFS	focused feasibility study
FIRM	Flood Insurance Rate Map
gpm	gallons per minute
HDPE	high-density polyethylene
HLP	heap leach pad
MCSC	minimum cost to site closure
N/P	neutralization/precipitation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	operations and maintenance
OU	operable unit
PA	preliminary assessment
PMP	probable maximum precipitation
RAGs	remedial action goals
RAOs	remedial action objectives
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SDDENR	South Dakota Department of Environment and Natural Resources
SI	site inspection
Site	Gilt Edge Mine NPL Site
TDS	total dissolved solids
UOS	URS Operating Services
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WTP	water treatment plant
mg/L	milligram per liter
°F	degrees Fahrenheit

Part 1
Declaration

1.1 Site Name and Location

The Gilt Edge Mine NPL Site (Site) (EPA ID No. SDD987673985) is located southeast of the towns of Lead and Deadwood in the northern Black Hills in Lawrence County, South Dakota. Specifically, the site is in parts of Sections 4, 5, 6, 7, 8, and 9, Township 4 North, Range 4 East of the Deadwood South Quadrangle, Lawrence County, South Dakota (U. S. Geological Survey [USGS] 1971).

EPA has organized the site management and remedial response activities into three operable units:

- Operable Unit 1: Site-Wide Gilt Edge Mine
- Operable Unit 2: Interim Water Treatment Operations
- Operable Unit 3: Ruby Gulch Waste Rock Dump

1.2 Statement of Basis and Purpose

This decision document presents the selected remedy for an interim response action at the Gilt Edge Mine OU2, Interim Water Treatment Operations, in Lawrence County, South Dakota. The selected remedy was chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. The decision is based on the administrative record file for this site. The State of South Dakota concurs with the selected remedy.

1.3 Assessment of the Site

The response action selected in this interim ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 Description of the Selected Remedy

EPA completed a focused feasibility study (FFS) for the Interim Water Treatment Operations OU in August 2001. This ROD will be consistent with, and will not preclude implementation of, the final remedy(ies) at the Site.

Operable Unit 2, the subject of this ROD, addresses contamination associated with surface water acid rock drainage (ARD). The remedy selected by EPA for this interim remedial action is:

(a) collection and diversion of ARD seep flows for treatment, and
(b) conversion of the existing sodium hydroxide treatment plant to a less costly lime-based or metals-coordination treatment/filtration system .

The purpose of the selected remedy for this interim action is to:

(1) reduce the migration of metal contaminants and acid water to Strawberry Creek from Hoodoo Gulch and Pond C;

(2) reduce metals-contaminant concentrations in surface water discharged to Strawberry Creek;

(3) increase the net amount of ARD treatment through the current water treatment system to 250 gallons per minute (gpm), thereby reducing the threat of contaminant release to downgradient water consumers, and

(5) reduce the operating costs of the water treatment system.

The major components of this interim remedial action include:

- Collect and convey ARD seep flows from Hoodoo Gulch and Pond C to the water treatment plant (WTP).
- Modify the existing sodium hydroxide-based WTP to convert to either (1) a lime-based neutralization/precipitation (N/P) process, including, if necessary, a circular clarifier and/or filtration equipment for post sedimentation effluent polishing, or (2) construct a new optimized chemical precipitation WTP using a proprietary metals-coordination process with microfiltration and pH adjustment
- If necessary, de-water solids produced with a filter press, and contain de-watered sludge on site.

1.5 Statutory Determinations

This interim action is protective of human health and the environment in the short term and is intended to provide protection until a final ROD is signed; complies with those federal and state requirements that are applicable or relevant and appropriate for this limited-scope action with the exception of water quality standards for selenium and TDS (this ROD provides a limited interim waiver of these standards); and is cost-effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment and, thus, supports the statutory mandate. This action does not constitute the final remedy for the Interim Water Treatment Operations OU; the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to address fully the threats posed by conditions at the Gilt Edge Mine Site. Because this remedy will result in hazardous substances remaining on site above health based levels, a review will be conducted to ensure that the remedy continues to provide protection of human health and the environment within 5 years after commencement of the remedial action. Because this is an interim action ROD, review of this site and the remedy will be ongoing as EPA continues to develop remedial alternatives for the Site-Wide Gilt Edge Mine Site OU.

1.6 ROD Data Certification Checklist

The following information is included in the decision summary section of this interim ROD. Additional information can be found in the administrative record file for this site.

- Chemicals of concern and their respective concentrations
- Cleanup levels established for chemicals of concern and the basis for these levels
- How contaminated waters constituting principle threats are addressed
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy costs are projected
- Key factor(s) that led to selecting the interim response action

The following information was not included in the decision summary section of this interim ROD because of work in progress.

- Baseline risk presented by the chemicals of concern
- Current and reasonably anticipated future land uses assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and interim ROD
- Potential land and groundwater use that will be available at the site as a result of the selected remedy

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11/30/01
Date

Concurrence:
Tim Tollefsrud, Director
Division of Environmental Services
South Dakota Department of Environment and Natural Resources

11/30/01
Date

Part 2
Decision Summary

2.1 Site Name, Location, and Description

The Gilt Edge Mine NPL Site (EPA ID No. SDD987673985) is located southeast of the town of Lead in the northern Black Hills in Lawrence County, South Dakota. Specifically, the site is in parts of Sections 4, 5, 6, 7, 8, and 9, Township 4 North, Range 4 East of the Deadwood South Quadrangle, Lawrence County, South Dakota (USGS 1971). The lead agency for the site is the EPA with support from SDDENR. The source of funding for this site is expected to be the Superfund trust fund, with South Dakota providing 10 percent of the cleanup costs as required by CERCLA.

The Gilt Edge Mine NPL Site is an abandoned 258-acre open pit, cyanide heap leach gold mine, developed in highly sulfidic rock (see Figure 1). The area has been mined intermittently by several owners beginning in the late 1800s. Cyanide leaching, mercury amalgamation, and zinc precipitation among other methods were used to recover gold. Placement of the Gilt Edge Mine Site on the NPL is based on releases of cadmium, cobalt, copper, manganese, lead, and zinc that have been documented in Strawberry Creek, a tributary to Bear Butte Creek, and Bear Butte Creek. Strawberry Creek and Bear Butte Creek are classified by the South Dakota Department of Environment and Natural Resources as:

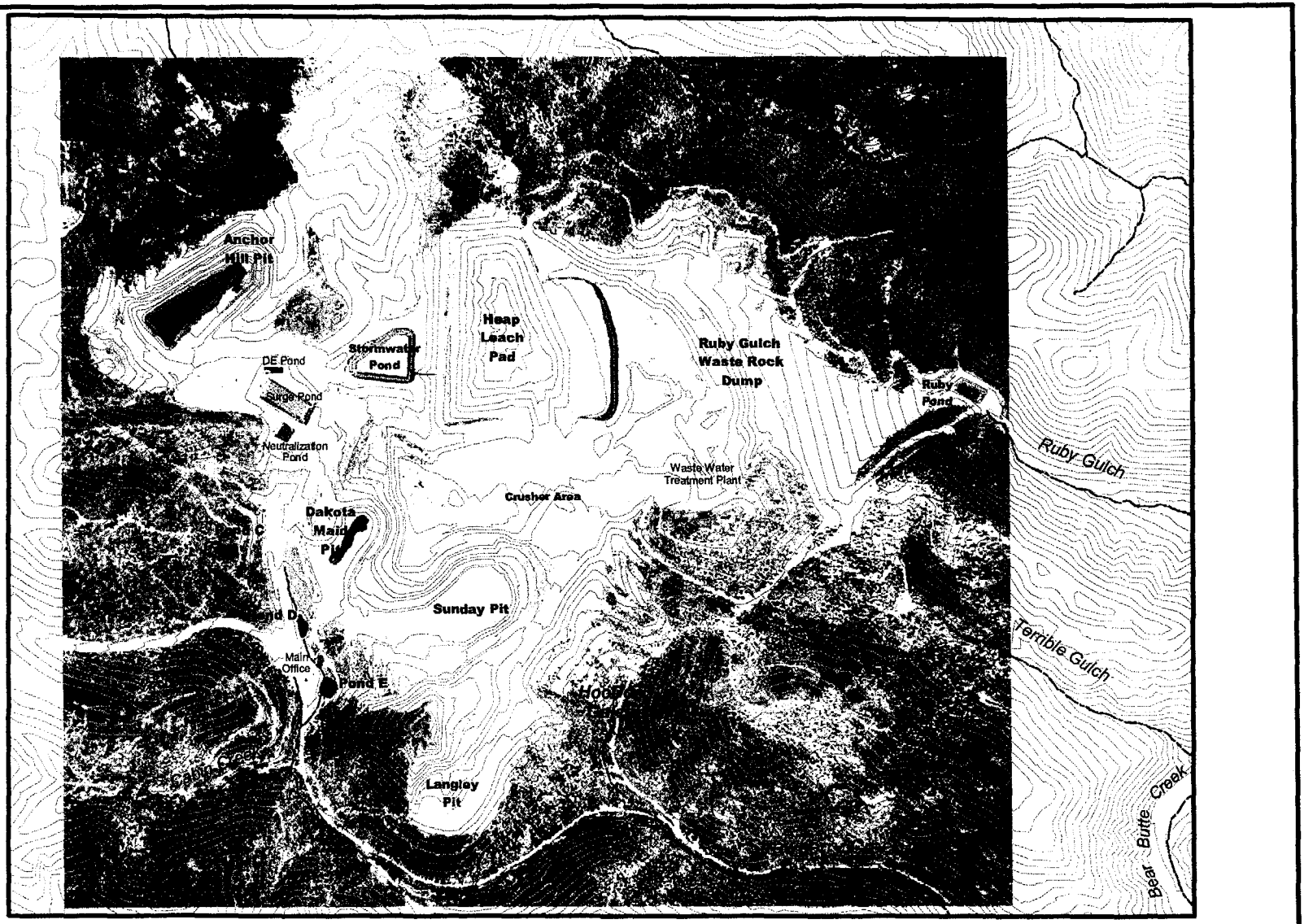
- Cold water marginal (Strawberry Creek) and cold water permanent (Bear Butte Creek) fish life propagation waters
- Limited-contact recreation waters
- Fish and wildlife propagation, recreation, and stock watering waters
- Irrigation waters

2.2 Site History and Enforcement Activities

2.2.1 Site History

Mining activities began at the site in 1876 when the Gilt Edge and Dakota Maid claims were located. Historical underground mining operations extracted sulfide-bearing gold ores from irregular deposits in veins and fracture zones in the igneous rocks.

The property of the Gilt Edge Mines, Inc. is a consolidation of claims, including the Sunday, Rattlesnake Jack, Gilt Edge, Dakota Maid, Oro Fino groups, and others. The property has had a number of owners and operators over the past century (Bureau of Reclamation [BOR] 2000). The Oro Fino Mine was the first mine in the area, and it began and ended operations in 1893. No mining was conducted again until 1900. The Hoodoo-Union Hill group of mines



LEGEND

- Creek or Stream
- Topographic Contour - 25-foot interval
- Mine Site Extent

N

400 0 400 800 Feet

Figure 1

SITE FEATURES
GILT EDGE MINE SITE
LAWRENCE COUNTY, SOUTH DAKOTA

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was located adjacent to the Gilt Edge group. The Hoodoo-Union Hill group was active around 1900. The Anchor Mountain mine was also historically active in 1900. The original Gilt Edge Mining Company operated from 1900 to 1902. No mining was conducted between 1902 and 1905. The Gilt Edge-Maid Gold Mining Company operated from 1905 to 1916. Production of gold and silver and small amounts of copper, lead, and zinc are reported from the properties at Gilt Edge. Mining continued sporadically until 1916. No mining occurred at the Gilt Edge Mine between 1916 and 1935.

The Gilt Edge Mining Company was incorporated in South Dakota in 1935; the mine reopened in 1937 and operated until 1941 (EPA 2000a). In 1938, the Gilt Edge Mine milling operation used a cyanidization gold extraction process that was capable of processing 125 tons of ore per day. Mercury amalgamation was used on the jig concentrate, while zinc precipitation was used on the flotation solids (URS Operating Systems [UOS] 1999).

Production of gold and silver, along with small amounts of copper, lead, and zinc, were reported from the properties at Gilt Edge. Copper caused losses in the cyanide circuit in 1940, which prompted management to install flotation cells; the copper concentrates were sold to Montana smelters. The mines also produced a small amount of tungsten in 1941. Underground mines include the Gilt Edge, Pyrite, Rattlesnake Jack, Hoodoo, Union Hill, and Anchor. The underground mining operations broke through to the surface leaving gloryhole openings and some limited surface mining at the site (UOS 1999).

Mill tailings were deposited in Strawberry Creek and Bear Butte Creek by Gilt Edge Mines, Inc. at the request of the residents of Galena and Sturgis in an effort to have the tailings plug up sink holes in Bear Butte Creek to preserve stream flow through the towns (EPA 2000a). Mill tailings were discharged to Strawberry Creek until the mine closed in 1941. Piles of acidic tailings were left along Strawberry Creek. These tailings continually discharged acid and metals into Strawberry Creek and contributed to sediment loads as the piles eroded. During the early 1980s, SDDENR observed several tens of thousands of tons of acid-generating tailings in upper Strawberry Creek (UOS 1999). A spring at the base of these tailings was discharging water with a pH of 1.9. Underground mine entrances and shafts were also discharging acidic water and metals (EPA 2000a). No aquatic life was observed in Strawberry Creek at that time.

In 1984, Gilt Edge, Inc. applied for a permit to begin a heap leach operation. By that time, Gilt Edge, Inc. had acquired the claims of the Hoodoo-Union Hill and Anchor Hill Mining companies. Gilt Edge, Inc. was acquired by Brohm Mining Corporation (BMC) before a permit was issued (UOS 1999).

In 1986, the South Dakota Board of Minerals and Environment issued South Dakota Mining Permit No. 439 to BMC for the open pit/heap leach operations (UOS 1999). The permit contained several conditions that addressed the tailings and the potential for ARD. Beginning in 1993, over 150,000 tons of relic tailings were removed from the upper Strawberry Creek drainage by BMC. The permit contained a condition that allowed use of some of the tailings for the construction of the heap leach pad liner. Other tailings were mixed with fly ash from a local coal-fired power plant; these amended tailings were placed on upper portions of the pit benches and were top soiled in 1994 (UOS 1999). Another condition of the permit required BMC to install a pumpback system designed to prevent acid discharges from the mine

workings from entering Strawberry and Bear Butte Creeks. Construction of the open-pit mine and cyanide heap leaching facilities was initiated in August 1987. Mining of the Dakota Maid and Sunday open pits was completed in 1992, which resulted in the removal of old glory hole openings.

In 1991, cyanide leaked from the cyanide heap leach pad into Strawberry Creek and Bear Butte Creek. Unpermitted discharges of acid water, aluminum, cadmium, copper, lead, and zinc from two areas were identified by EPA during an inspection in 1992 under the National Pollutant Discharge Elimination System (NPDES). In 1993, EPA issued an NPDES surface water discharge permit to BMC to address metals and cyanide discharges. Three NPDES compliance points were designated, including one in Strawberry Creek and two in Ruby Gulch, an intermittent tributary to Bear Butte Creek. NPDES permit violations based on low pH and levels in excess of permitted concentrations of cadmium, copper, and zinc have occurred on several occasions since the permit was issued.

Previous work done by BMC's consultant, OEA Research, Inc., documents the impact to benthic macro invertebrate communities along Strawberry Creek, as well as downstream of the confluence of Strawberry Creek with Bear Butte Creek (UOS 1999). ARD from the Ruby Waste Dump was first detected in 1993.

Subsequent operations by BMC developed the North and Southeast Langley Pits and the Anchor Hill pit areas. A large-scale mining permit for the Anchor Hill deposit was issued by the State of South Dakota on January 19, 1996. The Anchor Hill project was split into Phase I, located on private land, and Phase II on United States Department of Agriculture (USDA) Forest Service land. Mining of the Phase I deposit was initiated in May of 1996 and completed by August of 1997. The Langley Pit area was mined at the same time (1996 to 1997) as Anchor Hill Phase I.

Phase II of the Anchor Hill project was delayed because of the need for completion of an environmental impact statement by the USDA Forest Service. A favorable Forest Service decision was issued for Phase II of Anchor Hill in November 1997. However, in response to appeals, the USDA Forest Service withdrew its approval on February 18, 1998. On May 21, 1998, BMC reported that it would abandon the site by May 29, 1998. The state filed for a temporary restraining order to prevent BMC's abandonment of the Gilt Edge Mine Site. The temporary restraining order was granted on May 29, 1998 in circuit court in Sturgis, South Dakota. The temporary restraining order was followed by a preliminary injunction granted on June 5, 1998 in circuit court in Deadwood, South Dakota. BMC's parent company, Dakota Mining Corporation, filed for bankruptcy in Canada in July 1999. SDDENR assumed water treatment operations using the South Dakota Regulated Substance Response Fund in 1999 and sought NPL listing from EPA in February 2000. The Site was placed on the National Priorities List in December 2000.

2.2.2 Enforcement-Related Activities

The following summarizes the history of documented releases of hazardous substances into surface water and related enforcement actions at the site.

December 1939 through September 1941 - Mine tailings were discharged down Strawberry Creek and into Bear Butte Creek. When the mine closed in 1941, piles of acidic tailings were left along Strawberry Creek. These tailings continually discharged acid and metal-laden water into the creek, until they were removed by Brohm Mining Corporation (BOR 2000).

June 20 to 21, 1991 - Cyanide leaked from the cyanide heap leach pad and was released into Strawberry Creek and Bear Butte Creek. Sodium cyanide was used in the heap leach process to extract gold from crushed ore (EPA 2000b). SDDENR issued Brohm a Notice of Violation (NOV) and Order and received a penalty of $99,800.

1991 - A preliminary assessment of the Gilt Edge Mine Site was prepared by SDDENR.

May 19, 1992 - EPA conducted an NPDES Inspection and found that contaminated water was discharging from two areas without a permit: (1) water seeping from the toe of Ruby Dump, and (2) pollutants from several point sources entering the Strawberry Creek diversion culvert through sedimentation ponds. The pH of the water from the toe of Ruby Dump was low and contained the following pollutants: aluminum, cadmium, copper, lead, and zinc; the pH of water discharged to Strawberry Creek was also low and contained the following pollutants: ARD, aluminum, cadmium, copper, iron, lead, and zinc (EPA 2000b).

August 10, 1992 - EPA transmitted an inspection report to Brohm requiring application for a NPDES permit (EPA 2000b).

November 24, 1992 - EPA issued a Findings of Violation and Order for Compliance, setting forth monitoring requirements and interim performance standards for Strawberry Creek and Ruby Gulch (EPA 2000b).

April 19, 1993 - SDDENR issued a NOV based on low pH and concentrations of sulfate, aluminum, copper, iron, manganese, and zinc in the Ruby Gulch discharge (EPA 2000b).

September 14, 1993 - EPA executed an Order for Compliance on Consent, which superceded the November 24, 1992 order (EPA 2000b).

September 15, 1993 - EPA issued NPDES permit Number SD-0026891 to Brohm (EPA 2000b).

February 15, 1994 - SDDENR issued a letter regarding NPDES permit violations at Compliance Point 002 in Ruby Gulch (for pH, cadmium, copper, and zinc) (EPA 2000b).

March 31, 1994 - EPA issued a Notice of Proposed Assessment of Class II Civil Penalty on NPDES permit Number SD-0026891 (EPA 2000b).

August 25, 1994 - EPA issued a Consent Order based on permit violations, including February 1994 violations in Ruby Gulch (EPA 2000b).

February 20, 1997 – SDDENR issued a NOV for the discharge of acid mine discharges into Strawberry Creek. Brohm paid a $5,400 penalty.

September 15, 1997 - SDDENR issued a NOV for two discharges of acid mine drainage into Strawberry Creek. Brohm paid an $18,000 penalty.

September 5, 1998 - SDDENR issued a NOV and Order for Compliance for NPDES permit violations (including cadmium, copper, and zinc) at Strawberry Creek Compliance Point 001 in 1996, 1997, and 1998 (EPA 2000b).

March 31, 1994 through January 31, 2000 - Numerical violations of NPDES permit limits at Compliance Points 001 and 002 (EPA 2000b).

July 1999 - SDDENR averted an acid water discharge by operating necessary water treatment operations at the Site using the state's Regulated Substance Response Fund. SDDENR operated the water treatment plant to remove metals using standard pH adjustment methods with sludges discharged back into an open pit.

1999 - UOS prepared the site inspection (SI) for the Site in 1999. Soil, sediment, and surface water sampled were collected and analyzed for heavy metals and cyanide during the SI (UOS 1999).

2000 - In February the Governor of South Dakota requested that EPA propose the Site for the Superfund National Priorities List (NPL) and provide emergency response, as well as long-term remedial cleanup. The Site was proposed for NPL listing on May 11, 2000. The final listing of the Site was on December 1, 2000. In August EPA's Region 8 Emergency Response Program assumed site-wide interim water-treatment operations and also began cleanup activities at the Ruby Gulch Waste Rock Dump (Ruby Dump).

Present - Superfund Remedial Response Program remedial investigations and feasibility studies and cleanup activities are now under way.

2.3 Community Participation

The final FFS and proposed plan for the Gilt Edge Mine Site Interim Water Treatment Operations OU2 were made available to the public in September 2001. They can be found in the administrative record file in the EPA Region 8 Superfund Records Center, 999 18th Street, Denver, Colorado, and in the information repository maintained at the Hearst Public Library in Lead, South Dakota. The notice of the availability of the FFS and the proposed plan was published in the *Black Hills Pioneer* and the *Weekly Prospector* during the week of September 3, 2001. A public comment period was held from September 3, 2001 to October 3, 2001. In addition, a public meeting was held on September 13, 2001 to present the proposed plan to a broader community audience than those that had already been involved at the site. At this meeting, representatives from EPA and SDDENR answered questions about the site and the remedial alternatives. EPA's response to the questions and comments received during this period is included in the Responsiveness Summary, which is part of this interim ROD.

2.4 Scope and Role of Operable Units

As with many Superfund sites, the problems at the Gilt Edge Mine Site are complex. As a result, EPA has organized the work into three operable units:

- Operable Unit 1 (OU1): Site-Wide Gilt Edge Mine
- Operable Unit 2 (OU2): Interim Water Treatment Operation
- Operable Unit 3 (OU3): Ruby Gulch Waste Rock Dump

Operable Unit 1, Site-Wide Gilt Edge Mine, will address overall contamination of the site. OU1 will address all remedy components for the site, including final water treatment plans and any residual risks associated with the Ruby Dump. EPA is currently implementing a remedial investigation and feasibility study and a site-wide risk assessment for this operable unit.

Operable Unit 2, Interim Water Treatment Operation, the subject of this interim ROD, addresses the continuing need to cost-effectively treat ARD produced by residual leachate from the Ruby Dump; from site-wide ARD formed as a result of precipitation; and from pump-down of ARD stored in pits and ponds on site. Discharge of this water without treatment poses a current and potential risk to human health and the environment because contaminant concentrations are greater than the surface water quality criteria for Strawberry Creek and Bear Butte Creek. A focused feasability study completed in August 2001 examined in detail the basis for interim risk management and cost-effective interim response. This interim ROD will implement improved and more cost effective water management and treatment than that begun under the Early-Action Interim ROD issued in April 2001. This interim ROD will be consistent with, and will not preclude implementation of, the final remedy(ies) at the Site.

Operable Unit 3, Ruby Gulch Waste Rock Dump, addresses contamination associated with the largest ARD source on the site, the Ruby Dump. ARD generated from the sulfide materials of the Ruby Dump, if not reduced and contained, poses a major threat of erosion, contamination, and releases into the Ruby Gulch drainage and Bear Butte Creek. EPA selected an interim remedy for OU3 in a ROD signed on August 30, 2001. The action for OU3 addresses this threat by: reducing the volume of contaminated materials exposed; reducing infiltration that produces large quantities of ARD; and containing the materials of the Ruby Dump.

2.5 Site Characteristics

2.5.1 Surface Features

The Gilt Edge Mine NPL Site is located in the Black Hills of South Dakota, immediately adjacent to the upper reaches of Strawberry Creek and Ruby Gulch. The area has mountainous topography with elevations from approximately 5,320 to 5,520 feet above mean sea level (UOS 1999). The Site (see Figure 1) consists of a variety of features listed below.

- Ruby Gulch Waste Rock Dump (59.1 acres) was constructed as a tiered valley fill in the Ruby Gulch drainage for disposal of waste rock from the mining activities, as well as spent ores from the leach pads. The Ruby Dump is recognized as a significant source of ARD from the Gilt Edge mining operations (UOS 1999).

- Ruby Pond is a containment pond located in the Ruby Gulch drainage at the toe of the Ruby Dump to capture the ARD emanating from the waste rock. This lined pond has a reported capacity of 1,200,000 gallons. The ARD that drains from the Ruby Dump is collected in the containment pond and then pumped to the Sunday pit for storage prior to treatment. The ARD is treated at an onsite water treatment plant and released into the Strawberry Creek drainage. ARD from other site sources, including the Anchor Hill Pit and Dakota Maid Pit, is also pumped to the Sunday Pit for holding and treatment.
- Heap Leach Pad covers 37 acres with approximately 3.2 million tons of spent ore. Two eastward expansions to this pad were built; however, no ore was processed on the last expansion pad. The heap leach pad and its expansion areas consist variously of asphalt and several types of polyethylene and soil composite liner materials.
- Sunday Pit is a 29.5-acre pit that is partially backfilled. In October 2000, the pit contained approximately 65 million gallons of acid water. In September 2001 the pit contained 16 million gallons.
- Dakota Maid Pit is a 17.1-acre pit that is partially backfilled. In October 2000, the pit contained no standing water. In September 2001 the pit contained 3.5 million gallons.
- Langley Pit is an 8.1-acre pit mined by BMC in early 1997. The northern portion of the pit is partially backfilled.
- Anchor Hill Pit is a 23.6-acre pit mined as recently as 1997. In October 2000, the pit contained 56 million gallons of acid water. In September 2001 the pit contained 72 million gallons.
- Process Plant and Ponds occupy 14.5 acres and include the plant buildings, Surge Pond, Neutralization Pond, and Diatomaceous Earth Pond, all constructed with high density polyethylene (HDPE) primary liners and HDPE/soil composite secondary liners (EPA 2000b).
- Ponds C, D, E, and the Stormwater Pond occupy approximately 15 acres and in September 2001 contained approximately 6.5 million gallons of water.

2.5.2 Geology

2.5.2.1 Regional Setting

The Gilt Edge Mine NPL Site is located in the North-Central Black Hills of South Dakota in an area intruded by Tertiary age igneous rocks. The site hosts many rock types and has a complicated geologic structure (BOR 2000).

The porphyry ores historically mined at the site occur in thin sheets of auriferous limonite in small fractures or impregnations of decomposed parts of the porphyry. The limonite merges downward into pyrite and other sulfides, particularly copper sulfide. The main ore shoots occur where parallel and cross fracturing have formed brecciated zones that have become partly or wholly mineralized. The shoots are irregular in shape; some have been stoped as much as 100 feet in length and 50 feet in width (UOS 1999). Recent open pit mining has exposed large areas of sulfide bearing high walls and acid-generating fills to precipitation and groundwater.

2.5.2.2 Soils

There are three different soil associations encountered at the Gilt Edge Mine Site. These are the waste rock materials (Cc), the Grizzly-Virkula association, steep (GBE), and the Virkula association, hilly (VCE).

Grizzly soils are low in fertility and organic matter content. Their available water capacity is high. Permeability is moderately slow. These soils have a runoff that is rapid and a high shrink-swell potential.

Virkula soils are low in fertility and organic matter content. Their available water capacity is moderate to high. Permeability is moderately slow. These soils have a runoff that is medium to rapid and a high shrink-swell potential.

2.5.3 Climate

According to the Great Plains International Data Network, mean, minimum, and maximum temperatures in January and July are 5 and 33 degrees Fahrenheit (°F), and 55 and 80°F, respectively. Mean number of freeze-free days is 150. Prevailing winds are out of the northwest at approximately 10 to 13 miles per hour (UOS 1999).

Mean annual precipitation in the Black Hills area ranges from 19 to 24 inches. Mean annual snowfall is approximately 60 to 100 inches per year (UOS 1999). Precipitation is higher at the Site, ranging from 25 to 30 inches per year. For the purposes of stormwater modeling, the 10-year, 24-hour storm event was rated at 3.1 inches of precipitation, and the 100-year, 24-hour storm event was rated at 6.0 inches of precipitation. In response to measurements of intense storms at the mine in the 1990s, mine consultants Steffen, Robertson, and Kirsten revised upwards the design storm events for the site to 9.47 inches for the 100-year, 24-hour event; 5.87 inches for the 25-year, 24-hour event; and 4.28 inches for the 10-year, 24-hour event. The probable maximum precipitation (PMP) event has been estimated to be a 6-hour storm event of 19.6 inches (BOR 2000).

2.5.4 Site Groundwater

Detailed site investigations regarding groundwater aspects are ongoing as part of the site-wide studies. Groundwater is known to be a contributor to water inflows into the western portion of the site. In addition, investigations in the Dakota Maid and Sunday Pit areas indicate that fault and fracture zones are flow paths that can convey waters from the pit zones into the Strawberry Creek drainage alluvial and bedrock aquifers.

Groundwater monitoring wells GW-8 and GW-9 are alluvial and bedrock wells, respectively, located near the toe of the Ruby Waste Rock Dump. Well GW-9 was abandoned in 1996.

Well GW-9 did not show significant changes over time, and the chemistry did not suggest major impact from ARD. Well GW-8, a shallow alluvial well, has shown significant degradation in water quality over time as the dump has changed to strongly acid-generating conditions. The pH has declined significantly, while total dissolved solids (TDS) have increased. Trace elements have also typically increased in concentration over time, with the exception of iron, which has decreased.

Groundwater monitoring wells GW-8A and GW-9A are, respectively, alluvial and bedrock wells located approximately 600 feet downgradient from the Ruby Dump cutoff trench. Concentrations of pH, TDS, arsenic, cadmium, copper, iron, and zinc present in wells GW-8A and GW-9A indicate ARD water produced from the Ruby Waste Rock Dump is being captured by the Ruby Dump cutoff trench and pond. There was no corresponding increase in trace elements at either the alluvial well (GW-8A) or the bedrock well (GW-9A) when the increase occurred at well GW-8.

2.5.5 Site Surface Water

Surface water is considered the most significant media for offsite transport of contaminants. Surface water has been impacted by mining operations from the Site throughout the reach of Strawberry Creek from the Site to Bear Butte Creek and within Bear Butte Creek from Strawberry Creek to Galena and points further downstream. Untreated surface water contained at the Site exhibits low pH and contains elevated metal and sulfate concentrations.

2.5.5.1 Drainages

The surface water at the Site drains through three sub-basins into Bear Butte Creek. The sub-basins are Strawberry Creek drainage, Hoodoo Gulch, and Ruby Gulch. The topography is characterized by mountainous terrain with narrow valleys. Anchor Hill forms the highest point on the north side of the Site area at an elevation of 5,680 feet. An unnamed peak on the east side of the Site area is at elevation 5,650 feet. The lowest point is at approximately 4,880 feet at the confluence of Bear Butte and Ruby Gulch. The mountain slopes range from 6 to 60 percent, and the soil permeability is classified as moderate, averaging about 4 inches per hour (BOR 2000).

Topography directs surface water flow from the Gilt Edge Mine Site to Strawberry Creek. Strawberry Creek flows approximately 1.5 miles before draining into Bear Butte Creek. Approximately 2 miles downstream of the Strawberry Creek and Bear Butte confluence, Bear Butte Creek becomes a losing stream that flows into outcrops of the Pahasapa limestone (UOS 1999).

The USGS maintains a gauging station in Bear Butte Creek 0.5 miles downstream of the Bear Butte/Strawberry Creek confluence. Water discharge data from October 1996 to September 1997 indicate that Bear Butte Creek's high flow is in April, with more than 100 cubic feet per second (cfs) for 5 days and a 1-day maximum of 180 cfs. By June, the flow has fallen to less than 10 cfs. March, April, May, and June gauging data show flows over 10 cfs in Bear Butte Creek, with all other months having flows under 10 cfs. It is possible that Strawberry Creek could approach 10 cfs under high water flow conditions, but for the majority of the year, the flow in Strawberry Creek is well under 10 cfs (UOS 1999).

The preliminary assessment (PA) indicates that the Site is not located within a regulated floodplain. Information obtained from a Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) indicates that Strawberry Creek, Ruby Gulch, and Terrible Gulch are not located within a 500-year floodplain. However, at their immediate confluence with Bear Butte Creek, these drainages lie within the Bear Butte Creek 100-year floodplain.

2.5.5.2 Contamination

ARD generation at the Site is composed of surface water runoff and groundwater contributions from underground mine workings and the open mine pits. Preliminary calculations of surface water runoff based on estimated annual average precipitation (27 inches) and limited data for groundwater contributions from the mine workings indicate that the Site will generate an annual average ARD surface water flow rate of approximately 170 gpm. The same preliminary calculations and data indicate that for the maximum annual precipitation (approximately 43 inches over the period of record [1909 to 1999 at Lead, South Dakota]) the Site will generate an annual ARD flow rate of 375 gpm. These flow rates are based on the Site water balance model (CDM Federal Programs Corporation [CDM Federal] 2001).

Water contamination within the site was described in the Early-Action Interim ROD (April 2001) and remains unchanged. Water quality data from June 2000 are shown below, indicating the extreme toxicity of the ARD waters in the existing site impoundments.

Metal	Results in parts per billion (ppb)	Surface Water Quality Daily Maximum Goal (ppb)
Arsenic	1,480	332.5
Cadmium	692	5.9
Copper	97,900	67.6
Lead	33.3	32.5
Selenium	51.6	8.75

2.5.5.3 Operational Controls and Treatment

Management of water at the site involves a variety of impoundments, pits, pumps, pump-houses, and pipelines connected to a water treatment plant (see Figure 2). In addition, several ARD seep discharges into Strawberry Creek and Hoodoo Gulch are mitigated by routing the ARD flows through containers of sodium-hydroxide to neutralize the discharges flowing into the receiving waters.

A containment pond for the Ruby Dump is used to capture the ARD from the dump. This containment pond was built within the Ruby Gulch drainage below the waste rock repository. The ARD that drains from the Ruby Dump is collected in the containment pond and then pumped to the Dakota Maid/Sunday Pit from the Ruby Pond Pumphouse. The ARD is then pumped and/or siphoned to Pond E near Strawberry Creek. Some ARD drains from Dakota Maid Pit into Pond D near the former location of the Joe King Adit. Pond D drains into Pond E, a lined pond. From Pond E, ARD is pumped to a water treatment plant where it is treated for release into the Strawberry Creek drainage. The pump station at Pond E (Strawberry Pond Pumphouse) can also direct flow to turbomisters for evaporation or pump flow back to the Dakota Maid/Sunday Pit. ARD from the Anchor Hill Pit and Langley Pit is also pumped to the Dakota Maid/Sunday Pit where it follows the same flow path to the water treatment plant for treatment. In April 1998, an estimated 136,000,000 gallons of ARD waters were awaiting treatment at the Site. As of September 2001, the Site contained ARD waters requiring treatment as follows: the Sunday Pit contained about 16 million gallons, the Dakota Maid Pit contained an estimated 3.5 million gallons, and Anchor Hill Pit contained about 72 million gallons.

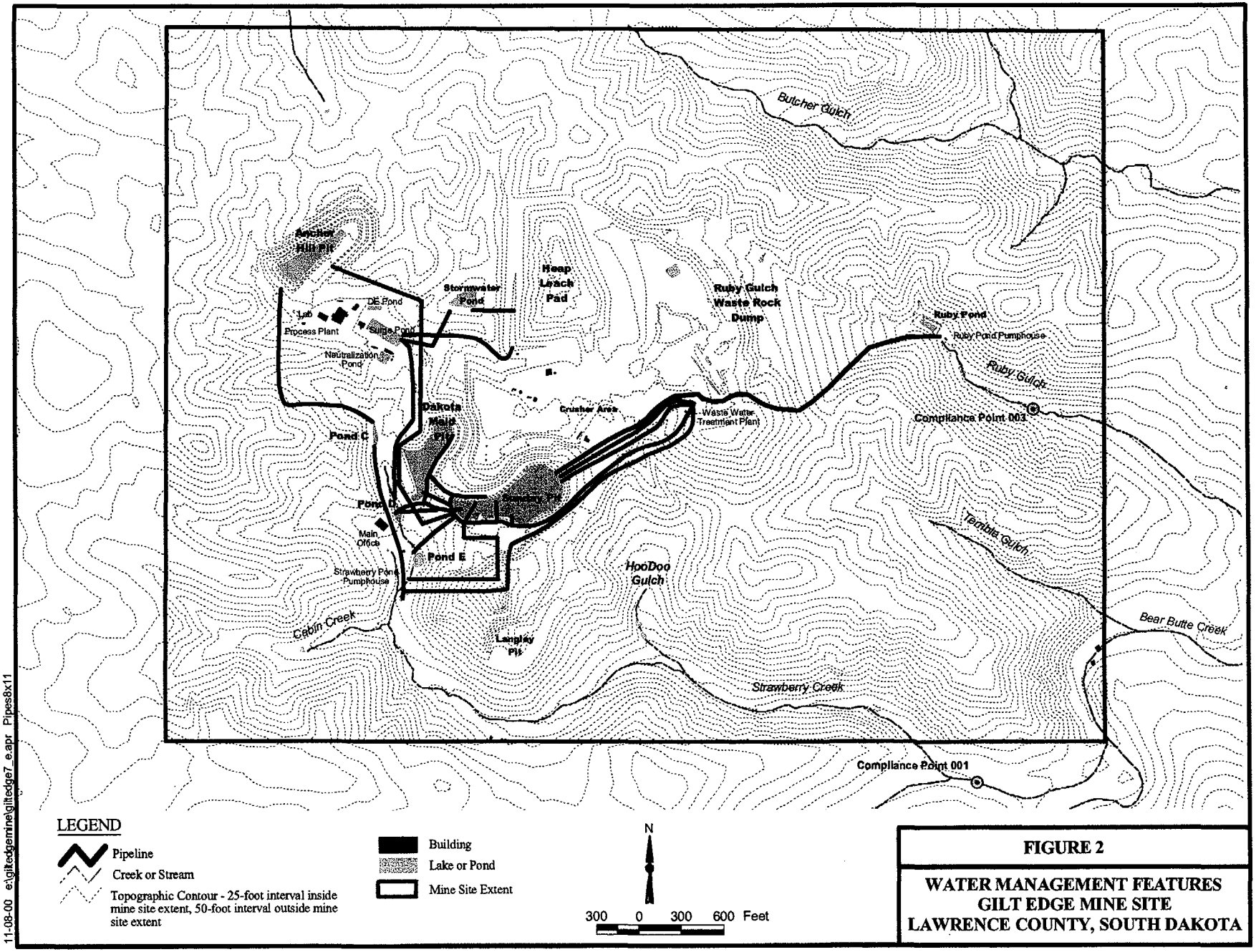

FIGURE 2

WATER MANAGEMENT FEATURES
GILT EDGE MINE SITE
LAWRENCE COUNTY, SOUTH DAKOTA

11-08-00 e:\giltedgemine\giltedge7_e.apr Pipes8x11

The water treatment plant is located near the top of Ruby Gulch. It is a sodium hydroxide N/P plant consisting of an up-flow rapid mix tank where 50 percent solution sodium hydroxide is mixed with influent ARD and recycled metal precipitate sludge from the clarifier. Following the rapid mix tank, the ARD/sodium hydroxide solution flows to a flocculation tank that precedes a lamella plate clarifier. Polymer is added to the flow just prior to entering the flocculation tank. Effluent from the clarifier flows to an effluent storage tank and is subsequently discharged by gravity flow/pumped flow to Strawberry Creek. The water treatment plant was reported to have a design capacity of 360 gpm (BOR 2000), but without sludge filtering the net treatment rate of the WTP has been only 200 gallons per minute. Only by utilizing a temporary sludge settling pond has a 250 gpm net discharge rate been realized.

Besides seeking more reliable and controlled sludge management, EPA and DENR have had a strong interest in seeking opportunities for cost reduction and improved treatment reliability and efficiency. The Focused Feasibility Study was conducted to carry out this technical assessment of interim water treatment operations.

BMC obtained a NPDES permit when it operated the mine site. This permit was terminated by SDDENR after mining operation were ceased. EPA has continued to operate the water treatment plant under the Early-Action Interim ROD, with the water quality limits of the former permit as the initial interim discharge objectives. This interim response action is aimed at improving discharges to better meet State of South Dakota water quality standards presently in effect for Strawberry Creek (the receiving waters for discharge from the water treatment system).

2.6 Current and Potential Future Site and Resource Uses

The site is currently an abandoned hard rock mine. The Site and the surrounding area is zoned as a PF - Park Forest District by Lawrence County. The following future site usages may be permitted in the PF - Park Forest District:

- Detached single-family dwellings, cabins, and summer homes.
- Transportation and utility easements, alleys, and right-of-way.
- Public parks and/or playgrounds.
- Historical monuments or structures.
- Utilities substations.
- Plant nursery.
- Tree or crop growing areas and grazing lands.
- Other uses approved under county and state conditional use permits.

Special use permits issued by the county and mining permits issued by the state contain land-use restrictions that currently remain in effect for the Site.

2.7 Site Risks

Site-wide risk assessments that closely evaluate human health and ecological risk are presently in the early stages. Remedial investigations and risk assessments identify sources of contamination (volume and toxicity), the pathways for contaminant releases, and the effects of potential exposure and contaminant concentrations. While the risk assessments focus on

toxicological risk effects of exposure and dose, this interim remedial action aims to reduce risk by treating ARD prior to being discharged from the site.

Surface water at the site which is in contact with oxygen and sulfide minerals becomes ARD and contains high concentrations of metals. This acidic water can harm those who drink the water or get it on their skin. Site surface water that becomes ARD contains cadmium, copper, lead, nitrate and thallium in concentrations above the federal safe drinking water standards. Without containment and treatment, ARD water would flow from the site into drainages that ultimately discharge into the Madison Aquifer, a drinking water source for the Boulder Canyon Development, City of Sturgis and a Veterans Administration well. Thus, a pathway exists from the Gilt Edge Mine to these water supplies, as well as private water supply wells nearer to the site along Bear Butte Creek. If Gilt Edge Mine waters were released untreated, downgradient water quality and human health could be adversely impacted.

Metals-contaminated surface water from the site has harmed aquatic life in both Strawberry and Bear Butte Creeks. In Strawberry Creek, bottom-feeding macro invertebrates that are an important part of the food chain have been adversely impacted. Bear Butte Creek is managed as a fishery by the South Dakota Department of Game, Fish and Parks. Measured concentrations of arsenic, cadmium, copper, selenium, and zinc are above toxicity levels for aquatic receptors. Water treatment continues to be necessary in order to protect these streams from actual or threatened releases of hazardous substance into the environment.

2.8 Interim Remedial Action Objectives

Interim remedial action objectives (RAOs) are media-specific (e.g., mine waste, ARD, etc.) and meet the goal of protecting the environment.

A Focused Feasibility Study (FFS) for OU2 Interim Water Treatment Operations (August 2001) examined in detail the basis for interim risk management and cost-effective operations.

The following interim RAOs and goals were defined in the FFS for the interim water treatment action:

- Prevent direct exposure of human and environmental receptors to elevated concentrations of contaminants in surface water drainage from the Site.
- Reduce or eliminate ARD water flow into Ruby Gulch and Strawberry and Bear Butte Creeks.
- Achieve compliance, to the extent possible and practicable for the interim, with currently applicable water quality standards.
- Minimize waste and waste disposal requirements.
- Integrate water treatment with overall Site closure and reclamation activities
- Maintain compatibility with site-wide remedial action objectives and final water treatment remedial action.
- Minimize expenditures for water treatment at the Site during closure activities (determine a preliminary minimum cost to site closure (MCSC) comparison between recommended alternatives, based on present worth analysis).

2.9 Description of Alternatives

The FFS identified remedial action alternatives, and through a screening process EPA and DENR eliminated the following options from further consideration:

- Adding filter presses to current water treatment operations was rejected due to high cost and inability to meet water quality standards.
- Alternatives which provided for adding a full-stream membrane filtration or sulfate removal process to the current system were rejected due to both high interim costs and uncertainty of meeting the total dissolved solids (TDS) water quality standards.
- Alternatives which provided for building completely new water treatment systems were rejected due to very high interim costs and the uncertainty of meeting TDS standards.

EPA is unsure if any of the water treatment systems that were retained for evaluation and interim use will be able to meet current water quality standards for total dissolved solids (TDS) and selenium (see detailed discussion in Section 2.10.1.2). Because of this uncertainty, EPA is invoking an interim waiver of standards for TDS and selenium pursuant to CERCLA Section 121(d)(4)(A) (See discussion in Section 2.10.1.2 below).

The following seven remedial response alternatives were retained for detailed evaluation in the FFS. They include options to intercept ARD releases into offsite drainages, and alternatives for interim water treatment. Alternatives 3a and 3b address the diversion and collection of ARD. Alternatives 6a through 6b address the need for an upgrade or expansion of the existing WTP. Alternatives from these two groups are combined for an overall solution to address site conditions.

- Alternative 1: No Action

ARD Diversion and Collection Alternatives:

- Alternative 3a: Divert ARD Flow from Hoodoo Gulch to Sunday Pit; Divert ARD flow from Pond C to Pond D
- Alternative 3b: Divert ARD Flow from Hoodoo Gulch to Strawberry Pond; Divert ARD flow from Pond C to Pond D

Upgrade of WTP Alternatives:

- Alternative 6a: Upgrade Existing Caustic Chemical Precipitation Treatment Plant with Filtration (Interim Applicable or Relevant and Appropriate Requirement (ARAR) Waiver)
- Alternative 6b: Convert Existing Caustic Chemical Precipitation Treatment Plant to Lime Precipitation and Upgrade with Filtration (Interim ARAR Waiver)
- Alternative 6c: Construct New Microencapsulation/Precipitation Treatment Plant (Interim ARAR Waiver)
- Alternative 6d: Construct New Optimized Chemical Precipitation Treatment Plant Using Proprietary Metals Coordination Process (Interim ARAR Waiver)

2.9.1 Description of Remedy Components

Alternative 1 - No Action

Superfund regulations require EPA to evaluate a "No Action" alternative to provide a baseline for comparison to other alternatives. The no action alternative would discontinue current ARD treatment at the WTP. ARD would continue to be generated and would fill any storage volume currently available in the open pits. Once the pits reach their storage capacity, untreated ARD would discharge to Strawberry Creek and Bear Butte Creek via the Hoodoo Gulch, Ruby Gulch, and Strawberry Creek drainages. There would be no reduction in ARD contaminant concentrations because no treatment, containment, or removal of contaminants from ARD is included in this alternative. Alternative 1 includes surface water monitoring and 5-year site reviews since ARD would continue to migrate off the Site indefinitely. Additionally, Alternative 1 would require pumping of untreated ARD from the open pits to Strawberry Creek to allow other site closure activities to occur.

Options for Intercepting ARD Seep Flows

Alternative 3a - Divert ARD Seep Flows from Hoodoo Gulch to Sunday Pit; Divert Pond C ARD Seep Flows to Pond D

The individual ARD seeps from Hoodoo Gulch would be collected in concrete sumps and flow by gravity to a seep storage tank. Water collected in the tank from the sumps would subsequently be pumped to Sunday Pit. The seep flows upstream (east) of Pond C would be intercepted as surface water runoff in a HDPE-lined channel located to the east of Pond C. The channel would flow to the south with discharge to Pond D. The routing of Hoodoo Gulch (via Sunday Pit) and Pond C (via Pond D) seep flows to the WTP would ensure effective treatment and reduce the contaminant loadings to Strawberry Creek. This alternative would be implemented with one of Alternatives 6a, 6b, 6c, or 6d. Alternative 3a would consist of operating and maintaining the pumps. Other O&M requirements for the diversion and collection system are included in Alternative 6.

Alternative 3b - Divert ARD Seep Flows from Hoodoo Gulch to Strawberry Pond; Divert Pond C ARD Seep Flows to Pond D

Alternative 3b is similar to Alternative 3a except that Hoodoo Gulch seep flows would be pumped to Strawberry Pond instead of to the Sunday Pit. Alternative 3b would include operation and maintenance of the pumping system. Other O&M requirements for the diversion and collection system are included in Alternative 6.

Options for Interim Water Treatment Systems

Alternative 6a – Upgrade Existing Caustic Chemical Precipitation Treatment Plant with Filtration

Alternative 6a consists of upgrading the existing sodium hydroxide WTP with a circular clarifier and filtration equipment for post sedimentation effluent polishing at an optimized treatment capacity of 300 gpm. Solids produced by the process would be dewatered with a filter press and landfilled on site. Final acid pH adjustment equipment would also be provided

in the event that effluent pH requires adjustment to meet the discharge limit. Alternative 6a includes O&M of the upgraded WTP and compliance and operation monitoring.

Alternative 6b – Convert Existing Caustic Chemical Precipitation Treatment Plant to Lime Precipitation and Upgrade with Filtration
Alternative 6b consists of converting the existing sodium-hydroxide WTP to a lime N/P process with the addition of lime slaking and lime slurry chemical feed equipment and upgrades, including a circular clarifier and filtration equipment for post sedimentation effluent polishing. The total treatment capacity of Alternative 6b would be 300 gpm. Solids produced by the process would be dewatered with a filter press and landfilled on site. Final acid pH adjustment equipment would also be provided in the event that effluent pH requires adjustment to meet the discharge limit. Alternative 6b includes O&M of the upgraded WTP and compliance and operation monitoring.

Alternative 6c – Construct New 300-gpm Microencapsulation/Precipitation Treatment Plant
Alternative 6c consists of constructing a new 300 gpm WTP using a proprietary microencapsulation/precipitation process. The total treatment capacity of Alternative 6c would be 300 gpm. Solids produced by the process would be landfilled on site. The new treatment plant would be located downstream of Pond E near the Strawberry Pond pumphouse. Alternative 6c includes O&M of the newly constructed WTP and compliance and operation monitoring.

Alternative 6d — Construct New 300-gpm Optimized Chemical Precipitation WTP Using Proprietary Metals Coordination Process with Microfiltration and pH Adjustment
Alternative 6d consists of constructing a new 300-gpm WTP using a proprietary metals coordination process with microfiltration and pH adjustment. The existing WTP would be decommissioned. The total treatment capacity of Alternative 6d would be 300 gpm. Solids produced by the process would be dewatered with a filter press and landfilled on site. Potential exists to dispose of solids at an offsite metals recycling facility. The new treatment plant would be located downstream of Pond E near the Strawberry Pond pumphouse. Alternative 6d includes O&M of the newly constructed WTP and compliance and operation monitoring.

2.9.2 Common Elements and Distinguishing Features of Each Alternative

2.9.2.1 Common Elements

The following components are common amongst the alternatives evaluated:

- Alternatives 3a and 3b involve the collection of ARD and conveyance of ARD to the WTP.
- The time estimated in the FFS to dewater the site, 2.1 years, is dependent not only on treatment of ARD currently contained in onsite pits and ponds, but also on treatment of ARD that is formed as a result of precipitation in contact with onsite materials that are not yet reclaimed.
- Based on the minimum cost to site closure (MCSC) analysis, which factors the anticipated production of ARD due to precipitation and current site conditions, the continuation of

treatment of ARD stored on site in pits and ponds, and the anticipated time to site closure with the capital and O&M cost for treatment, the optimum treatment rate was determined to be 300 gpm. Therefore, Alternatives 6a, 6b, 6c, and 6d all increase the treatment capacity of the existing WTP to 300 gpm.

- Alternatives 6a and 6b include pH adjustment if the effluent pH requires adjustment to meet the discharge limit.
- Solids produced by the processes evaluated in Alternatives 6a, 6b, 6c, and 6d would be contained onsite . Alternatives 6a, 6b, and 6d include dewatering of solids with a filter press prior to disposal.
- Treatment of stored ARD includes the volume stored in the Anchor Hill Pit.
- Because the technologies evaluated will not be effective in achieving TDS and selenium surface water quality discharge standards, an interim ARAR waiver for TDS and selenium will be required.
- For estimating costs during the focused feasibility study, remedial action projects typically involve construction costs that are expended at the beginning of the project (e.g., capital cost) and costs in subsequent years that are required to implement and maintain the remedy after the initial construction period (e.g., annual O&M costs, periodic costs). Present worth analysis is a method to evaluate expenditures (including both capital and O&M) that occur over different time periods. This standard methodology allows for cost comparisons of different remedial alternatives on a basis of a single cost figure for each alternative. A discount rate of 7 percent, based on the NCP and EPA's *A Guide to Developing Cost Estimates During the Feasibility Study* (EPA 2000c) was used to develop present worth costs.

2.9.2.2 Distinguishing Features

The distinguishing features of each alternative are discussed below.

Alternative 1 - No Action

The no action alternative would discontinue current ARD treatment with the existing sodium hydroxide neutralization/precipitation WTP. ARD would continue to be generated and fill any storage volume currently available in the open pits. Once the pits reach their storage capacity, untreated ARD would discharge to Strawberry Creek and Bear Butte Creek via the Hoodoo Gulch, Ruby Gulch, and Strawberry Creek drainages. There would be no reduction in ARD contaminant concentrations because no treatment, containment, or removal of contaminants from ARD is included in this alternative. The no action alternative includes costs for site security, maintenance of vehicles, and maintaining electricity to the site.

Estimated Capital Cost:	$0
Estimated Annual O&M Cost:	$194,000
Estimated Periodic Cost:	$21,000
Estimated 5-year Present Worth:	$476,000

Alternative 3a — Alternative 3a - Divert ARD Seep Flows from Hoodoo Gulch to Sunday Pit; Divert Pond C ARD Seep Flows to Pond D

The individual ARD seeps from Hoodoo Gulch would be collected in concrete sumps and flow by gravity to a seep storage tank. Water collected in the tank from the sumps would

subsequently be pumped to Sunday Pit. The seep flows upstream (east) of Pond C would be intercepted as surface water runoff in a HDPE-lined channel located to the east of Pond C. The channel would flow to the south with discharge to Pond D.

Estimated Capital Cost:	$262,000
Estimated Annual O&M Cost:	$1,900
Estimated 3-year Present Worth:	$266,000

Alternative 3b – Divert ARD Seep Flows from Hoodoo Gulch to Strawberry Pond; Divert Pond C ARD Seep Flows to Pond D

Alternative 3b is similar to Alternative 3a except that Hoodoo Gulch seep flows would be pumped to Strawberry Pond instead of Sunday Pit.

Estimated Capital Cost:	$307,000
Estimated Annual O&M Cost:	$1,900
Estimated 2.1-year Present Worth:	$311,000

Alternative 6a — Upgrade Existing Caustic Chemical Precipitation Treatment Plant with Filter Presses

Alternative 6a consists of upgrading the existing sodium hydroxide WTP with a circular clarifier and filtration equipment for post sedimentation effluent polishing. Solids produced by the process would be dewatered with a filter press prior to onsite landfilling.

Estimated Capital Cost:	$1,690,000
Estimated Annual O&M Cost:	$4,030,000
Estimated 2.1-year Present Worth:	$9,789,000

Alternative 6b – Convert Existing Caustic Chemical Precipitation Treatment Plant to Lime Precipitation and Upgrade with Filtration

Alternative 6b is similar to Alternative 6a; however, the existing WTP would be converted to a lime N/P process with the addition of lime slaking and lime slurry chemical feed equipment. Solids produced by the process would be dewatered with a filter press prior to onsite landfilling.

Estimated Capital Cost:	$2,496,000
Estimated Annual O&M Cost:	$3,001,000
Estimated 2.1-year Present Worth:	$8,527,000

Alternative 6c – Construct New 300-gpm Microencapsulation/Precipitation Treatment Plant

Alternative 6c consists of constructing a new 300 gpm WTP, using a proprietary microencapsulation/precipitation process. The total treatment capacity of Alternative 6c would be 300 gpm. Solids produced by the process would be landfilled on site without dewatering.

Estimated Capital Cost:	$1,985,000
Estimated Annual O&M Cost:	$3,332,000
Estimated 2.1-year Present Worth:	$8,681,000

Alternative 6d – Construct New 300-gpm Optimized Chemical Precipitation WTP Using Proprietary Metals Coordination Process with Microfiltration and pH Adjustment
Alternative 6d is similar to Alternative 6c; however, a proprietary metals coordination process with microfiltration and pH adjustment would be used as part of the new WTP. Solids produced would be first be dewatered with a filter press prior to onsite landfilling.

Estimated Capital Cost:	$2,475,000
Estimated Annual O&M Cost:	$2,846,000
Estimated 2.1-year Present Worth:	$8,195,000

2.10 Comparative Analysis of Alternatives

This section describes the regulatory criteria against which remedy alternatives are evaluated as the basis for remedy selection. There are nine criteria used to evaluate the alternatives, which are divided into threshold criteria, primary balancing criteria, and modifying criteria.

2.10.1 Threshold Criteria

Alternatives must meet the first two threshold criteria, to be retained for further consideration.

- Overall protection of human health and the environment. Overall protection of human health and the environment addresses each alternative's ability to provide adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

- **Compliance with Applicable and Relevant and Appropriate Requirements (ARARs).** Section 121(d) of CERCLA and NCP §300.400(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs", unless such ARARs are waived under CERCLA section 121(d)(4).

2.10.1.1 Overall Protection of Human Health and the Environment

All of the alternatives, except the "no action" alternative, are protective of human health and the environment. Alternatives 3a and 3b would significantly reduce migration of metal contaminants and acid water to Strawberry Creek from Hoodoo Gulch and Pond C by collecting and allowing for contained and process-controlled treatment of the ARD seep flows. Alternatives 3a and 3b would prevent an untreated discharge from the Site by collecting ARD and conveying it to the WTP. Alternatives 3a and 3b are protective of human health and the environment when combined with Alternatives 6a, 6b, 6c, or 6d.

Treatment of the seep flows in the WTP would reduce the metals contaminant concentrations and adjust the discharge pH to the neutral range (6.0 to 9.0) and allow for discharge of a

consistently treated effluent to Strawberry Creek. Alternative 6a is not effective in treating TDS and its effectiveness for selenium removal is unknown. Alternative 6b may reduce TDS below the ARAR limit while its effectiveness for selenium removal is also unknown. Alternative 6c may reduce TDS below the ARAR limit and may also be effective in removing selenium. Alternative 6d may also reduce TDS below the ARAR limit and in a pilot-scale study has shown effectiveness in reducing selenium below the ARAR limit.

2.10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Compliance with ARARs addresses whether a remedy will meet all the applicable or relevant and appropriate requirements of federal and state environmental statutes. Appendix A summarizes the ARARs compliance status of this action and documents ARARs compliance for the selected remedy.

All of the alternatives, with the exception of the "no action" alternative, are expected to comply with ARARs with the exception of the Total Dissolved Solids (TDS) and selenium water quality standards. EPA is unsure if any of the water treatment systems evaluated will meet current water quality standards for TDS and selenium. Because of this uncertainty, EPA will waive these standards for the short term with the understanding that they will be part of the final site remedy objectives. It is anticipated that elements of the remedial action to be undertaken at the site (waste containment and capping) will reduce the total volume and ARD concentration such that a final water treatment system(s) can more effectively achieve required TDS and selenium standards.

A significant product of the chemical reactions in the ARD process is the formation of sulfate compounds that remain in solution, resulting in highly elevated TDS. Sulfate compounds are the primary reason that ARD exceeds the TDS ARAR. Because the scientific basis for the current TDS standard is not definitive, it has been determined that a site-specific toxicology study should be conducted to determine the specific toxicity-characteristics of sulfate TDS to site-specific aquatic life. EPA and SDDENR will evaluate the study results and decide on the final TDS standard for the site.

Selenium, although it is a metal, is not easily removed from solution by precipitation at high pHs. Selenium is more effectively removed by adsorption onto an iron precipitate at pHs <4. This significant difference in optimum removal conditions makes simultaneous efficient removal of selenium and other metals very difficult. Investigation of selenium removal methods using anaerobic biological processes is underway at the mine site and other ARD generating sites in the United States. These investigations will provide information for the final determination of selenium ARARs at the site.

2.10.2 Primary Balancing Criteria

Alternatives which meet the threshold criteria are evaluated against the following five criteria known as the primary balancing criteria:

- Long-term effectiveness and permanence. Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

- Reduction of toxicity, mobility, or volume through treatment. Reduction of toxicity, mobility, or volume refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

- Short-term effectiveness. Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy.

- Implementability. Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

- Cost. Cost evaluates the estimated capital and O&M costs of each alternative in comparison to other, equally protective, measures.

2.10.2.1 Long-Term Effectiveness and Permanence

All of the alternatives, except the "no action" alternative, provide long term effectiveness and permanence by reducing the risks through collection, conveyance, and treatment of ARD and surface water. The construction of seep collection, storage, pumping, and transmission facilities, considered in Alternatives 3a and 3b, along with Alternatives 6a, 6b, 6c, or 6d can provide effective long-term treatment of the Hoodoo Gulch and Pond C ARD seeps. A 300-gpm treatment rate is expected to provide greater than 90 percent certainty that ARD generated at the Site could be treated prior to discharge. However, an improperly operated and maintained treatment plant and equipment could significantly reduce treatment efficiency, allowing discharge of highly contaminated surface water to Strawberry Creek and Bear Butte Creek.

2.10.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

The EPA remedial investigation/feasibility study (RI/FS) guidance (EPA 1988) states that reduction of toxicity, mobility, or volume is only accomplished by treatment. Because surface water controls are not considered treatment, Alternatives 3a and 3b by themselves are not effective in reduction of toxicity, mobility, or volume of ARD. However, when combined with Alternatives 6a, 6b, 6c, or 6d, Alternatives 3a and 3b are highly effective in the reduction of toxicity, mobility or volume of ARD through treatment.

Alternatives 6a, 6b, 6c, and 6d provide active treatment of ARD, thereby significantly reducing the toxicity and volume of contamination that would otherwise by discharged into Strawberry and Bear Butte Creeks. Treatment of metal-contaminated ARD waters, results in extraction of the dissolved metals as solids, which are sequestered in sludge that can be contained onsite.

These alternatives are considered highly effective in the reduction of toxicity, mobility, and volume of metals contamination migrating off site.

2.10.2.3 Short-Term Effectiveness

This criterion addresses (1) short-term risks to the community, (2) potential impacts to workers during the action, (3) potential environmental impacts of the remedial action and the reliability of protective mitigation measures, and (4) the time required for implementation of the remedy.

Impacts to community. Because implementation of an interim remedial action for OU2 would be conducted primarily on site, construction of the remedy should not impact the community. The major impact to the community during construction will be limited to the transport of equipment and materials to the site.

Impacts to workers. Excavation, trenching, grading, and other activities associated with construction of the upgrades could cause short-term exposure to airborne and waterborne contamination; however, this exposure could be reduced through dust control/suppression measures and hydraulic controls, as well as proper use of appropriate levels of personal protective equipment during construction.

Environmental protection mitigation. Alternatives 3a and 3b would provide collection and conveyance of ARD, preventing further discharge of ARD to Strawberry Creek and Bear Butte Creek as soon as construction is completed. Alternatives 6a and 6b would provide an increased treatment capacity to address the additional collection of ARD and ARD stored in onsite ponds and pits as soon as the WTP is upgraded. Alternatives 6c and 6d would not provide treatment of ARD until a new WTP is designed and constructed, and meanwhile the existing WTP would be operating beyond its capacity and effectiveness.

Remedy timing. Alternatives 3a and 3b can be constructed in a relatively short time frame to provide collection and conveyance of ARD from Hoodoo Gulch and Pond C. Alternatives 6a and 6b can be constructed in a relatively short time frame to provide the necessary ARD treatment capacity to address surface runoff and treatment of ARD currently stored in onsite pits and ponds. Alternatives 6c and 6d would require pilot-scale testing prior to design and construction of a new WTP.

Based on the above criterion, Alternatives 3a, 3b, 6a, and 6b have high short-term effectiveness because they can be implemented in a relatively short time frame. Because Alternatives 6c and 6d involve the design and construction of a new WTP, they have moderate short-term effectiveness.

2.10.2.4 Implementability

The components for Alternatives 3a and 3b, the Hoodoo Gulch and Pond C seep collection, storage, pumping, and conveyance systems, are easily obtained and can be installed using conventional construction equipment. These alternatives would require excavation, construction of concrete sumps, storage tank installation, trenching, pipe installation, pump installation, and channel construction and lining.

The equipment and materials required for upgrades to the existing WTP under Alternatives 6a and 6b or construction of a new WTP under Alternatives 6c and 6d are readily available and can be installed using conventional construction equipment. Due to local climatic conditions, construction of the upgrades would need to occur during the construction season that typically runs from April through November of each year.

Chemicals required for continuous operation of the WTP under Alternatives 6a and 6b are readily available in the local area and can be supplied to the Site in the quantities necessary. It is unknown if all of the chemicals required for Alternatives 6c and 6d are readily available in the local area and can be supplied to the Site in the quantities necessary at competitive prices. Application of Alternatives 6a and 6b have been field proven for treatment of similar ARD streams. However, application of Alternatives 6c and 6d to similar ARD waste streams is limited. In addition, independent verification of process performance and anticipated chemical usage for Alternatives 6c and 6d could not be obtained for the purposes of the FFS. Independent verification of process performance by pilot testing along with disclosure of process specifics under a non-disclosure agreement with proprietors is required to ensure effectiveness and implementability.

2.10.2.5 Cost

Present worth costs (projected over 5 years for Alternative 1 and 2.1 years for all other alternatives) for each alternative are presented in Section 2.10.4, Table 2.

Amongst the alternatives considered for diversion, collection, and conveyance of ARD, Alternative 3a, $266,000, is the least costly to implement. Of the alternatives considered for upgrade of the existing WTP or construction of a new WTP, Alternative 6d, $8,195,000, is the least costly to implement.

2.10.3 Modifying Criteria

The last two criteria are modifying criteria and are used to evaluate the technical and administrative concerns the state and the public may have regarding each alternative. Consideration of these two criteria may cause EPA to modify its choice of cleanup strategy. Accordingly, these criteria are evaluated after public comments are received on the proposed plan.

- State acceptance indicates whether the state agrees with, opposes, or has no comment on the preferred alternative. No comments were received from any state agencies, other than SDDENR.

- Community acceptance includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. EPA held a public meeting on the Proposed Plan. Attendees sought clarification on a variety of technical related to the FFS, as well as the basis for the interim ARAR waiver. One written comment expressing support for a lime-based treatment system was received.

2.10.4 Summary of Detailed Analysis of Alternatives

Table 1 below summarizes the detailed analysis of the alternatives. Present worth cost for each alternative is presented below.

Table 1 Summary of Detailed Analysis of Alternatives

Alternative	*Overall Protection of Human Health and the Environment*	*Compliance with ARARs*	*Long-Term Effectiveness and Permanence*	*Reduction of Toxicity, Mobility, or Volume Through Treatment*	*Short-Term Effectiveness*	*Implement-ability*	*Present Worth Cost**
1	Low	Low	Low	Low	Low	Very High	$476,000
3a	High	High	High	Very High	High	Very High	$266,000
3b	High	High	High	Very High	High	Very High	$311,000
6a	High	High	High	Very High	High	High	$9,789,000
6b	High	High	High	Very High	High	High	$8,527,000
6c	High	High	High	Very High	Moderate	Moderate	$8,681,000
6d	High	High	High	Very High	Moderate	Moderate	$8,195,000

*Cost for Alternative 1 is based on a 5-year present worth. Cost for Alternatives 3a, 3b, 6a, 6b, 6c, and 6d are based on minimum cost to site closure (MCSC) for interim water treatment and represents the optimum combination of capital and O&M expenditures. The MCSC is based on a 95 percent probability that the time required for completion of site reclamation activities and dewatering will be approximately 2.1 years. Cost includes treatment of water stored on site in pits and ponds, as well as surface water runoff collected as a result of precipitation.

2.11 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by the site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

Acid water contained in pits and ponds on site and ARD generated as a result of precipitation are considered principal threat wastes because they present a significant risk to human health and the environment should exposure occur. Without water collection and treatment, contaminant sources at the Gilt Edge Mine are uncontained with respect to the surface water pathway and are free to release from the Site down the Strawberry Creek and Ruby Creek drainages. Both the Strawberry and Ruby Creek drainages contribute to Bear Butte Creek.

2.12 Documentation of Significant Changes

Subsequent to completion of the FFS in August 2001, the simple site water balance has been updated with recent actual precipitation amounts, water treatment flowrates, and ARD stored within the onsite pits and ponds.

Total precipitation measured at the NOAA gauging station located near Lead, South Dakota was 28.72 inches during the period October 1999 to October 2000 and 28.40 inches during the period October 2000 to October 2001. Precipitation measured at the Gilt Edge Mine was 18.70 inches during the October 1999 - October 2000 period (2000 period) and 17.33 inches during the October 2000 - October 2001 period (2001 period).

During the 2000 period, approximately 107,800,000 gallons were treated at the water treatment plant (annual average treatment rate of 205 gpm). Approximately 118,300,000 gallons of water were treated during the 2001 period (annual average treatment rate of 224 gpm). The water treatment plant influent rate of about 250 gpm was not changed during the two water years, however, the net discharge of treated ARD from the site was increased due to decanting the Storm Water Pond that contained sludge/water generated at the plant. Decanting water from the Storm Water Pond amounted to approximately 13,700,000 gallons of additional water discharge from the site in 2001 period.

Continuing low-precipitation at the site has enabled further discharge of water from the site via the Storm Water Pond. Updates to the FFS water budget to reflect the recent drier site conditions indicate that the objective of dewatering pits in time to accommodate OU1 remedial action can still be achieved at treatment capacity less than 300 gpm–even in the event of an onset of a period of wetter-than-average precipitation. Consequently, EPA and DENR have determined that the treatment rate of a newly constructed or modified water treatment plant can be adjusted from the 300 gpm system recommended in the FFS to a 250 gpm system. Although the treatment rate has been decreased by 50 gpm, costs presented in the FFS should still be in the required accuracy range of -30% to +50% for the reduced treatment rate. Additionally, since all of the alternatives have similar cost behavior in terms of scaled down flow rates, cost comparisons between the alternatives remain valid.

Dewatering charts for the site have been modified using this new information and are available in CDM Federal Program Corporation's Technical Memorandum dated October 2001.

2.13 Selected Interim Remedy

Based upon consideration of CERCLA requirements, the detailed analysis of alternatives, and public comments, EPA has determined that combining (a) the collection and diversion of ARD seeps for treatment (Alternative 3a) and (b) conversion of the existing sodium-hydroxide treatment plant to a less-costly 250 gallon-per-minute lime-based (Alternative 6b) or metals-coordination (Alternative 6d) precipitation system ,with necessary filtration, is the appropriate interim remedy for the contaminated surface water at the Gilt Edge Mine Site OU2. This remedy is expected to achieve the objectives for the interim remedial response, and, except as noted for TDS and selenium, meet currently applicable water quality standards.

2.13.1 Rationale for the Selected Interim Remedy

For the remedy component addressing improvements to collection and control of ARD seeps, Alternatives 3a and 3b are essentially identical, except for costs. Transferring ARD from Hoodoo Gulch to Sunday Pit involves a shorter conveyance distance to pre-treatment storage, resulting in lower capital and construction costs, making Alternative 3a the preferred option.

For the remedy component addressing the water treatment process, conversion of the existing WTP or constructing a new WTP to increase the efficiency and capacity of treatment will (a) reduce operating costs, and (b) allow treatment of the significant stored volume of ARD in a timely manner to coincide with site-wide reclamation activities. Alternative 6a, which would continue water treatment using the existing plant, has the highest interim operating costs of all alternatives. Alternative 6c has higher operating costs and lower short-term effectiveness and implementability than Alternative 6b. While Alternative 6d also has lower short-term effectiveness and implementability than Alternative 6b, this treatment option remains attractive due to it's potential for significantly lower operating costs than other alternatives. Alternative 6b is the highest-ranking alternative with respect to all of the evaluation criteria, however due to the above considerations, both Alternatives 6b and 6d are viable alternatives for remedy, pending the results of further pilot-testing.

2.13.2 Description of Selected Interim Remedy

The remedy selected by EPA and SDDENR for this interim remedial action is (a) collection and diversion of ARD seeps for treatment and (b) conversion of the existing sodium-hydroxide treatment plant with a less-costly lime-based or metals-coordination precipitation system with filtration (combining Alternative 3a with either Alternative 6b or 6d). The principal components of the selected remedy are as follows:

- Collection of ARD seeps in Hoodoo Gulch in concrete sumps and conveyance to the Sunday Pit for water treatment
- Collection of ARD seep flows upstream of Pond C in an HDPE-lined channel and conveyance to Pond D for water treatment
- Conversion of the existing sodium hydroxide-based water treatment process to a 250 gallon-per-minute net treatment capacity system consisting of, subject to completion of pilot-test evaluations, either:
  - a lime-based neutralization/precipitation process with lime slaking and slurry chemical feed equipment upgrades, including if necessary circular clarifier and filtration equipment for post sedimentation effluent polishing and pH adjustment equipment, or
  - a new WTP utilizing a proprietary metals-coordination process with microfiltration and pH adjustment.

2.13.3 Summary of the Estimated Interim Remedy Costs

The information in Table 2 is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the administrative record

file, an Explanation of Significant Differences (ESD), or a ROD amendment. The cost estimates prepared for the selected remedy were developed with a discount rate of 7 percent over a time period of 2.1 years (time to achieve MCSC). This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost. Reduced treatment capacity from 300 gpm to 250 gpm (discussed in Section 2.12) would not significantly alter the cost estimates or basis for comparison presented in Table 2. Completion of detailed remedial designs and construction estimates may result in reductions to the cost estimates presented below.

Table 2 Summary of Estimated Interim Remedy Costs

Selected Interim Remedy	*Capital Cost*	*O&M Cost*	*Present Worth Cost*	*Total Present Worth Cost*
Alternative 3a - Divert ARD Seep Flows from Hoodoo Gulch to Sunday Pit and Divert Pond C ARD Seep Flows to Pond D	$262,000	$1,900	$266,000	$8,787,000
Alternative 6b - Convert Existing Caustic Chemical Precipitation Treatment Plant to Lime Precipitation and Upgrade with Filtration	$2,496,000	$3,001,000	$8,527,000	
Alternative 3a - Divert ARD Seep Flows from Hoodoo Gulch to Sunday Pit and Divert Pond C ARD Seep Flows to Pond D	$262,000	$1,900	$266,000	$8,461,000
Alternative 6d - Construct New Optimized Chemical Precipitation WTP Using Proprietary Metals Coordination Process with Microfiltration and pH Adjustment	$2,475,000	$2,846,000	$8,195,000	

2.13.4 Expected Outcome of Selected Interim Remedy

The selected interim remedy is expected to provide:

- An appropriate margin of safety against acid water being released from the site to Strawberry Creek and Bear Butte Creek without treatment
- Appropriate capacity to provide timely treatment of ARD stored on site in pits and ponds and ARD formed as a result of precipitation
- Increased removal efficiency of contaminants of concern, achieving optimized compliance with current water quality standards, and
- Significant interim cost-savings

2.14 Statutory Determinations

Based on the information currently available, EPA and SDDENR believe the selected interim remedy meets the threshold criteria and provides the best balance of all alternatives with respect to NCP threshold criteria, primary balancing criteria , and modifying criteria. EPA and SDDENR expect the selected interim remedy to satisfy the following statutory requirements of CERCLA Section 121(b):

- Be protective of human health and the environment
- Comply with ARARs (with interim TDS and selenium ARAR waiver)
- Be cost-effective
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum practical extent
- Satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met

2.14.1 Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment because the existing risk of ARD discharge to Strawberry Creek and Bear Butte Creek will be reduced or eliminated. The selected remedy will not pose unacceptable short term risks during implementation and provides long-term effectiveness and permanence.

2.14.2 Compliance with Applicable or Relevant and Appropriate Requirements

The ARARs for OU2 are outlined in Appendix A. Pilot-scale testing and WTP scale-up operations will determine to what extent the selected water treatment process will achieve ARARs for TDS and selenium. As discussed in Section 2.10.1.2, an interim waiver of the applicable South Dakota surface water quality standard for TDS and selenium is necessary in the event that the selected remedy is not able to sufficiently reduce TDS and selenium in discharge water. This interim waiver is being invoked pursuant to CERCLA Sec. 121(d)(4)(A), which authorizes selection of a remedial action that does not attain a legally applicable level or standard, provided that the remedial action being selected is only part of a total remedial action that will attain such level or standard of control when completed.

2.14.3 Cost-Effectiveness

EPA and SDDENR have determined that the selected remedy is cost effective in mitigating the principal risks posed by contaminated water. Section 300,430(f)(ii)(D) of the NCP requires evaluation of cost effectiveness. Overall effectiveness is determined by the following three balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost effective. The selected remedy meets the criteria and provides the best overall effectiveness in proportion to its cost. The estimated total present worth cost for the selected remedy is between $8,461,000 and $8,787,000 (Alternative 3a combined with Alternatives 6b or 6d).

2.14.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

In the focused feasibility study, EPA evaluated potentially applicable remediation and process options involving physical/chemical and biological technologies. These technologies were screened out of further detailed analyses due to technical infeasibility for site application, low implementability, and/or excessively high cost. The only aspects of treatment that were retained for detailed analysis were for ARD collection and conveyance and physical/chemical ARD water treatment. Physical/chemical options were found to provide the best balance of tradeoffs for implementability, long-term effectiveness and permanence and reduction of toxicity, mobility, and volume of contaminants. The selected remedy represents the maximum extent to which permanence and treatment can be practicably utilized at the Site for surface water treatment.

2.14.5 Preference for Treatment as a Principal Element

Various collection and treatment options were considered. Based on the available collection methods and site characteristics and the technologies for treatment of ARD-type waters Collection and Diversion Flows for Treatment and Replacement of the Existing Sodium Hydroxide Precipitation Treatment Plant with a Less Costly Lime-Based or Metals-Coordination Precipitation System with Filtration was determined to be the most cost effective solution under this interim action.

2.14.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within 5 years after commencement of the remedial action. Because this is an interim action ROD, review of this site and the remedy will be ongoing as EPA continues to develop remedial alternatives for the Site-Wide Gilt Edge Mine Site OU.

2.15 References

Bureau of Reclamation (BOR). 2000. *Closure Plan for Gilt Edge Mine, Lawrence County, South Dakota.* U.S. Department of Interior, Bureau of Reclamation, Technical Services Center, Denver, Colorado. February 11.

CDM Federal Programs Corporation (CDM Federal). 2001. Final Focused Feasibility Study for Gilt Edge Mine Site; Interim Water Treatment Operations Operable Unit 2, Lawrence County, South Dakota.

CDM Federal Programs Corporation (CDM Federal). 2001. Technical Memorandum: 2000 Simple Site Water Balance, Gilt Edge Mine NPL Site, Lawrence County, South Dakota. October.

URS Operating Services (UOS). 1999. *Analytical Results Report for Site Inspection for Gilt Edge Mine, Lead, South Dakota.* July 12.

U.S. Geological Survey (USGS). 1971. 7.5 minute - Series Topographic Quadrangle Map of Deadwood, South Dakota. 1:24,000 scale.

U. S. Environmental Protection Agency (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. EPA/540/6-89/004. Office of Emergency and Remedial Response. Washington, D.C.

_____. 1993. Brohm Mining Corporation Authorization to Discharge Under the National Pollutant Discharge Elimination System. Permit No. SD-0026891.

_____. 2000a. Hazard Ranking System Package. May.

_____. 2000b. NPL Site Narrative at Listing: Gilt Edge Mine, Lead, South Dakota. Federal Register Notice. May 11.

_____. 2000c. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. EPA/540/R/00/002. Office of Emergency and Remedial Response. Washington, D.C. July.

_____. 2001. Early-Action Interim ROD for Water Treatment Operations. April.

Part 3
Responsiveness Summary

Responsiveness Summary for Interim Water Treatment Proposed Actions Operable Unit 2
Gilt Edge Mine NPL Site
Lawrence County, South Dakota

This Responsiveness Summary provides responses to comments received by the Unite States Environmental Protection Agency (EPA) regarding the Proposed Plan for temporary management and treatment of metals-contaminated water or acid rock drainage, coming from the Gilt Edge Mine Superfund Site in South Dakota. The Proposed Plan was issued on September 3, 2001. EPA received several e-mail letters of support for the proposed plan following the public meeting . Questions and comments on the Proposed Plan were received at the September 13 public meeting, and a transcript of the meeting has been placed in the Administrative Record. The transcript is on file in the administrative record for the site available at the Hearst Public Library, 315 Main street, Lead South Dakota and at the EPA Region 8 Superfund Records Center, 999 18th St, 3rd Floor, South Tower, Denver, Colorado 80202.

EPA has given full consideration to the questions and comments posed at the September 13 public meeting: the following Responsiveness Summary has been prepared to assure that all the questions and comments were addressed in finalizing the Interim Water Treatment Record of Decision (ROD) for Operable Unit 2 (OU2).

Comment No. 1 (Precipitation Data)

One commenter wanted clarification regarding the methods used to project precipitation at the site.

Public Meeting Response: Historical precipitation data was plugged into a computer model that generated the possibilities for precipitation hitting the site and looked at whether the combination of the on-site storage plus the treatment could handle the projected releases based on historical data. It was noted that the model did not use daily precipitation rates but used average monthly historical precipitation data thus offsetting the fluctuation which the occasional afternoon heavy shower brings.

Commenter wanted to know if pH was measured in the 90 years of precipitation data collected?

Public Meeting Response: No, only amounts of rainfall were measured.

Comment No.2 (Storage Capacity)

Commenter wanted to know about the relationship of storage capacity to water treatment.

Public Meeting Response: After looking at 24 scenarios, a scenario was chosen which was the closest to actual site conditions. With a 300 gallon per minute capacity the site could be dewatered by about mid 2003. This is about 100 gallons per minute more than what exists there now. The amount of water needing treatment there is affected by the effectiveness of the Ruby Cap project. It is expected that the Ruby Waste dump will be shedding clean water.

Comment No. 3 (Waiver for selenium and Total Dissolved Solids (TDS))

One commenter wanted to know about EPA's request for a waiver for selenium and TDS. Would it be temporary?

Public Meeting Response: This is an interim waiver because it is intended to be only for the interim of two to three years . Putting in a membrane system which would manage these problems is very expensive. By the time the liners, caps and covers are in place there will a reduction in the volumes of water at the site that need treating. It would be EPA's intent that the site-wide final remedy will have to meet the water quality standards for that segment of the river. It was noted that the State sets the stream standards.

Comment No. 4 (Anchor Hill Pit treatment test)

One commenter wanted to know why EPA is not using the biological treatment system now being tested if it is cheaper than the treatment systems being considered in this proposed plan.

Public Meeting Response: The current tests in place have some promise for success, however, it is not a proven system that EPA wants to count on for now. EPA wants to see them work through one year's time. That is not possible to have completed before EPA needs to get the proposed system underway.

Comment No. 4 (Costs)

Question as to who is paying for the costs of water treatment at the site?

Public Meeting Response: 90% is paid for by the Federal Government and 10% is paid for by the State of South Dakota

Upon careful review of the transcript it appears that all the questions asked at the public meeting for the Proposed Plan were for clarification purposes and were answered satisfactorily at the meeting. EPA did receive one email correspondence during the comment period, expressing support for a lime-based treatment system.

Appendix A

Identification and Description of Applicable or Relevant and Appropriate Requirements

APPENDIX A

SUMMARY OF FEDERAL AND STATE ARARs COMPLIANCE
GILT EDGE MINE NPL SITE
OPERABLE UNIT 2: Interim Water Treatment

Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Surface Water			
Safe Drinking Water Act, 42 U.S.C. § 300f, et seq., [Chemical Specific] National Primary and Secondary Drinking Water Regulations 40 CFR 141 and 143 [Chemical Specific]	Relevant and Appropriate	The National Primary and Secondary Drinking Water Regulations (40 CFR 141 and 143) establish maximum contaminant levels (MCLs) for chemicals in drinking water distributed in public water systems. The primary standards are enforceable in South Dakota under the South Dakota Codified Law (SDCL) § 34A-3A-1, et seq., and Administrative Rules of South Dakota (ARSD) § 74:04:05.	Safe Drinking Water Act MCLs are relevant and appropriate to Gilt Edge Mine OU2 remedial actions because both influent and discharged water may infiltrate the aquifers found beneath the Gilt Edge Mine Site. These aquifers are currently a source for public water supplies. Additionally the preamble to the National Contingency Plan (NCP) states that MCLs are relevant and appropriate for groundwater that is a current or potential source of drinking water.
Federal Surface Water Quality Requirements, Clean Water Act 33 U.S.C. §§ 1251, et seq. [Chemical Specific]	Applicable	As provided under Section 303 of the Clean Water Act, 33 United States Code (U.S.C.) § 1313, the State of South Dakota has promulgated water quality standards. These standards are identified in the following sections.	Contaminated water emanating from the site will be intercepted and treated as part of OU2 - Interim Water Treatment pursuant to federal and state Clean Water Act requirements.
Clean Water Act Point Source Discharges Requirements 33 U.S.C. § 1342. [Action Specific]	Applicable	Section 402 of the Clean Water Act, 33 U.S.C. § 1342, et seq., authorizes the issuance of permits for the "discharge" of any "pollutant." This includes stormwater discharges associated with "industrial activity." See 40 CFR 122.1 (b)(2)(iv). "Industrial activity"includes inactive mining operations that discharge stormwater contaminated by contact with, or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations, see 40 CFR 122.26 (b)(14)(iii).	Because the State of South Dakota has been delegated the authority to implement the Clean Water Act, these requirements are enforced in South Dakota through the South Dakota Surface Water Discharge System (SDSWD). Storm water discharge best management practices will be implemented during remedial action.

APPENDIX A

SUMMARY OF FEDERAL AND STATE ARARs COMPLIANCE
GILT EDGE MINE NPL SITE
OPERABLE UNIT 2: Interim Water Treatment

Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
State of South Dakota Surface Water Quality Standards SDCL § 34A-2-11, et seq., and implementing regulations [Chemical Specific]	Applicable	The Clean Water Act, 33 U.S.C. § 1251, et seq., provides the authority for each state to adopt water quality standards (40 CFR 131) designed to protect beneficial uses of each water body and requires each state to designate uses for each water body. Pursuant to this authority and the criteria established by the South Dakota regulations, SDCL § 34A-2-11, et seq., establishes requirements for restoring and maintaining the quality of surface and groundwater. Specific requirements follow.	Contaminated water emanating from the site will be intercepted and treated as part of OU2 - Interim Water Treatment pursuant to federal and state Clean Water Act requirements.
The Belle Fourche River and Certain Tributaries' Use ARSD § 74:51:03:10 [Chemical Specific] ARSD § 74:51:01:46 (Class 3 waters) [Chemical Specific] ARSD § 74:51:01:51 (class 8 waters) [Chemical Specific]	Applicable	This provision designates beneficial uses for the Belle Fourche River and certain tributaries.	Strawberry Creek is a tributary Bear Butte Creek, which is a tributary to the Belle Fourche River. From Bear Butte Creek to Section 5, T 4 N, R 4 E Strawberry Creek is designated as coldwater marginal fish life propagation waters and limited-contact recreation waters.
Coldwater Marginal Fish Life Propagation Waters ARSD § 74:51:01:46 [Chemical Specific] ARSD § 74:51:01:32 (effluent limitations related to coldwater fisheries) [Chemical Specific]	Applicable with interim selenium waiver	Establishes criteria for coldwater marginal fish life propagation waters. All numerical criteria of this ARAR will be met except for the selenium (Se) chronic criteria of 5 μg/L. This ARAR waiver is discussed in ROD Section 2.14.2.	

APPENDIX A

SUMMARY OF FEDERAL AND STATE ARARs COMPLIANCE
GILT EDGE MINE NPL SITE
OPERABLE UNIT 2: Interim Water Treatment

Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Effluent limitations for discharges to trout fishery waters ARSD § 74:51:01:32 [Chemical Specific]	Applicable	Effluents discharged from water pollution control facilities into waters classified for the beneficial use of coldwater permanent fish life propagation and coldwater marginal fish life propagation must be of high quality. In order to protect these uses, the effluent may not exceed 10 milligrams per liter (mg/L) of suspended solids and 10 mg/L of 5-day biochemical oxygen demand (BOD). The limit for suspended solids must be met at all times based on the results of a 24-hour composited sample. The limit for 5-day BOD must be met at all times based on the results of any one 24-hour composited sample of the effluent. Neither pollution characteristic may exceed 17.5 mg/L in any one grab sample collected during the sampling period.	Bear Butte Creek above and below the Strawberry Creek confluence has been designated as a coldwater permanent fishery by SD DENR.
Priority Pollutants and Chemicals ARSD § 74:51:01:55 [Chemical Specific]	Applicable with interim selenium waiver	This provision establishes levels at which toxic pollutants are, or may become, injurious to public health, safety, or welfare; plant, aquatic, and animal life; or the existing or designated uses of waters may not be present in the surface waters of the state. The toxic pollutants to which this section applies are the priority pollutants and chemicals in 40 CFR Part 131 (July 1, 1995) and any other toxic pollutants or substances determined by the State of South Dakota to be of concern at a specific site. All numerical criteria of this ARAR will be met except for the selenium (Se) chronic criteria of 5 μg/L. This ARAR waiver is discussed in ROD Section 2.14.2.	Applicable to all waters of the state. Bear Butte and Strawberry Creek receive water from the site and are considered waters of the state.

APPENDIX A

SUMMARY OF FEDERAL AND STATE ARARs COMPLIANCE
GILT EDGE MINE NPL SITE
OPERABLE UNIT 2: Interim Water Treatment

Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Beneficial Use for Waters of South Dakota ARSD § 74:51:01:42 [Chemical Specific] ARSD § 74:51:03:01 ARSD § 74:51:03:02 [Chemical Specific]	Applicable	This provision establishes beneficial uses for waters of South Dakota. The beneficial use classifications of surface waters established do not limit the actual use of the waters. The classifications designate the minimum quality at which the surface waters of the state are to be maintained and protected. All streams in South Dakota are assigned the beneficial uses of irrigation and fish and wildlife propagation, recreation, and stock watering.	Surface water downstream of the Gilt Edge Site has a designated beneficial use as coldwater marginal fish life, propagation (Strawberry Creek), and coldwater permanent fishery (Bear Butte Creek above and below the Strawberry Creek confluence). Contaminated water emanating from this Site will be intercepted and treated as part of OU2-Interim Water Treatment pursuant to federal and state Clean Water Act requirements. As a result, beneficial uses of surface waters downstream from the site will be maintained.
Limited Contact Recreation Waters ARSD § 74:51:01:51 [Chemical Specific]	Applicable	Criteria for limited contact recreation waters. The criteria of parameters for limited contact recreation waters and their allowable variations that are not included under § 74:51:01:55, unless set under § 74:51:01:24	SD DENR designates Strawberry and Bear Butte Creeks as limited contact recreation waters
Fish and Wildlife Propagation, Recreation, and Stock Watering Waters ARSD § 74:51:01:52 [Chemical Specific]	Applicable with interim TDS waiver	Criteria for fish and wildlife propagation, recreation, and stock watering waters. The criteria of parameters for fish and wildlife propagation, recreation, and stock watering waters and their allowable variations that are not included under § 74:51:01:55 and Appendix B, unless set under § 74:51:01:24. All criteria of this ARAR will be met except for the Total Dissolved Solids (TDS) criteria of $\leq$ 2,500 mg/L 30-day average and $\leq$ 4,375 mg/L daily maximum. This ARAR waiver is discussed in ROD Section 2.14.2.	
Irrigation Waters ARSD § 74:51:01:53 [Chemical Specific]	Applicable	Establishes criteria and allowable variations for various parameters for water classified for the beneficial use of irrigation.	The South Dakota Department of Environment and Natural Resources designates all waters of the state as irrigation waters

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SUMMARY OF FEDERAL AND STATE ARARs COMPLIANCE
GILT EDGE MINE NPL SITE
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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Substantive SDSWD Permit Requirements ARSD § 74:52:01-11 [Action Specific] Materials Causing Pollutants to Form in Water ARSD § 74:51:01:05 [Action Specific] Visible Pollutants Prohibited ARSD § 74:51:01:06 [Action Specific] Acids and Alkalis ARSD § 74:51:01:07 [Action Specific] Taste- and Odor-Producing Materials ARSD § 74:51:01:08 [Action Specific] Biological Integrity of Waters ARSD § 74:51:01:12 [Action Specific] Restrictions for Water with Dual Classification ARSD § 74:51:01:03 [Action Specific] Application of Criterion to Contiguous Waters ARSD § 74:51:01:04 [Action Specific]	Applicable	These provisions state that a discharge from any point source into surface waters may not occur without a valid State of South Dakota surface water discharge permit. Point sources requiring permits include industrial discharges and privately owned treatment works. Sites under CERCLA are required to meet the substantive requirements of a permit but do not have to actually obtain the permit.	All contaminated waters emanating from the Site are intercepted and treated as part of OU2 - Interim Water Treatment pursuant to federal and state Clean Water Act requirements.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Anti Degradation of the Waters of South Dakota ARSD § 74:51:01:34 ARSD § 74:51:01 [Action Specific] Beneficial Use Maintained and Protected ARSD § 74:51:01:34 [Action Specific] Future Beneficial Use Maintained and Protected ARSD § 74:54:01:03 [Action Specific]	Applicable	This provision establishes an anti-degradation policy for surface waters of South Dakota. The existing beneficial uses of surface waters of the state and the level of water quality that is assigned by designated beneficial uses shall be maintained and protected. Surface waters of the state in which the existing water quality is better than the minimum levels prescribed by the designated beneficial use shall be maintained and protected at that higher quality level. The State of South Dakota may allow a lowering of the water quality to levels established under the designated beneficial use if it is necessary in order to accommodate important economic or social development in the area in which the waters are located. Surface waters of the state, which do not meet the levels of water quality assigned to the designated beneficial use shall be improved as feasible to meet those levels. No further reduction of water quality may be allowed for surface waters of the state that do not meet the water quality levels assigned to their designated beneficial uses as a result of natural causes or conditions, and all new discharges must meet applicable water quality standards. The State of South Dakota shall assure that regulatory requirements are achieved for all new and existing point sources and that nonpoint sources are controlled through cost effective and reasonable best management practices.	Surface water downstream of the Gilt Edge Site has a designated beneficial use as coldwater marginal fish life, propagation (Strawberry Creek), and coldwater permanent fishery (Bear Butte Creek above and below the Strawberry Creek confluence). Contaminated water emanating from this Site will be intercepted and treated as part of OU2-Interim Water Treatment pursuant to federal and state Clean Water Act requirements.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Ground Water			
Groundwater Quality Standards ARSD § 74:54:01 [Chemical Specific]	Applicable	Existing and future beneficial uses of groundwater shall be maintained and protected. Waters of the state in which ambient water quality is better than the minimum levels prescribed shall be maintained and protected at the better water quality. Groundwater that has an ambient concentration of 10,000 mg/L or less total dissolved solids (TDS) is classified as having the beneficial use of drinking water supplies, suitable for human consumption.	Groundwater beneath the Gilt Edge site meets the established TDS requirements and the human consumption beneficial use must be restored and maintained. Contaminated water emanating from the site will be intercepted and treated as part of OU2 - Interim Water Treatment pursuant to federal and state Clean Water Act requirements.
Air Quality			
National Ambient Air Quality Standards 40 CFR 50.6; (PM-10); 40 CFR 50.7 (PM 2.5); and 40 CFR 50.12 (Lead). [Chemical Specific]	Relevant and Appropriate	These provisions establish standards for PM-10, PM 2.5, and lead emissions to air.	National ambient air quality standards (NAAQS) are implemented through the New Source Review Program and State Implementation Plans (SIPs). South Dakota has adopted the federal standards for particulate and lead emissions. State air quality standards are applicable and federal standards are relevant and appropriate. The federal New Source Review program addresses only major sources. Emissions associated with proposed remedial action in OU2 will be limited to fugitive dust emissions associated with earth moving activities during construction, which will occur only in isolated areas over a short period of time and will have dust control mitigation measures implemented.
South Dakota Ambient Air Quality Standards ARSD § 74:36:02:02 and ARSD § 74:36:02:03 [Chemical Specific]	Applicable	South Dakota has adopted the federal standards for particulate (PM 10 and PM 2.5) and lead emissions. These standards apply to the entire State of South Dakota, and no person may cause these standards to be exceeded. These standards include normal background levels of air pollutants.	Dust mitigation control measures will be implemented during construction activities.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Historic & Archeological Resources			
National Historic Preservation Act (NHPA), 16 U.S.C. § 470 40 CFR 6.301(b) 36 CFR 800 [Location Specific]	Applicable	This statute and its implementing regulations require federal agencies to take into account the effect of this response action upon any district, site, building, structure, or object that is included in or eligible for the Register of Historic Places.	Archeological and cultural resource surveys and inventories were completed as part of the application process by Brohm Mining Company for a state mining permit for the Gilt Edge Mine. Pursuant to the state mining permit the State Historical Preservation Office (SHPO) has granted clearance for Gilt Edge Mine area of operations as having "No Adverse Affects" on cultural resources. Remedial activities will occur within the area of operations. If any remedial action activities are necessary beyond previously permitted and inventoried areas, SHPO consultation and NHPA compliance will be addressed during remedial design.
Archaeological and Historic Preservation Act 16 U.S.C. § 469 40 CFR 6.301(c) [Location Specific]	Applicable	This statute and its implementing regulations establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	
Historic Sites, Buildings and Antiquities Act 16 U.S.C. § 461, et seq., 40 CFR 6.310(a) [Location Specific]	Applicable	This statute and its implementing regulations require federal agencies to consider the existence and location of land marks on the National Registry of National Landmarks and to avoid undesirable impacts on such landmarks.	
Wildlife Management			
Fish and Wildlife Coordination Act 16 U.S.C. §§ 1531, et seq., 40 CFR 6.302(g) [Location Specific]	Applicable	This statute and its implementing regulations require that federal agencies or federally funded projects ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provides for adequate protection of fish and wildlife resources.	U.S. Fish and Wildlife is actively involved in this project and have approved all planned actions as being protective of fish and wildlife resources.
Endangered Species Act, 16 U.S.C. § 1531 40 CFR 6.302(h) 50 CFR 17 and 402 [Location Specific]	Applicable	This statute and its implementing regulations provide that federal activities not jeopardize the continued existence of any threatened or endangered species.	EPA has consulted with representative of the U.S. Fish and Wildlife Service and South Dakota Department of Game, Fish & Parks to determine the existence of federal threatened or endangered species or state species of concern within the project area. These agencies have confirmed that this action will not impact or threaten such resources.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Migratory Bird Treaty Act, 16 U.S.C. §§ 703, et seq. Location Specific]	Applicable	This requirement establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the U.S. Fish and Wildlife Service during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.	EPA's consultation requirements are being met (1) through direct participation by U.S. Fish and Wildlife Service representatives on the inter-agency site investigation and remedial action planning and management team and (2) through continued consultation during remedial design and remedial construction.
Bald Eagle Protection Act, 16 U.S.C. §§ 668, et seq. [Location Specific]	Applicable	This requirement establishes federal responsibility for protection of bald and golden eagles, and requires continued consultation with the U.S. Fish and Wildlife Service during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald and golden eagles.	
Floodplains and Special Aquatic Resources			
Floodplain Management Regulations 40 CFR 6.302(b), and Executive Order No. 11988. [Location Specific]	Applicable	These require that actions be taken to avoid, to the extent possible, adverse effects associated with direct or indirect development of a floodplain, or to minimize adverse impacts if no practicable alternative exists.	The Flood Insurance Rate Map prepared by the Federal Emergency Management Agency for Lawrence County, South Dakota, indicates there are no flood hazard areas in the project area.
Permits for dredged and fill materials Clean Water Act §1344 (section 404) and 40 CFR 230 Executive Order No. 11990. [Location Specific]	Applicable	Discharge of dredged or fill materials into waters of the US is prohibited without a permit. Adverse impacts associated with the destruction or loss of wetlands and other special aquatic sites are to be avoided. Wetlands are defined as those areas that are inundated or saturated by groundwater or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.	Based on consultations with representatives of the U.S. Fish and Wildlife Service; South Dakota Department of Game, Fish & Parks; and the U.S. Army Corps of Engineers, there are no wetland areas that will be affected within or adjacent to those portions of the site affected by this action.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
Waste & Site Management			
Federal RCRA Subtitle D Solid Waste Requirements: 40 CFR 257.3-1 40 CFR 257.3-2 40 CFR 257.3-3 40 CFR 257.3-4 40 CFR 257.3-8(d) [Action Specific]	Applicable	40 CFR 257 establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. This part comes into play whenever there is a "disposal" of any solid or hazardous waste from a "facility."	Applicable to an onsite disposal unit that would be constructed to contain waste materials generated by interim water treatment.
Federal RCRA Subtitle C Hazardous Waste Requirements: [Action Specific]	Relevant and Appropriate	RCRA Subtitle C requirements are applicable to any hazardous wastes generated at the Gilt Edge site as part of this action.	
General Facility Standards 40 CFR 264 Subpart B [Action Specific]		The State of South Dakota has been delegated authority to implement the federal RCRA Subtitle C and D programs. The state's RCRA authorities are contained in State of South Dakota Solid Waste Requirements (SDCL § 34A-6), Hazardous Waste Requirements (SDCL § 34A-11), and Mined Land Reclamation Requirements (SDCL § 45-6B), and have been applied to the Brohm mine site through the state-issued mining permit. The substantive requirements of Brohm's permit (439 as amended) are applicable to this Superfund remedy.	
State of South Dakota Solid Waste Requirements; Location Standards ARSD § 74:27:07-17 [Location Specific]	Applicable	Sets forth location standards that all solid waste disposal sites must meet. These requirements apply to any person involved in any aspect of the management of solid waste, including recycling, processing, transporting, storing, or disposing of solid waste.	Applicable to an onsite disposal unit that would be constructed to contain waste materials generated by interim water treatment.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
State Hazardous Waste Management Requirements SDCL 34A-11 and corresponding rules ARSD § 74:28 [Action Specific] Surface Impoundment Closure ARSD § 74:28:25:01 [Action Specific] Waste Pile Closure ARSD § 74:28:25:01 [Action Specific] Landfill Closure ARSD § 74:28:25:01 [Action Specific]	Relevant and Appropriate	All federal RCRA Subtitle C requirements for hazardous waste treatment, storage, and disposal facilities are incorporated by reference as State of South Dakota requirements as provided for under ARSD § 74:28:25:01 unless mentioned otherwise. Specific requirements have been referenced back to the state hazardous waste requirements for surface impoundment, waste pile, and landfill closure requirements.	Mining waste at Gilt Edge is exempt from the state Hazardous Waste Management Act and RCRA Subtitle C under the Bevill exclusion. However, if water treatment plant sludge is disposed on-site, and the disposal activity involves the use of a waste management unit sufficiently similar to a hazardous waste regulated unit, and the unit is to receive wastes sufficiently similar to a hazardous waste, the RCRA Subtitle C requirement pertaining to that type of waste management unit would be relevant and appropriate (55 FR 8763)
State of South Dakota Solid Waste Requirements SDCL § 34A-6 [Action Specific] Definitions SDCL § 34A-6-1.3 [Action Specific] Facility Design and Construction ARSD § 74:27:12 [Action Specific] Closure and Post-Closure ARSD § 74:27:15 [Action Specific]	Applicable	Sets forth standards that all solid waste disposal sites must meet. These requirements apply to any person involved in any aspect of the management of solid waste, including recycling, processing, transporting, storing, or disposing of solid waste. Rubble sites, construction demolition sites, restricted-use sites, nonmunicipal solid waste monofills, and other types of facilities not specifically listed must be designed and constructed to protect human health and prevent degradation of the environment, including ambient groundwater quality, surface water quality, and air quality.	The definition of solid waste includes sludge from a waste treatment plant. Facilities designed to contain this sludge produced by the OU2 treatment facility must comply with SDCL § 34A-6.

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Statute and Regulatory Citation [ARAR Type]	ARAR Determination	Description	Comment
South Dakota Mined Land Reclamation Act SDCL 45-6B, and ARSD § 74:29 [Action Specific]	Applicable	This act sets forth standards by which mine operators are to conduct reclamation of all affected lands. Certain discrete portions of the statutory or regulatory provisions are relevant and appropriate requirements. The definition of reclamation is the employment during and after a mining operation of procedures to minimize the disruption from the mining operation and to provide for the rehabilitation of the affected land through the rehabilitation of plant cover, soil stability, water resources, or other measures appropriate to the subsequent beneficial use of the mined and reclaimed lands.	EPA's consultation with SDDENR during remedial design development will satisfy this requirement.
Noxious Weeds ARSD § 12:62:03, et seq. [Action Specific] ARSD § 12:62:03:01.06 (identification of noxious weeds statewide) [Action Specific] ARSD § 12:62:03:01.07 (identification of noxious weeds locally) [Action Specific]	Applicable	A locally noxious weed is defined as any weed that is biennial, perennial, or a pernicious annual, capable of spreading rapidly, not controllable without special preventive chemical, mechanical, biological, and cultural practices, capable of materially reducing the production of crops or livestock, and capable of decreasing the value of the land.	Noxious weed management at the site will be managed by the State of South Dakota.

Appendix B

Selected Remedy Cost Estimate Spreadsheets

CDM Camp Dresser & McKee Inc.
Preliminary Opinion of Probable Cost

Project: *Gilt Edge Mine* Updated: *7-Sep-01*
Project #: *4000-30291* Estimator: *BCD*
Location: *Lawrence County, South Dakota* Project Status: *Final ARD WTP FFS (-30% to +50%)*

Alternative 3a - Divert ARD Flow from Hoodoo Gulch to Sunday Pit and Install ARD Diversion Ditch At Pond C
The seepage from Hoodoo Gulch would be collected within a collection (sump) system prior to convergence with Strawberry Creek. Collected water would flow by gravity to a storage tank and subsequently be pumped to Sunday Pit. A HDPE lined interception channel would be constructed to collect seepage upstream of Pond C as surface water run-off. The channel would flow to the south, with discharge to Pond D.

Cumulative seepage flow rate, gpm = 10 gpm
Transfer flow rate, gpm = 30 gpm

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1	CAPITAL COSTS					
1.1	CIVIL/SITEWORK					
1.1.1	Sumps (Hoodoo Gulch)	*5 total*				
1.1.1.1	Excavation	5	CY	52	1,000	Means Heavy Construction Cost Data (2001), 02240-500-0300
1.1.1.2	Backfill	4	CY	22	1,000	Means Heavy Construction Cost Data (2001), 02315-100-0300
1.1.2	Pond C Collection Ditch					
1.1.2.1	Excavation	500	CY	4.05	3,000	Means Heavy Construction Cost Data (2001), 02315-900-0050
1.1.2.2	Compaction	500	CY	2.71	2,000	Means Heavy Construction Cost Data (2001), 02315-900-1900
1.1.2.3	Trimming	8625	SF	0.42	4,000	Means Heavy Construction Cost Data (2001), 02315-900-2100
1.1.3	Piping (Trenching, Backfill, and Bedding)					
1.1.3.1	Sump Collectors	350	LF	3.57	2,000	Means Heavy Construction Cost Data (2001), 02315-940-0700, -1700, and -130-0200
1.1.3.2	Main Collector	900	LF	3.57	4,000	Means Heavy Construction Cost Data (2001), 02315-940-0700, -1700, and -130-0200
1.1.3.3	Transfer to Sunday Pit	2300	LF	2.05	5,000	Means Heavy Construction Cost Data (2001), 02315-940-2850 and -130-0200
				Subtotal	*22,000*	
1.2	STRUCTURAL					
1.2.1	Concrete Sump	5	EA	1,054	6,000	Means Heavy Construction Cost Data (2001), 02630-200-0800
1.2.1.1	HDPE Liner for Sump	250	SF	7.67	2,000	based on Means (2001), 02660-400-0200 and $60/hr at 5hrs per sump
1.2.2	HDPE Lining for Pond C Collection Ditch	10875	SF	1.05	12,000	Means Heavy Construction Cost Data (2001), 02630-400-0200
1.2.3	Concrete Foundation for Storage Tank	3	CY	161	500	Means Heavy Construction Cost Data (2001), 03300-130-4050
				Subtotal	*21,000*	
1.3	PROCESS/MECHANICAL					
1.3.1	Piping					
1.3.1.1	CPVC - 1" (Sump Collectors)	350	LF	2.45	900	Herco Catalog (1998), p.96 and Means Heavy Construction Data (2001), 02510-840-2100
1.3.1.2	CPVC - 2" (Main Collection Header)	900	LF	4.65	5,000	Herco Catalog (1998), p.96 and Means Heavy Construction Data (2001), 02510-840-2120
1.3.1.3	CPVC - 3" (Transfer to Sunday Pit)	2300	LF	9.10	21,000	Herco Catalog (1998), p.96 and Means Heavy Construction Data (2001), 02510-840-2160
1.3.1.4	Valves and Appurtenances	1	LS	15,600	16,000	General Note 8
1.3.2	Storage Tank	1	LS	10,000	10,000	VQ - General Note 1
1.3.3	Submersible Pump	1	EA	4,500	5,000	VQ - General Note 1
				Subtotal	*58,000*	

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1.4	ELECTRICAL	1	LS	24,000	*24,000*	see Note A below
1.5	INSTRUMENTATION and CONTROLS	1	LS	12,000	*12,000*	see Note A below
	Capital Costs			**Subtotal**	**137,000**	
1.6	CONSTRUCTION PRORATES	1	LS	82,000	*82,000*	General Note 10
	General Conditions (Overhead) [a]		20% of Total Cost	28,000		
	Contractor's Profit [b]		10% of Total Cost + GC	17,000		
	Scope and Bid Design Contingency [c]		20% of Total Cost + GC + Profit	37,000		
1.7	ENGINEERING COSTS	1	LS	43,000	*43,000*	General Note 11
	Remedial Design		8% of Total Cost + Const Prorates	18,000		
	Project Management		5% of Total Cost + Const Prorates	11,000		
	Construction Management		6% of Total Cost + Const Prorates	14,000		
	CAPITAL COSTS			**Total**	**262,000**	
2	**ANNUAL O&M COSTS**					
2.1	ARD Transfer rom Hoodoo Gulch Seepage Storage Tank to Sunday Pit (at 8 hrs/day)	5	HP	429/(HP*yr)	*1,000*	General Note 5
	Annual O&M Costs			**Subtotal**	**1,000**	
2.2	CONSTRUCTION PRORATES	1	LS	700	*700*	General Note 10
	General Conditions (Overhead) [a]		20% of Total Cost	200		
	Contractor's Profit [b]		10% of Total Cost + GC	200		
	Scope and Bid Design Contingency [c]		20% of Total Cost + GC + Profit	300		
2.3	ENGINEERING COSTS	1	LS	200	*200*	see Note B below
	Construction Management		6% of Total Cost + Const Prorates	200		
	ANNUAL O&M COSTS			**Total**	**1,900**	

Notes

A Capital costs for the following items are estimated as a percentage of total Process/Mechanical costs and based on remote location of construction from known electrical sources:

Electrical	40%	(Means(2001);based on trenching, conduit, and backfill)
Instrumentation and Controls	20%	

B Technical Services (i.e., Remedial Design, Project Management) not included in this alternative's analysis; accounted for in Alternative 6.

CDM Camp Dresser & McKee Inc.

Preliminary Opinion of Probable Cost

Project:	*Gilt Edge Mine*	Updated:	*7-Sep-01*
Project #:	*4000-30291*	Estimator:	*BCD*
Location:	*Lawrence County, South Dakota*	Project Status:	*Final ARD WTP FFS (-30% to +50%)*

Alternative 6b - Convert Existing Caustic Chemical Precipitation ARD WTP to Lime Precipitation and upgrade With Additional Treatment Train and Filtration (ARAR waiver)
This alternative would consist of conversion of the existing caustic-addition treatment processt to a lime-addition precipitation treatment process. Sludge residuals are disposed of at an on-stie location (e.g., dewatered, lined ponds). Optimized operations include addition of a lime slaking system; polishing filter; sludge residual treatment using a filter press; and annual O&M operations for the treatment plant including utilities, staff, administration, site snow removal, and weekly monitoring sampling and support.

Existing Treatment Capacity, gpm =	300 gpm
NewTreatment Capacity, gpm =	0 gpm
Total Treatment Capacity, gpm =	300 gpm

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1	CAPITAL COSTS					
1.1	CIVIL/SITEWORK					
1.1.1	Excavation	243	CY	10	3,000	PW - General Note 1
1.1.2	Fine Grading	243	SY	0.85	300	Means Heavy Construction Cost Data (2001), 02305-440-1100
1.1.3	Structural Fill below SOG	81	CY	20	2,000	PW - General Note 1
1.1.4	Aggregate below SOG	81	CY	19	2,000	Means Heavy Construction Cost Data (2001), 02315-505-1100
1.1.5	Disposal (non-contaminated materials)	1	LS	1,000	1,000	Means Heavy Construction Cost Data (2001), 02220-875-5550
				Subtotal	*8,300*	
1.2	STRUCTURAL					
1.2.1	Pre-Fabricated Steel Building	2000	SF	10	20,000	Means Cost Data (2001), 13128-700-1100, x-6900
1.2.2	Concrete, Building/Clarifier/Sludge Storage Foundations	182	CY	250	46,000	Means Cost Data (2001), 03310-240-4050
				Subtotal	*66,000*	
1.3	*PROCESS/MECHANICAL*					
1.3.1	Headworks Pump	0	EA	0	0	VQ - General Note 1
1.3.2	Sludge Mixing Tank	0	LS	0	0	VQ - General Note 1
1.3.2.1	Mixer	0	LS	0	0	VQ - General Note 1
1.3.3	Rapid Mix Tank	0	LS	0	0	VQ - General Note 1
1.3.3.1	Mixer	0	LS	0	0	VQ - General Note 1
1.3.4	Polymer Storage Tank	0	LS	0	0	VQ - General Note 1
1.3.4.1	Polymer Activation/Feed System	0	LS	0	0	VQ - General Note 1
1.3.5	Flocculation Tank	0	LS	0	0	VQ - General Note 1
1.3.5.1	Mixer	0	LS	0	0	VQ - General Note 1
1.3.6	Circular Clarifier	1	EA	184,000	184,000	VQ - General Note 1
1.3.6.1	Sludge Recycle Pump	1	EA	16,875	17,000	VQ - General Note 1
1.3.6.2	Sludge-to-Waste Pump	2	EA	16,875	34,000	VQ - General Note 1

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1.3.6.3	Post Clarifier Acid Addition					
1.3.6.3.1	Acid Storage Tank	1	EA	14,000	14,000	VQ - General Note 1
1.3.6.3.2	Metering Pump	1	EA	5,600	6,000	Means (2000), Env. Cost Data, 33-32-0122
1.3.6.3.3	Rapid Mix Tank	1	EA	4,500	5,000	VQ - General Note 1
1.3.6.3.4	Mixer	1	EA	2,500	3,000	VQ - General Note 1
1.3.7	Disc Filter	1	LS	108,750	109,000	VQ - General Note 1
1.3.8	Settled Water Storage Tank	1	LS	10,000	10,000	VQ - General Note 1
1.3.9	Sludge Conditioning/Handling Equipment					
1.3.9.1	Sludge Storage Tank	1	LS	47,921	48,000	VQ - General Note 1
1.3.9.2	Sludge Transfer Pump to Filter Press	1	EA	16,875	17,000	VQ - General Note 1
1.3.9.3	Polymer Storage Tank	1	EA	3,750	4,000	VQ - General Note 1
1.3.9.4	Polymer Activation/Feed System	1	LS	6,500	7,000	VQ - General Note 1
1.3.9.5	Filter Press	1	EA	225,000	225,000	VQ - General Note 1
1.3.9.6	Filtrate Return Pump	1	EA	16,875	17,000	VQ - General Note 1
1.3.10	Piping					
1.3.10.1	PVC - 1"	80	LF	9	800	Means Heavy Construction Cost Data (2001), 15108-520-4410
1.3.10.2	PVC - 2"	0	LF	11	0	Means Heavy Construction Cost Data (2001), 15108-520-4460
1.3.10.3	PVC - 4"	300	LF	15	5,000	Means Heavy Construction Cost Data (2001), 15108-520-4480
1.3.10.4	PVC - 6"	0	LF	21	0	Means Heavy Construction Cost Data (2001), 15108-520-4490
1.3.10.5	PVC - 8"	100	LF	33	4,000	Means Heavy Construction Cost Data (2001), 15108-520-4500
1.3.10.6	PVC - 12"	0	LF	66	0	Means Heavy Construction Cost Data (2001), 15108-520-4490
1.3.10.7	HDPE - 2"	0	LF	15	0	General Note 9
1.3.10.8	HDPE - 4"	0	LF	23	0	General Note 9
1.3.10.9	HDPE - 8"	200	LF	32	7,000	General Note 9
1.3.10.10	Valves and Appurtenances	1	LS	11,000	11,000	General Note 8
				Subtotal	*727,800*	
1.4	EXISTING WTP CONVERSION	1	LS	331,000	*331,000*	General Note 12
1.4.1	Lime Slaker, Slurry Mixing Tank, and Feed Pump	1	LS	260,000		VQ - General Note 1
1.4.2	Electrical	1	LS	32,000		General Note 6
1.4.3	Instrumentation and Controls	1	LS	39,000		General Note 6
1.5	ELECTRICAL	1	LS	84,000	*84,000*	General Note 6
1.6	INSTRUMENTATION and CONTROLS	1	LS	105,000	*105,000*	General Note 6
	Capital Costs			**Subtotal**	**1,323,000**	
1.7	CONSTRUCTION PRORATES	1	LS	774,000	*774,000*	General Note 10
	General Conditions (Overhead)[a]		20% of Total Cost	265,000		
	Contractor's Profit [b]		10% of Total Cost + GC	159,000		
	Scope and Bid Design Contingency [c]		20% of Total Cost + GC + Profit	350,000		

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1.8	ENGINEERING COSTS	1	LS	399,000	*399,000*	General Note 11
	Remedial Design	8% of Total Cost + Const Prorates		168,000		
	Project Management	5% of Total Cost + Const Prorates		105,000		
	Construction Management	6% of Total Cost + Const Prorates		126,000		
	CAPITAL COSTS			Total	2,496,000	
2	ANNUAL O&M COSTS					
2.1	CHEMICALS					
2.1.1	Hydrated lime	300	gpm	542	163,000	VQ - General Note 1
2.1.2	Polymer	300	gpm	174	53,000	VQ - General Note 1
2.1.3	Acid	300	gpm	13	4,000	VQ - General Note 1
				Subtotal	*220,000*	
2.2	SLUDGE DISPOSAL		see General Note 2			
2.3	MONITORING/SAMPLING					
2.3.1	Compliance Monitoring	1	LS	27,000	*27,000*	General Note 13
2.3.2	Operational Monitoring	1	LS	41,000	*41,000*	General Note 14
				Subtotal	*68,000*	
2.4	STAFF					
2.4.1	Plant Engineer	1	annual salary	82,500	83,000	General Note 4
2.4.2	Operators	9	annual salary	38,100	343,000	General Note 4
2.4.3	Mechanic	2	annual salary	59,800	120,000	General Note 4
2.4.4	Chemist	1	annual salary	39,600	40,000	General Note 4
2.4.5	Security	2	annual salary	34,200	69,000	General Note 4
2.4.6	Administrative Assistant	1	annual salary	25,000	25,000	General Note 4
				Subtotal	*680,000*	
2.5	OTHER DIRECT COSTS					
2.5.1	Project Manager	1040	hours per year	40	42,000	General Note 4
2.5.2	Junior Engineer	240	hours per year	30	8,000	General Note 4
2.5.3	Project Engineer	240	hours per year	50	13,000	General Note 4
				Subtotal	*63,000*	
2.6	INDIRECT COSTS					
2.6.1	Radio and Pager Rental	1	LS	2,000	2,000	General Note 4

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
2.6.2	Vehicles					
2.6.2.1	Dozer	12	months	4,325	52,000	Means Heavy Construction Cost Data (2001), 01590-200-4150
2.6.2.2	Front Loader	12	months	6,000	72,000	Means Heavy Construction Cost Data (2001), 01590-200-4730
2.6.2.3	Suburban	12	months	900	11,000	Means Heavy Construction Cost Data (2001), 01590-400-7250
2.6.2.4	Pickup Truck (3 total)	12	months	2,250	27,000	Means Heavy Construction Cost Data (2001), 01590-400-7200
2.6.2.5	Fuel	1	year	138,000	138,000	based on hourly costs for above Items, 8 hrs/365 days
2.6.3	Road Grading	4	per year	5,000	20,000	General Note 4
2.6.4	Temporaty Lab	12	months	350	5,000	Means Heavy Construction Cost Data (2001), 01520-500-0550
2.6.5	Supplies	1	LS	132,000	132,000	General Note 4
2.6.6	Utilities					
2.6.6.1	Water	1	LS	5,000	5,000	General Note 4
2.6.6.2	Phone	12	months	500	6,000	Means Heavy Construction Cost Data (2001), 01520-550-0140
2.6.6.3	Electrical					
2.6.6.3.1	Pumps					
2.6.6.3.1.1	Ruby Gulch to Sunday Pit	150	HP	429/(HP*yr)	22,000	General Note 5; 8 hours per day average over year
2.6.6.3.1.2	Pond E to (E) WTP	150	HP	429/(HP*yr)	65,000	General Note 5; 24 hours/day, 365 days/year
2.6.6.3.1.3	Heap Leach Recirculating (On-Solution)	150	HP	429/(HP*yr)	38,000	General Note 5; October through April, 24 hours/day
2.6.6.3.1.4	Heap Leach Recirculating (concurrently w/2.5.6.3.1.3)	15	HP	429/(HP*yr)	4,000	General Note 5; October through April, 24 hours/day
2.6.6.3.1.5	Sludge Recycle	15	HP	429/(HP*yr)	7,000	General Note 5
2.6.6.3.1.6	Sludge-to-Waste	5	HP	429/(HP*yr)	3,000	General Note 5
2.6.6.3.1.7	Sludge Storage to Filter Press	10	HP	429/(HP*yr)	5,000	General Note 5
2.6.6.3.1.8	Filtrate Return Pump	5	HP	429/(HP*yr)	3,000	General Note 5
2.6.6.3.2	Chemical Feed Systems					
2.6.6.3.2.1	Lime Slaker System	2.5	HP	429/(HP*yr)	2,000	General Note 5
2.6.6.3.2.2	Polymer Activation/Feed System	1.5	HP	429/(HP*yr)	1,000	General Note 5
2.6.6.3.2.3	Sludge Polymer Activation/Feed System	1.5	HP	429/(HP*yr)	700	General Note 5
2.6.6.3.3	Mixers					
2.6.6.3.3.1	Sludge Mixing Tank	2	HP	429/(HP*yr)	1,000	General Note 5
2.6.6.3.3.2	Rapid Mix	5	HP	429/(HP*yr)	3,000	General Note 5
2.6.6.3.3.3	Flocculation	2	HP	429/(HP*yr)	1,000	General Note 5
2.6.6.3.3.4	Sludge Storage Tank	5	HP	429/(HP*yr)	3,000	General Note 5
2.6.6.3.3.5	Clarifier Rake	2	HP	429/(HP*yr)	900	General Note 5
2.6.6.3.4	Sludge Handling Equipment					
2.6.6.3.4.1	Filter Press	7	HP	429/(HP*yr)	4,000	General Note 5
2.6.6.4	Fuel for Pumps/Heaters (diesel and propane)	12	months	10,080	121,000	Based on actual site usage + 20% adjustment for new WTP building
				Subtotal	*755,000*	
	Annual O&M Costs			**Subtotal**	**1,786,000**	
2.7	CONSTRUCTION PRORATES	1	LS	1,045,000	*1,045,000*	General Note 10
	General Conditions (Overhead) [a]		20% of Total Cost	358,000		
	Contractor's Profit [b]		10% of Total Cost + GC	215,000		
	Scope and Bid Design Contingency [c]		20% of Total Cost + GC + Profit	472,000		

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
2.8	ENGINEERING COSTS	1	LS	170,000	*170,000*	General Note 11
	Construction Management	6% of Total Cost + Const Prorates		170,000		
	ANNUAL O&M COSTS			Total	3,001,000	
				per month	$250,083	
				per 1,000 gallons	$19.03	

Project:	*Gilt Edge Mine*	Updated:	*7-Sep-01*
Project #:	*4000-30291*	Estimator:	*BCD*
Location:	*Lawrence County, South Dakota*	Project Status:	*Final ARD WTP FFS (-30% to +50%)*

Alternative 6d - Construct New Optimized Chemical Precipitation ARD WTP Using Proprietary Metals Coordination Process and Microfiltration (ARAR Waiver)

This alternative would consist of the construction of a new ARD treatment plant. The treatment process would utilize an optimized precipitation treatment process using proprietary polymer technology to encapsulate metal hydroxides. Chemical reagents would be used to adjust pH during the process prior to addition of polymers. Sedimentation followed by microfiltration membranes would be used to remove the metal precipitates. Sludge residuals are disposed of at an on-stie location (e.g., dewatered, lined ponds). The process train also includes the chemical and polymer feed systems; mix tanks; sedimentation tanks; sludge tanks; and all pumps, instrumentation and appurtenances. Also included are annual O&M operations for the treatment plant including utilities, staff, administration, site snow removal, and weekly monitoring sampling and support.

Treatment Capacity, gpm = 300 gpm

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1	CAPITAL COSTS					
1.1	CIVIL/SITEWORK					
1.1.1	Excavation	940	CY	10	10,000	PW - General Note 1
1.1.2	Fine Grading	940	SY	1	1,000	Means Heavy Construction Cost Data (2001), 02305-440-1100
1.1.3	Structural Fill below SOG	313	CY	20	7,000	PW - General Note 1
1.1.4	Aggregate below SOG	313	CY	19	7,000	Means Heavy Construction Cost Data (2001), 02315-505-1100
1.1.5	Disposal (non-contaminated materials)	1	LS	2,000	2,000	Means Heavy Construction Cost Data (2001), 02220-875-5550
				Subtotal	*27,000*	
1.2	STRUCTURAL					
1.2.1	Pre-Fabricated Steel Building	8100	SF	9	73,000	Means Cost Data (2001), 13128-700-1100, x-6900
1.2.2	Concrete, Building and Tank Foundations	313	CY	250	79,000	Means Cost Data (2001), 03310-240-4050
				Subtotal	*152,000*	
1.3	PROCESS/MECHANICAL					
1.3.1	Headworks Pump	1	EA	44,000	44,000	VQ - General Note 1
1.3.2	Optimized Precipitation process train, including:	1	LS	1,469,000	1,469,000	VQ - General Note 1; see Note A below
	pumps					
	chemical storage					
	chemical feed					
	membranes					
	piping					
	accessories					
	filter press					
	electrical and I&C					

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
1.3.3	Settled Water Storage Tank	1	EA	21,500	22,000	VQ - General Note 1
1.3.4	Sludge Conditioning/Handling Equipment					
1.3.4.1	Sludge Storage Tank	1	LS	47,921	48,000	VQ - General Note 1
1.3.4.2	Sludge Transfer Pump to Filter Press	1	EA	16,875	17,000	VQ - General Note 1
1.3.5	Piping					
1.3.5.1	PVC - 1"	0	LF	9	0	Means Heavy Construction Cost Data (2001), 15108-520-4410
1.3.5.2	PVC - 2"	0	LF	11	0	Means Heavy Construction Cost Data (2001), 15108-520-4460
1.3.5.3	PVC - 4"	100	LF	15	2,000	Means Heavy Construction Cost Data (2001), 15108-520-4480
1.3.5.4	PVC - 6"	0	LF	21	0	Means Heavy Construction Cost Data (2001), 15108-520-4490
1.3.5.5	PVC - 8"	40	LF	33	2,000	Means Heavy Construction Cost Data (2001), 15108-520-4500
1.3.5.6	PVC - 12"	0	LF	66	0	Means Heavy Construction Cost Data (2001), 15108-520-4490
1.3.5.7	HDPE - 2"	0	LF	15	0	General Note 9
1.3.5.8	HDPE - 4"	0	LF	23	0	General Note 9
1.3.5.9	HDPE - 8"	600	LF	32	20,000	General Note 9
1.3.5.10	Valves and Appurtenances	1	LS	15,000	15,000	General Note 8
				Subtotal	*1,639,000*	
1.4	ELECTRICAL	1	LS	15,800	16,000	General Note 6
1.5	INSTRUMENTATION and CONTROLS	1	LS	19,700	20,000	General Note 6
	Capital Costs			**Subtotal**	**1,854,000**	
1.6	CONSTRUCTION PRORATES	1	LS	225,000	*225,000*	General Note 10; see Note A below
	General Conditions (Overhead) [a]	20% of Total Cost		77,000		
	Contractor's Profit [b]	10% of Total Cost + GC		47,000		
	Scope and Bid Design Contingency [c]	20% of Total Cost + GC + Profit		102,000		
1.7	ENGINEERING COSTS	1	LS	396,000	*396,000*	General Note 11; see Note A below
	Remedial Design	8% of Total Cost + Const Prorates		167,000		
	Project Management	5% of Total Cost + Const Prorates		104,000		
	Construction Management	6% of Total Cost + Const Prorates		125,000		
	CAPITAL COSTS			**Total**	**2,475,000**	

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
2	ANNUAL COSTS					
2.1	CHEMICALS					
2.1.1	pH Adjustment	1	LS	65,000	65,000	VQ - General Note 1
2.1.2	Chemicals (inc. proprietary)	1	LS	75,000	75,000	VQ - General Note 1
				Subtotal	*140,000*	
2.2	SLUDGE DISPOSAL		see General Note 2			
2.3	MONITORING/SAMPLING					
2.3.1	Compliance Monitoring	1	LS	27,000	*27,000*	General Note 13
2.3.2	Operational Monitoring	1	LS	41,000	*41,000*	General Note 14
				Subtotal	*68,000*	
2.4	STAFF					
2.4.1	Plant Engineer	1	annual salary	82,500	83,000	General Note 4
2.4.2	Operators	8	annual salary	38,100	305,000	General Note 4
2.4.3	Mechanic	2	annual salary	59,800	120,000	General Note 4
2.4.4	Chemist	1	annual salary	39,600	40,000	General Note 4
2.4.5	Security	2	annual salary	34,200	69,000	General Note 4
2.4.6	Administrative Assistant	1	annual salary	25,000	25,000	General Note 4
				Subtotal	*642,000*	
2.5	OTHER DIRECT COSTS					
2.5.1	Project Manager	1040	hours per year	40	42,000	General Note 4
2.5.2	Junior Engineer	240	hours per year	30	8,000	General Note 4
2.5.3	Project Engineer	240	hours per year	50	13,000	General Note 4
				Subtotal	*63,000*	
2.6	INDIRECT COSTS					
2.6.1	Radio and Pager Rental	1	LS	2,000	2,000	General Note 4
2.6.2	Vehicles					
2.6.2.1	Dozer	12	months	4,325	52,000	Means Heavy Construction Cost Data (2001), 01590-200-4150
2.6.2.2	Front Loader	12	months	6,000	72,000	Means Heavy Construction Cost Data (2001), 01590-200-4730
2.6.2.3	Suburban	12	months	900	11,000	Means Heavy Construction Cost Data (2001), 01590-400-7250
2.6.2.4	Pickup Truck	12	months	2,250	27,000	Means Heavy Construction Cost Data (2001), 01590-400-7200
2.6.2.5	Fuel	1	year	138,000	138,000	based on hourly costs for above Items, 8 hrs/365 days
2.6.3	Road Grading	4	per year	5,000	20,000	General Note 4
2.6.4	Temporaty Lab	12	months	350	5,000	Means Heavy Construction Cost Data (2001), 01520-500-0550
2.6.5	Supplies	1	LS	131,800	132,000	General Note 4
2.6.6	Utilities					
2.6.6.1	Water	1	LS	5,000	5,000	General Note 4
2.6.6.2	Phone	12	months	500	6,000	Means Heavy Construction Cost Data (2001), 01520-550-0140

Item		Quantity	Unit	Unit Bare Cost ($)	Total Bare Cost (nearest $100)	Notes
2.6.6.3	Electrical					
2.6.6.3.1	Pumps					
2.6.6.3.1.1	Ruby Gulch to Sunday Pit	150	HP	429/(HP*yr)	22,000	General Note 5; 8 hours per day average over year
2.6.6.3.1.2	Pond E to (E) WTP	150	HP	429/(HP*yr)	65,000	General Note 5; 24 hours/day, 365 days/year
2.6.6.3.1.3	Heap Leach Recirculating (On-Solution)	150	HP	429/(HP*yr)	38,000	General Note 5; October through April, 24 hours/day
2.6.6.3.1.4	Heap Leach Recirculating (concurrently w/2.5.6.3.1.3)	15	HP	429/(HP*yr)	4,000	General Note 5; October through April, 24 hours/day
2.6.6.3.2	General Process Train	132.5	HP	429/(HP*yr)	57,000	General Note 5
2.6.6.3.3	Sludge Handling Equipment					
2.6.6.3.3.1	Filter Press	5	HP	429/(HP*yr)	3,000	General Note 5
2.6.6.4	Fuel for Pumps/Heaters (diesel and propane)	12	months	10,080	121,000	Based on actual site usage + 20% adjustment for new WTP building
				Subtotal	*780,000*	
	Annual O&M Costs			**Subtotal**	**1,693,000**	
2.7	CONSTRUCTION PRORATES	1	LS	991,000	*991,000*	General Note 10
	General Conditions (Overhead)[a]		20% of Total Cost	339,000		
	Contractor's Profit [b]		10% of Total Cost + GC	204,000		
	Scope and Bid Design Contingency [c]		20% of Total Cost + GC + Profit	448,000		
2.8	ENGINEERING COSTS	1	LS	162,000	*162,000*	General Note 11
	Construction Management		6% of Total Cost + Const Prorates	162,000		
	ANNUAL O&M COSTS			**Total**	**2,846,000**	
				per month	**$237,167**	
				per 1,000 gallons	**$18.05**	

Notes

A Construction Prorates and Engineering Costs are not applied to Item 1.3.2; quoted costs include materials and installation of proprietary process train.