SUMMITVILLE MINE SUPERFUND SITE
FIVE-YEAR REVIEW REPORT
SEPTEMBER 2005

1.0 INTRODUCTION

This five-year review is a statutory review of the Summitville Mine Superfund Site required under the Comprehensive Environmental Response, Compensation Liability Act (CERCLA), 42 U.S.C. 9601 et. seq., and the National Contingency Plan for Oil and Hazardous Substances (NCP), 40 U.S.C. Part 300. The purpose of the review is to determine whether remedial response actions are protective of human health and the environment and to recommend ways to attain or maintain that protection. In accordance with the Comprehensive Five-Year Review Guidance, EPA 540-R-01-007, June 2001 (Guidance), this five-year review does not reconsider decisions made during the remedy selection process but evaluates the implementation and performance of the selected remedies. The State of Colorado Department of Public Health and Environment (CDPHE) conducted this review.

This is the second five-year review completed for the Summitville Mine Superfund Site. In keeping with the requirements of CERCLA 121 (c) and the NCP, the subsequent five-year review triggers from the signature date of the previous five-year review. The first Summitville Mine Superfund Site five-year review was completed in August 2000.

The CDPHE community involvement program is committed to promoting communication between citizens and CDPHE. The Community Involvement Plan (CIP) Update (Appendix A) describes the community involvement and public participation approach developed for the Summitville Mine Superfund Site, Rio Grande County, Colorado. This CIP updates the previous Community Involvement Plan, dated September 1999.

Overall, the results of this second five-year review indicate that all immediate threats at the site have been addressed and the remedy is expected to be protective of human health and the environment after all components are completed as proposed. Long-term protectiveness of the remedial actions will be verified through monitoring of the environmental media, both on the mine site and the downstream impacted aquatic environments of the Wightman Fork and Alamosa River. Based on current information and data, the site is relatively stable and the interim remedies are functioning as anticipated; however until all components of the Final Site-Wide Record of Decision (ROD) are implemented, it is unlikely that the Remedial Action Objectives (RAOs) and Remedial Action Levels (RALs) will be achieved. The more important components of the final remedy that have not been constructed, and therefore impacts current protectiveness are: a new Water Treatment Plant, adequate storage capacity, management of the mine pool, rehabilitation of the Reynolds Adit, and improvements to the Wightman Fork diversion channel and the SDI spillway channel. As funding becomes available, these remaining remedial components will be constructed.

2.0 SITE BACKGROUND

2.1 Site Information

The Summitville Mine Superfund Site (SMSS) is located in the southeastern portion of the San Juan Mountains, in the southwest corner of Rio Grande County, approximately 60 miles west of Alamosa, Colorado (Figure 2-1). The site is defined as the permitted 1,231-acre mine site that covers most of Section 30 and the northern one-third of Section 31, Township 37 North, Range 4 East, of the 6th New Mexico Principal Meridian. The site is located within the San Juan mountain range of the Rocky Mountains, approximately two miles east of the Continental Divide.

Surface water (both treated and untreated) from the site ultimately drains to Wightman Fork, and then flows approximately five miles downstream to the confluence of the Alamosa River. The Alamosa River flows past the town of Jasper into Terrace Reservoir. Terrace Reservoir was constructed in 1911 as an irrigation reservoir, and that remains its primary function today. Water released from Terrace Reservoir is used for livestock watering, agricultural irrigation, and wildlife habitat. Important crops grown using Alamosa River water include alfalfa, barley, wheat, and potatoes. The Alamosa River feeds wetlands that are habitat for aquatic life and migratory waterfowl. Below Terrace Reservoir, the Alamosa River flows through Capulin and terminates at its final point of diversion. The Alamosa River is non-tributary to the Rio Grande River.

Since the 1870's, the ores targeted by the site were historically mined via underground methods for the recovery of precious metals such gold and silver, and copper to a lesser extent. Adits were driven into South Mountain for haulage of ore, drainage, and ventilation purposes. This underground mining activity resulted in a network of underground workings that are connected, either directly through raises, winzes, crosscuts, etc., or indirectly via fractures, faults, etc. In 1984, large-scale, open-pit mining began at the site. The open-pit mining operations used cyanide heap leaching to extract precious metals from the ore after it was placed on a heap leach pad.

Features and structures from the period of open-pit mining predominates the landscape. Site features are shown on Figure 2-2. One of the most noticeable features is the Highwall. The Highwall is a steep face of South Mountain that was created by open-pit mining. The mining exposed mineral-rich, sulfide bearing rock that is a source of acid mine drainage. Acid *mine* drainage results when sulfide mineral-bearing rock is exposed to oxidizing conditions through man-made activities, such as blasting, tunneling, stripping, crushing, grinding, etc. Acid *rock* drainage results when sulfide mineral-bearing rock is exposed to oxidizing conditions through natural weathering processes. Both processes are characterized by low pH surface water or ground water. The former North and South open-pit mines were located at the base of the Highwall; both pits have been backfilled, capped, and contoured. The Heap Leach Pad was constructed in the Cropsy Creek valley, east of the former mine pits. The Heap Leach Pad has been capped and revegetated. The Summitville Dam Impoundment (SDI), located near the downstream boundary of the site, is used to store contaminated water for treatment. Other notable site features include the Beaver Mud Dump, North Waste Dump, water treatment plant (WTP), and the Reynolds and Chandler Adits.

The State of Colorado is the lead agency for Operable Units 4 and 5 at the site, with primary responsibilities for site cleanup being delegated to the Colorado Department of Public Health and Environment (CDPHE). U.S. EPA Region VIII is the support agency for OU 4 and 5, but has been the lead agency responsible for emergency response and interim remedial actions (OU0, OU1, and OU2) since taking over the site in December 1992. The CERCLIS identification number for the site is COD983778432. Cleanup actions to date have been funded by the Superfund trust fund, the State of Colorado, and settlement funds.

2.2 Site History and Enforcement Activities

The following sections present a summary historical and enforcement activities at the Summitville Mine and later the Summitville Mine Superfund Site.

2.2.1 Mining History

Placer gold was discovered in Wightman Fork downstream of the present day Summitville Mine site in the summer of 1870. The source lode deposit was found on South Mountain in 1873, and miners established open cut workings on South Mountain by 1875. The target ore of these early mining operations consisted of native gold in placers and in vein quartz. The vein quartz was associated with iron oxides, which together, comprised the surficial, oxidized zone of the deposit. Early miners drove adits and shafts into the veins to access these deposits.

There was only minor production in the mine area from 1890 to 1925. However, the Reynolds Adit was driven during this period. The objective in driving the Reynolds Adit was twofold: (1) to serve as an ore-haulage adit for the upper workings, and (2) to dewater the upper workings, thereby facilitating mining. The Reynolds Adit is the lowermost adit in South Mountain. A significant gold find occurred on South Mountain in 1926, sparking renewed activity in the district.

In 1934, a 100-ton-per-day flotation/cyanidation mill and gold retort was installed at the current location of the Beaver Mud Dump. The dewatering filtrate from the flotation circuit was reportedly discharged directly into Wightman Fork throughout the mid-

1930s. During World War II, the U.S. Government mandated the termination of non-essential minerals mining to focus on essential minerals needed for the war effort. Gold production at Summitville ceased in response to the mandate and, from 1943 to 1945, a high-grade copper vein found in the Narrow Gauge and Reynolds Adits was developed. In 1949, water discharging from the Reynolds Adit reportedly ranged from 100 to 200 gallons per minute (gpm).

From 1950 to 1984, the South Mountain area was the target of several exploration and underground improvement programs. Copper, gold, and silver were sporadically produced during this period. As part of a program to extract copper from ore in the late 1960s to early 1970s, Wightman Fork was diverted from its original route to the north, and the Cleveland Cliffs Tailings Pond was constructed (later modified and renamed the Summitville Dam Impoundment, or SDI).

During the most recent mining operations (1984 through 1992), Summitville Consolidated Mining Company Incorporated (SCMCI) developed the South Mountain mineral reserves as a large tonnage, open pit, heap leach gold mine. Galactic Resources, Inc. was the parent company of SCMCI. During this period, SCMCI mined approximately 10 million tons of gold and silver bearing ore, which was subsequently crushed and placed onto a constructed clay and synthetic lined Heap Leach Pad. A dilute sodium cyanide solution was applied to the crushed ore on the Heap Leach Pad to leach out gold and silver. After percolating through the crushed ore, the "pregnant" solution was pumped from a series of recovery sumps completed in the lowermost portions of the Heap Leach Pad. The pregnant solution was subsequently pumped to a metals recovery plant, where gold and silver was removed from the solution with activated carbon. The effluent, or "barren" solution, was rejuvenated by restoring the target cyanide level and adjusting the pH, and then recycled through the Heap Leach Pad. Gold and silver were stripped from the carbon, precipitated from the stripping solution, smelted and sold.

2.2.2 Enforcement Activities

In October, 1984, SCMCI's parent company, Galactic Resources, Inc. obtained a mine permit for a full-scale open pit and heap leach operation from the Colorado Mined Land Reclamation Division (now the Division of Minerals and Geology). Construction on the Heap Leach Pad commenced in 1985, continued through the winter, and was completed during the summer of 1986. Numerous difficulties were experienced while constructing the Heap Leach Pad through the winter months, including several snow avalanches that damaged the pad liner. The Heap Leach Pad was originally designed as a zero-discharge facility. Water balances performed during the mine design phase assumed that ore placed on the Heap Leach Pad would be separated from snow accumulations by a temporary cover during the winter. SCMCI later opted not to cover the Heap Leach Pad in the winter. Consequently, snowmelt added a significant volume of water to the Heap Leach Pad that was not included in the original water balance.

The initial application of cyanide solution to ore on the Heap Leach Pad began on June 5, 1986. Within one week (June 10), cyanide was detected in the leak detection system, an indication that the Heap Leach Pad's primary liner was leaking. There were several cyanide leaks/spills from the pumpback system in 1987, for which both the Colorado Water Quality Control Division and the Mine Land Reclamation Board issued Notice of Violations.

When SCMCI began placing waste rock in the Cropsy Waste Pile upstream of the Heap Leach Pad, excess acid mine drainage generated in this area was also added to the Heap Leach Pad. This addition not only added to the growing water imbalance problems, but the acid mine drainage chemistry impacted the efficiency of the cyanide leaching process. Consequently, metals recovery suffered.

With all the additional water inputs to the Heap Leach Pad, SCMCI was forced to change its operation from that of a zero-discharge to a discharging facility. In May, 1989, the Water Quality Control Division approved SCMCI's discharge permit for a water treatment plant designed to treat contaminated water from the site, and to discharge the effluent to Wightman Fork. Because the water treatment plant could not adequately treat the volume of water to the standards required by the Water Quality Control Division permit, SCMCI received approval from the Mine Land Reclamation Division and the Water Quality Control Division to land apply contaminated water on-site. In a July, 1990 inspection of the site, the Water Quality Control Division discovered that the land application system was resulting in overland flow of land-applied fluids into Wightman Fork. In February, 1991, after monitoring rising concentrations of cadmium, copper, zinc, and cyanide in Wightman Fork, the State of Colorado cited SCMCI for violations of water quality rules and regulations for discharging without a permit and issued a Cease and Desist Order to SCMCI. A Remedial Measures Plan was developed as a result of this order. A number of 'Notice of Violations' was issued throughout 1991 and 1992 for a variety of permit violations. At this time, fish kills in the Alamosa River were reported.

On December 3, 1992, SCMCI announced pending bankruptcy and informed the State of Colorado that financial support for site operations would not continue beyond December 15, 1992. On December 4, 1992, the State of Colorado requested emergency response assistance from the U.S. EPA. On December 16, 1992, the U.S. EPA Region VIII Emergency Response Branch, as part of an Emergency Response Removal Action, assumed control of the site. The U.S. EPA immediately began water treatment plant modifications to treat cyanide-contaminated leachate from the Heap Leach Pad and acid mine drainage from the French Drain Sump, Cropsy Waste Pile, and Reynolds Adit.

Site operation oversight was undertaken by the U.S. Bureau of Reclamation (U.S. BOR) under an inter-agency agreement with the U.S. EPA. In December 1992, Environmental Chemical Corporation, under the direction of the U.S. BOR, began conducting an engineering evaluation and subsequently began modifications to water treatment processes and facilities.

The site was added to the Superfund National Priorities List on May 31, 1994. Since the U.S. EPA takeover of the site, the State of Colorado, Division of Minerals and Geology, CDPHE Water Quality Control Division and Hazardous Materials and Waste Management Division have participated in joint reviews and planning related to the interim remedial actions implemented at the site. In 1996, the U.S. EPA began transferring lead for certain work at the site to CDPHE. These lead activities include the site-wide reclamation (OU4), Remedial Investigation/ Feasibility Study and Remedial Design/Remedial Action (OU5), and other remedial investigations. In 2005, the EPA also transferred to the CDPHE, site operation and maintenance, including the WTP operations.

The United States filed a proof of claim in the SCMCI Chapter 7 bankruptcy case. There were not sufficient assets to fund a distribution to general unsecured creditors, and no payment was made on this claim. The bankruptcy case was closed on November 6, 2000. Government claims were also filed against Galactic Resources, Ltd in a bankruptcy proceeding in Canada, and a small distribution was received.

In 1996 and 1998, EPA entered into administrative settlements with companies involved at various times in mining operations or exploration activities at the Summitville Mine Site prior to SCMCI's heap leach gold mining operations.

In May 1996, the United States and the State of Colorado initiated a civil action against potentially responsible parties. In June 2001, the U.S. and the State reached a settlement with Robert Friedland, the former chairman of the board and chief executive officer of Galactic Resources, Ltd. Under the terms of the settlement, Mr. Friedland made a lump sum payment of approximately $20 million shortly after the settlement was approved by the district court.

Settlements were also reached with other viable potentially responsible parties including current and former operators and owners of the site.

3.0 REGULATORY COMPLIANCE

Consistent with Section 121(c) of the CERCLA, as amended, and Section 300.430(f) of the National Contingency Plan (NCP), CDPHE is performing the Five-Year Review for the Summitville Mine Superfund Site (SMSS). EPA determined the level of review based on site-specific considerations, including the nature of the response action, the status of the onsite response activities, proximity to populated areas and sensitive environments, and the interval since the last review was conducted. In most cases, EPA performs a Level I analysis for the Five-Year Review. A Level 1 analysis was previously performed for the Summitville Mine Superfund Site. The components of a Level I Five-Year Review, as suggested by EPA guidance (EPA, 1991; EPA, 1994a), include:

- Review of documented operation and maintenance of the site;
- Performance of a site visit;
- Limited analysis of site conditions;
- Review of the administrative record; and
- Review Federal and State environmental laws cited in the ROD to determine if they remain applicable or relevant and appropriate.

3.1 Statutory Review

A statutory Five-Year Review is required at any site where unlimited use and unrestricted exposure, based on ROD cleanup levels, have not been attained (EPA, 1991). A Five-Year Review is required no less than every five years after initiation of the selected remedial action. Future Five-Year Reviews will be prepared by EPA or upon designation, by CDPHE. Reviews require a site visit to review the status of the implemented remedy and to determine its protectiveness of human health and the environment. This document presents the results of the 2005 review, which has assessed all data since the last Five-Year Review in 2000. The Interim RODs and Final ROD, Annual Monitoring and Water Treatment Plant Reports for the Summitville Mine Superfund Site were reviewed for this Five-Year Review.

3.2 Applicable or Relevant and Appropriate Requirements

As part of the Five-Year Review, Applicable or Relevant and Appropriate Requirements (ARAR's) were reviewed. The primary purpose of this review is to determine if any newly promulgated or modified requirements of federal or state environmental laws have significantly changed the protectiveness of the remedies implemented at the site. The ARARs reviewed were those included in the Site's original decision documents. This document, in Section 3.5, also reviews the impact on the remedy of Colorado's environmental covenant law (Section 25-15-317 to 327, C.R.S.), an action specific ARAR enacted since the last five-year review.

The ARARs with the most significant impact to the remedy and that have undergone some changes since the Final Site-Wide Record of Decision issued in September 2001 are those applicable to surface water standards for the Alamosa River. This section focuses on and contains a description of the surface water standards waived in the September 2001 Site-Wide Record of Decision (ROD) for the final SMSS remedy and the rationale behind the waivers. Since the 2001 SMSS ROD, state water quality regulations have undergone a triennial review and in some cases, water quality standards important to the site remedy were modified by the State of Colorado. As such, applicable surface water quality standards promulgated since the issuance of the ROD are addressed. Potential future changes to surface water quality standards that may impact the final SMSS site wide remedy are also discussed. Figure 3-1 shows the Summitville Mine Superfund Site and its physical relationship to the Wightman Fork, the Alamosa River and the Terrace Reservoir, all of which are relevant to the application of the RAOs and RALs.

3.2.1 Surface Water ARAR Waivers

The September 2001 ROD for the final SMSS remedy included waivers of select stream standards published in Colorado Water Quality Control Commission (WQCC) Regulation No. 36, *Classification and Numeric Standards for Rio Grande Basin*. Specifically, the Agricultural and Class 1 Cold Water Aquatic Life use classifications were waived for Alamosa River Segments 6 and 3b, respectively. Additionally, the aluminum, iron and pH numeric standards were waived in Alamosa River Segment 3b. Technical impracticability under 40 CFR § 300.430(f)(1)(ii)(C)(3) was cited as the basis for these waivers. Stream segments in the Alamosa River basin are shown on Figure 3-1.

3.2.2 Alamosa River Segment 6

Alamosa River stream Segment 6 includes Wightman Fork from just west of the SMSS to its confluence with the Alamosa River (Figure 3-1). The agricultural use standard for Segment 6 was waived in the ROD. The basis for the waiver was that background loading of manganese was large enough to routinely cause the exceedance of the State of Colorado's agricultural standard of 200 µg/L for manganese in Segment 6.

3.2.3 Alamosa River Segment 3b

Alamosa River stream Segment 3b includes the Alamosa River from the mouth of Wightman Fork to the Town of Jasper (Figure 3-1). The Class 1 Cold Water Aquatic Life use classification was waived for this segment in the September 2001 SMSS ROD. Additionally, the aluminum, iron and pH numeric standards were waived for this segment in the ROD. The basis for the use classification waiver was the Use Attainability Analysis (UAA) performed by Posey and Woodling (1998). The basis for waiving the aluminum, iron and pH standards was historic water quality data collected at the downstream end of Segment 3a, at surface water monitoring station AR45.5. As discussed in the ROD, the naturally occurring mineralized terrain (Stunner Alteration Area) in the Iron, Alum and Bitter Creek drainages negatively impacts the water quality flowing from Segment 3a into Segment 3b. The results of this analysis are summarized below.

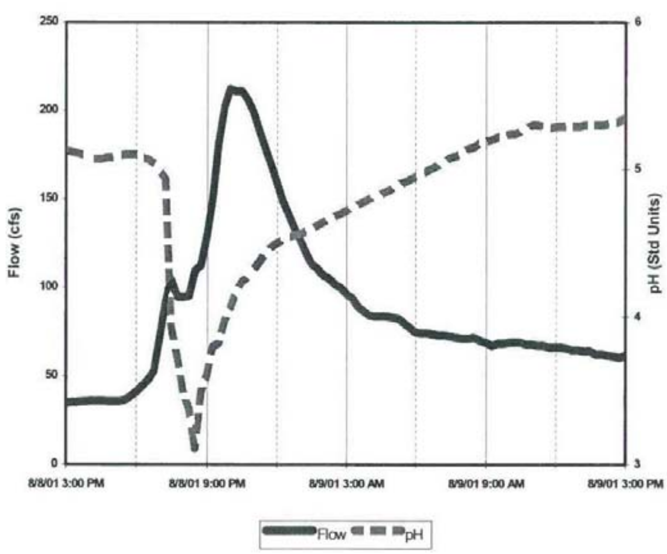
Segment 3a Water Quality compared to Alamosa River Standards in Segment 3b

Summary Statistic	**Aluminum**		**Iron Chronic Std of 12,000 µg/L**	**pH 6.5 to 9.0 S.U.**
	Acute Std of 750µg/L 10/1-4/30	**Chronic Std of 87µg/L 5/1-9/30**		
n =	25	162	208	188
Minimum	2,170	24.8	5.0	3.4
Maximum	17,920	120,730	180,000	7.2
Median	4,800	1,846	4,530	6.2
Percent of Samples that Exceeded the Standard	100%	99%	15%	61%

Notes:

- Aluminum and iron standards are for the total recoverable form.
- *n* = number of observations.
- Percent standard exceedance for aluminum and iron calculated as number of times the Segment 3a concentration exceeded the Segment 3b standard, divided by *n*.
- Percent standard exceedance for pH calculated as number of times Segment 3a value fell below the minimum pH standard, divided by *n*.

Not evident from these data is the impact that thunderstorms over the upper Alamosa River basin have on water quality. Flow and pH data measured at the continuous gage located at AR45.5 (Segment 3a) from run-off generated by an August 2001 thunderstorm over the Stunner Alteration Area are illustrated below.

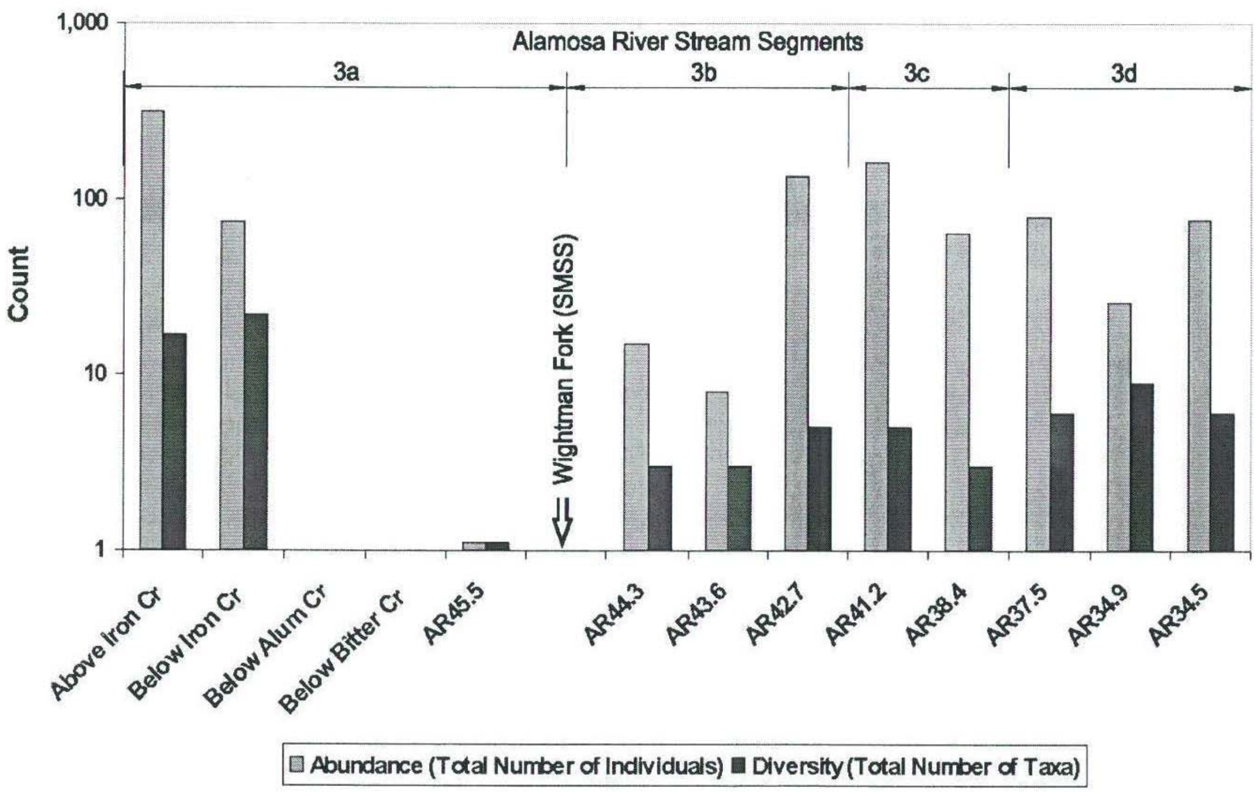


Impact on Alamosa River from August 2001 thunderstorm over Stunner Alteration Area.

Gage data from Alamosa River Segment 3a upstream of Wightman Fork (AR45.5).

These historic data from the Alamosa River upstream of Wightman Fork illustrate the chronic and acute impacts that the Stunner Alteration Area drained by Iron, Alum and Bitter Creeks has on water quality in Alamosa River Segment 3a. The cumulative impact of this poor quality water on aquatic life in the Alamosa River is best demonstrated by the results of a 2000 benthic macroinvertebrate field study performed by CDPHE. That study was designed to assess the abundance and diversity of benthic macroinvertebrates throughout the Alamosa River. As illustrated below, no macroinvertebrates were present in the Alamosa River Segment 3a downstream of Alum and Bitter Creeks, and only one individual was encountered immediately upstream of Wightman Fork (AR45.5).

MACROINVERTEBRATE ABUNDANCE AND DIVERSITY - FALL 2000



In summary, the naturally impaired water originating in Alamosa River Segment 3a flows into Segment 3b. Absent the input of Wightman Fork, aquatic life in Alamosa River Segment 3b would still be negatively impacted by poor quality water originating in the upper Alamosa River basin.

3.3 Changes to Surface Water Regulations

The regulations governing the State of Colorado surface water standards undergo a triennial review process. Changes to surface water quality standards are generally first made in the WQCC Regulation No. 31, *The Basic Standards and Methodologies for Surface Water*, and then to the basin-specific regulations (e.g., Regulation No. 36) during their subsequent triennial reviews.

Since the issuance of the September 2001 ROD for the final SMSS remedy, the state-wide basic standards (Regulation No. 31) were amended twice. Amendments made in November 8, 2004 (effective March 22, 2005); did not impact the SMSS. However, in the June 2005 triennial review for Regulation No. 31, WQCC adopted several changes to the state-wide basic standards that could potentially impact the SMSS. These changes are discussed in Section 3.3.2.

The regulations specific to the Alamosa River basin, Regulation No. 36, have been amended twice since the issuance of the ROD: December 10, 2001 (effective January 30, 2002); and September 9, 2002 (effective January 20, 2003). The changes to Regulation No. 36 (effective January 2003) potentially impact the SMSS operations and are discussed in Section 3.3.1. The next triennial review for Regulation No. 36 is scheduled for June 2007; the changes made to Regulation No. 31 in June 2005 would likely be formally adopted to Regulation No. 36 at that time.

3.3.1 Regulation No. 36

On September 9, 2002 (effective January 20, 2003), the WQCC adopted amendments to the regulations specific to the Alamosa River basin, Regulation No. 36. The changes made to Regulation No. 36 at that time included:

- The division of Alamosa River Segment 3c into two segments. Segment 3c was shortened to end at Ranger Creek, and a new segment, 3d, was created to extend from Ranger Creek to Terrace Reservoir. The current stream segments are shown on Figure 3-1.
- Water supply standards for iron, manganese and sulfate were modified to conform to changes made to Regulation No. 31.

The re-segmentation of the Alamosa River Segment 3c (previously Fern Creek to Terrace Reservoir) into two segments; 3c - Fern Creek to Ranger Creek and 3d – Ranger Creek to Terrace Reservoir, could potentially impact the SMSS operations. In response to the creation of the new segment, the CDPHE installed a seasonally operated gaging station near the upstream end of the new Segment 3d to collect continuous flow and water quality data. This new Segment 3d station, AR 37.5, became operational in 2003.

3.3.2 Regulation No. 31

In the June 2005 Rulemaking Hearing on the state-wide basic standards (Regulation No. 31), the WQCC adopted several changes that could impact the discharge goals for the future SMSS OU5 Water Treatment Plant. These changes include revising/updating the following:

- Cadmium acute and chronic standards.
- Aluminum chronic standard.
- Zinc acute and chronic standards.

The impacts that revising these water quality standards could have in Alamosa River Segments 3b, 3c, 3d and 8 (Figure 3-1) using historic data were evaluated in the following sections.

3.3.2.1 Cadmium

Resource Technologies Group, Inc (RTG) published draft discharge goals based on water quality standards for Alamosa River Segments 3b and 3c in Table 8 of their SMSS OU5 Water Treatment Plant Construction Documents Report. Estimated current and future average chronic cadmium standards for Alamosa River Segments 3b and 3c are presented below.

Segment	***Current Chronic Cadmium Standard (µg/L)***	***Future Chronic Cadmium Standard (µg/L)***
3b	2.0	0.23
3c	2.2	0.24

Revision of the cadmium standards could result in an order of magnitude decrease in the chronic standard for the hardness levels assumed for Alamosa River Segments 3b and 3c. This could impact the discharge goals for the future SMSS OU5 Water Treatment Plant.

- Under the current water quality standards, samples collected at the four locations exceeded the acute standard 7 percent of the time and the chronic standard 11 percent of the time. Exceedances of the current chronic cadmium standard at the four locations are summarized below:

Station	***Stream Segment***	***Current Chronic Cadmium Standard Exceedance Frequency***	
AR43.6	3b	3 of 19	16%
AR41.2	3c	3 of 24	13%
AR37.5	3d	0 of 5	0%
T1A	8	4 of 46	9%
	Total	***10 of 94***	***11%***

Total count does not include instances where the concentration and standard are below the detection limit.

- Under the future water quality standards the chronic cadmium standard would always be exceeded at Stations AR43.6 (Segment 3b) and AR41.2 (Segment 3c) and exceeded about half the time at AR37.5 (Segment 3d) and in Terrace Reservoir. The number of exceedances of the acute standard would still be low (about 10 percent). Exceedances under the future chronic cadmium standard at the four locations are summarized below:

Station	***Stream Segment***	***Future Chronic Cadmium Standard Exceedance Frequency***	
AR43.6	3b	16 of 16	100%
AR41.2	3c	21 of 21	100%
AR37.5	3d	2 of 4	50%
T1A	8	24 of 46	52%
	Total	***63 of 87***	***72%***

Total count does not include instances where the concentration and standard are below the detection limit.

3.3.2.2 Aluminum

Currently, the State of Colorado standards for aluminum are 87 µg/L (chronic) and 750 µg/L (acute). The standard for chronic aluminum was revised as follows:

> *"Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as $CaCO_3$ in the receiving water after mixing, the 87 ug/L chronic total recoverable aluminum criterion will not apply, and aluminum will be regulated based on compliance with the 750 ug/L total recoverable acute standard."*

The pH in both segments rarely exceeds a value of 7. Consequently, this is interpreted to indicate that the aluminum standards in the Alamosa River Segments 3b and 3c (i.e., the chronic value of 87 µg/L) would remain in place[2]. However, what will impact the aluminum standard in the Alamosa River is the change in the regulated form of aluminum from dissolved to total recoverable.

- Under the current water quality standards, samples exceeded the chronic standard at the following frequencies:

[2] The Segment 3b chronic aluminum standard is seasonal, in effect from May 1 through September 30. All other times there is no chronic standard and the acute standard of 750µg/L is in effect.

Station	Stream Segment	Current Chronic Aluminum Standard Exceedance Frequency	
AR43.6	3b	4 of 18	22%
AR41.2	3c	10 of 25	40%
AR37.5	3d	2 of 6	33%
T1A	8	2 of 53	9%
	Total	***18 of 102***	***18%***

There were a few instances where the dissolved aluminum concentration exceeded the acute standard at stations AR43.6 and AR41.2.

- Under the future water quality standard scenario where the total recoverable form of aluminum is considered, samples exceeded the chronic standard at the following frequencies:

Station	Stream Segment	Future Chronic Aluminum Standard Exceedance Frequency (Total Recoverable Form)	
AR43.6	3b	23 of 23	100%
AR41.2	3c	22 of 23	96%
AR37.5	3d	5 of 5	100%
T1A	8	28 of 53	53%
	Total	***78 of 104***	***75%***

For stations AR43.6, AR41.2 and AR37.5 all the total recoverable aluminum concentrations would also exceed the acute standard. In Terrace Reservoir (station T1A), the total recoverable concentrations would exceed the acute standard in 13 of 53 samples (25 percent).

3.3.2.3 Zinc

The State of Colorado revised the criteria for zinc. Estimated current and future average chronic zinc standards for Alamosa River Segments 3b and 3c are presented below.

Segment	Current Chronic Zinc Standard (µg/L)	Future Chronic Zinc Standard (µg/L)
3b	106	97
3c	117	108

Revision of the zinc standards will result in a slight decrease in the chronic standard for the hardness levels assumed for Alamosa River Segments 3b and 3c.

- Under the current water quality standards, samples collected in Segment 3d (AR37.5) and in Terrace Reservoir (T1A) did not exceed the acute or the chronic zinc standards. Samples collected in Segments 3b (AR43.6) and 3c (AR41.2) exceeded the acute and chronic zinc standards. Exceedances of the current chronic zinc standard at the four locations are summarized below:

Station	***Stream Segment***	***Current Chronic Zinc Standard Exceedance Frequency***	
AR43.6	3b	9 of 24	38%
AR41.2	3c	6 of 29	21%
AR37.5	3d	0 of 6	0%
T1A	8	0 of 63	0%
	Total	***15 of 122***	***12%***

- Under the future water quality standards, there still would be no exceedances in Segment 3d or in Terrace Reservoir. In Segments 3b (AR43.6) and 3c (AR41.2), the exceedance of the chronic standard would slightly increase; whereas, the exceedance of the acute standard would decrease. Exceedances under the future chronic zinc standard at the four locations are summarized below:

Station	***Stream Segment***	***Future Chronic Zinc Standard Exceedance Frequency***	
AR43.6	3b	14 of 24	58%
AR41.2	3c	8 of 29	28%
AR37.5	3d	0 of 6	0%
T1A	8	0 of 63	0%
	Total	***22 of 122***	***18%***

The published ICP-MS zinc detection limit of 10 µg/L is low enough to meet the future chronic standard down to a hardness value of 6 mg/L as $CaCO_3$. The hardness values in the Alamosa River system are above this level.

3.3.3 Potential Upcoming Standards

The EPA has proposed or is considering revisions to other water quality standards that may impact the SMSS in the future. These include:

- Nutrient Criteria;
- Selenium Aquatic Life Criteria; and
- Developing water Quality Criteria for Suspended and Bedded Sediments.

These proposed criteria are briefly discussed in the following subsections.

3.3.3.1 Nutrient Criteria

The EPA has proposed to adopt nutrient criteria into water quality standards. Nitrogen and phosphorous compounds will potentially be regulated under this standard. Of potential concern to the SMSS Water Treatment Plant would be a new nitrogen standard. Low concentrations of residual cyanide and cyanide degradation products enter the SDI from the Heap Leach Pad via the French Drain pipeline (sample location FD-1). Because cyanide and its degradation products include nitrogen-bearing compounds, nitrogen may be present in the WTP effluent.

3.3.3.2 Selenium Criteria

The EPA has published draft aquatic life water quality criteria for selenium (EPA-822-D-04-001). Because selenium is not a contaminant of concern at the SMSS, it should not impact the SMSS. It is mentioned here only because the draft criteria include a fish tissue concentration chronic exposure criterion. In the recently completed chronic fish study in Terrace Reservoir performed by the Colorado Division of Wildlife, selenium was found to be accumulating in the tissues of the stocked trout. However, the average concentration of selenium in the stocked trout, 1.3 µg/g, was below the proposed selenium criteria of 5.85 µg/g during summer or fall and 7.91 µg/g during winter for fish tissue.

3.3.3.3 Sediment Criteria

The State of Colorado, Water Quality Control Commission (WQCC) Policy, 98-1, *Provisional Implementation Guidance for Determining Sediment Deposition Impacts to Aquatic Life in Streams and Rivers*, was "to be considered" as a chemical specific ARAR in the September 2001 ROD (Policy 98-1 was finalized at the WQCC's May 9, 2005 Administrative Action Hearing). The EPA is preparing to develop and issue improved water quality criteria to manage suspended and bedded sediments that are carried by water and/or accumulate in a loose, unconsolidated form on stream beds.

3.4 Total Maximum Daily Loads (TMDLs)

The Alamosa River from Alum Creek to Colorado Highway 15, including Terrace Reservoir, has been on Colorado 303(d) lists since 1992 as water quality impaired. The water quality impairment is due to dissolved metals and low pH conditions. The focus of the Total Maximum Daily Load (TMDL) assessment, performed by the WQCD, is on the aquatic life impairments caused by contributions of dissolved metals and acidic drainage from natural sources, abandoned mines and the Summitville Mine Superfund Site. CDPHE prepared an estimated TMDL for the Wightman Fork and the Summitville Mine Superfund Site as it may apply to the Alamosa River. These TMDL estimates have not been approved by the CDPHE WQCD or the USEPA.

3.4.1 Wightman Fork – Alamosa River Load Allocation

One of the EPA comments on the draft Alamosa River TMDL issued by the WQCD was that loads from the SMSS to Wightman Fork and the Alamosa River should be allocated to point and non-point sources. In this section, the loads for the metals "pollutants" identified in the TMDL for Alamosa River Segment 3b are allocated to various sources. Specifically, loading for aluminum, copper and zinc in the Alamosa River downstream of Wightman Fork (Segment 3b) is allocated to the following point and non-point sources:

- SMSS background (WF1, WF1.5, CC-1, PL-0, NMT-1 and NMT-2).
- SMSS point sources (WTP discharge).
- SMSS non-point sources (Site Ditches, seepage through the SDI embankment, Wightman Fork and Cropsy Creek as they flow through the Summitville Site).
- Upper Alamosa River basin (Upstream of the Wightman Fork Confluence).

3.4.1.1 Data Analysis

The following sections present data analysis for the Total Maximum Daily Loads.

3.4.1.1.1 SMSS Background Loading

Background loading at the SMSS includes loading from the upper Wightman Fork basin, the upper Cropsy Creek basin and tributaries draining North Mountain. The data used to calculate these background loads includes the following surface water monitoring locations (Figure 3-2):

- Upper Wightman Fork basin
- Upper Cropsy Creek basin
- North Mountain tributaries

The loading from these three areas is combined to estimate the total SMSS background load.

3.4.1.2 SMSS Point Sources

The existing SMSS Water Treatment Plant (WTP) discharges effluent directly to Wightman Fork. The WTP typically operates from mid-April through October/November. Consequently, there is no WTP loading for the months of December through March.

The various ditch turnouts recently constructed at the SMSS represent potential point sources. The ditch turnouts can direct surface water from the site ditch system to the SDI for storage and treatment, or to either Wightman Fork or Cropsy Creek. Turnouts include the following surface water monitoring locations:

- A2-1 Ditch Turnout
- A2-2 Ditch Turnout
- Q Ditch Turnout
- T Ditch Turnout
- P Ditch Turnout
- L Ditch Turnout

The use of the site turnouts is relatively new to the operation of the site, and data is being collected to evaluate their load. Although the ditch turnouts were used during the Spring 2004 and 2005 runoff to divert water away from the SDI, insufficient data are available to evaluate the ditch turnouts as "point sources" at this time. Consequently, the impact of the turnouts will fall into the SMSS "non-point" source category.

Releases from the SDI are monitored at surface water monitoring location OW-1 (Figure 3-2). Historically, when releases were made from the SDI, they were the dominant point source loads to the Alamosa River for many metals. The following table summarizes releases and copper loading from the SDI since its construction in 1996 and from turnouts since their use in 2004:

Year	***Estimated Volume of Water Released from SDI Or Turnout Structures (gallons)***	***Estimated Mass of Copper Released (pounds)***
1996	0	0
1997	169,000,000	35,000
1998	9,800,000	15,000
1999	53,000,000	56,000
2000	0	0
2001	11,700,000	3,500
2002	0	0
2003	0	0
2004	56,000,000 Turnouts	2,350
2005	70,000,000 Turnouts	2,321

One of the objectives of the construction of the ditch turnouts (discussed above) is to minimize the potential for future releases from the SDI. While the SDI historically was a significant point source discharge, the objective of the agencies is to minimize if not eliminate these releases by diverting snowmelt away from the SDI to Wightman Fork and Cropsy Creek through the turnouts. This analysis does not consider the SDI as a metals loading source because, in the future, releases from the SDI will represent extreme conditions, not normal operating procedures.

3.4.1.3 SMSS Non-Point Sources

Surface water monitoring location WF5.5 is located immediately downstream of the SMSS (Figure 3-2). For surface water monitoring purposes, WF5.5 is considered the downstream site boundary or point of compliance. The non-point source loading from the SMSS is assumed responsible for the remaining loads measured at surface water monitoring location WF5.5.

3.4.1.5 Alamosa River Segment 3b Load Allocation

The loads at the mouth of Wightman Fork (WF0.0) were conservatively mixed with the loads from the Alamosa River upstream of Wightman Fork (AR45.5) to estimate the loads in Alamosa River Segment 3b. The Segment 3b load that was attributed to Wightman Fork was divided into the following measurable sources and then mixed the upper Alamosa River basin:

- SMSS WTP
- SMSS non-point sources
- Non-SMSS Wightman Fork loading (includes SMSS background and lower Wightman Fork loading)

The results of this analysis are discussed in the next subsection.

3.4.2 Data Evaluation

The allocations of the aluminum, copper and zinc loads to the various sources in Wightman Fork and to the upper Alamosa River basin are evaluated on a monthly basis. Three flow regimes are evaluated herein:

- High flow (spring runoff).
- Low flow, SMSS WTP effluent present.
- Low flow, SMSS WTP effluent absent.

3.4.2.1 High Flow Load Allocation

The allocation of metals loading at Wightman Fork surface water monitoring station WF5.5 during the high flow regime is summarized below:

Metal	***SMSS WTP***	***SMSS NPS***	***SMSS Background***
Aluminum	7%	92%	<1%
Copper	<1%	98%	<1%
Zinc	<1%	87%	12%

Note: Rounding may result in the sums of the percentages not equaling 100%.

The allocation of metals loading to Alamosa River Segment 3b during the high flow regime is summarized below:

Metal	***Wightman Fork***	***Upper Alamosa River Basin***
Aluminum	49%	51%
Copper	96%	4%
Zinc	85%	15%

Note: Rounding may result in the sums of the percentages not equaling 100%.

3.4.2.2 Low Flow, SMSS WTP Effluent Present Load Allocation

The allocation of metals loading at Wightman Fork surface water monitoring station WF5.5 during the low flow regime when effluent discharged from the SMSS WTP is present is summarized below:

Metal	***SMSS WTP***	***SMSS NPS***	***SMSS Background***
Aluminum	11%	87%	2%
Copper	2%	97%	1%
Zinc	1%	92%	7%

Note: Rounding may result in the sums of the percentages not equaling 100%.

The allocation of metals loading to Alamosa River Segment 3b during the low flow regime when effluent discharged from the SMSS WTP is present is summarized below:

Metal	***Wightman Fork***	***Upper Alamosa River Basin***
Aluminum	51%	49%
Copper	99%	1%
Zinc	83%	17%

Note: Rounding may result in the sums of the percentages not equaling 100%.

3.4.2.3 Low Flow, SMSS WTP Effluent Absent Load Allocation

The allocation of metals at Wightman Fork surface water monitoring station WF5.5 loading during the low flow regime when the SMSS WTP is off-line is summarized below:

Metal	***SMSS WTP***	***SMSS NPS***	***SMSS Background***
Aluminum	0%	100%	0%
Copper	0%	99%	<1%
Zinc	0%	93%	7%

Note: Rounding may result in the sums of the percentages not equaling 100%.

The allocation of metals loading to Alamosa River Segment 3b during the low flow regime when the SMSS WTP is off-line is summarized below:

Metal	***Wightman Fork***	***Upper Alamosa River Basin***
Aluminum	27%	73%
Copper	96%	4%
Zinc	80%	20%

Note: Rounding may result in the sums of the percentages not equaling 100%.

3.4.3 Discussion

The predominant source of aluminum loading to the Alamosa River Segment 3b is the upper Alamosa River basin. Non-point sources associated with the SMSS provide the next largest component. When operating, the SMSS Water Treatment Plant provides approximately 7 to 11 percent of the aluminum loading at WF5.5.

The predominant source of copper and zinc loading to the Alamosa River Segment 3b is Wightman Fork. Non-point sources associated with the SMSS provide the largest loading component at WF5.5. Background areas, including the upper Cropsy Creek and upper Wightman Fork basins, provide some zinc loading.

The SMSS non-point contribution might be overestimated because, prior to late-2001, it also includes the contribution of the pump house fault seep (which is now collected and directed to the SDI) and, in 2004 and 2005, includes the water directed off-site via the ditch turnout systems. Regardless, the remaining SMSS non-point sources continue to provide copper and zinc loading to the Alamosa River.

The dominant remaining non-point source loads associated with the SMSS include: 1) underflow to Wightman Fork in the area adjacent to the North Waste Dump and Chandler Groin (between sample points WF1.5 and WF2.5 on Figure 3-2), 2) and seepage through the SDI embankment (sample point SDI toe channel on Figure 3-2).

3.4 Summary

The following summarizes the results of the evaluations presented in this section:

- New cadmium standards would increase the frequency that the chronic standard is exceeded in Alamosa River and Terrace Reservoir.
- New aluminum standards that consider the total recoverable form instead of the dissolved form would increase the frequency that the chronic standard is exceeded in Alamosa River and Terrace Reservoir. The acute aluminum standard would also be frequently exceeded.
- New zinc standards would not substantially change the frequency that the standards are exceeded in Alamosa River and Terrace Reservoir.
- The new cadmium, aluminum and zinc standards would impact the discharge goals for the new water treatment, which the WQCD and EPA have indicated should meet the Alamosa River Segment 3b standards.
- The evaluations presented in this section indicate that the SMSS Water Treatment Plant is not a significant source of metals loading to the Alamosa River system.
- The predominant source of aluminum loading to the Alamosa River Segment 3b is the upper Alamosa River basin.
- The predominant sources of copper and zinc loading to the Alamosa River Segment 3b are sources in Wightman Fork. Non-point sources provide most of the copper and zinc loading at WF5.5.
- SMSS background sources provide some zinc loading at WF5.5.
- The upper Alamosa River basin provides 4 percent or less of the copper load to Segment 3b and between 15 and 20 percent of the zinc load to Segment 3b.
- The dominant remaining non-point source loads associated with the SMSS are underflow to Wightman Fork in the area adjacent to the North Waste Dump and Chandler Groin (comprising approximately 50% of the WF5.5 load) and seepage through the SDI embankment (comprising approximately 40% of the WF5.5 load).

3.5 Environmental Covenant

Section 320 of the Colorado Hazardous Waste Act, 25-15-320 C.R.S., provides that a property owner must provide an environmental covenant for an environmental remediation project that results in residual contamination at levels that do not allow unrestricted use, when the remedy utilizes an engineered feature or structure that requires monitoring, maintenance, or operation or one that will not function as intended if the engineered feature is disturbed. See Section 25-15-320(2), C.R.S. The environmental covenant law applies to "environmental remediation decisions" on or after July 1, 2001. The terms "environmental remediation decision" includes CERCLA remedial decisions.

Because the Final Site-Wide Record of Decision (September 2001) post dates the effective date of the environmental covenant law, this five year review incorporates the law's requirements on this remedy. Because remedial action at Summitville will not allow unrestricted use of the property at the completion of the remedial action, and since the remedial action will require continued operation of the engineering feature (water treatment) in order to maintain the protectiveness of the remedial action, the environmental covenant law is triggered at Summitville. To address the environmental covenant requirement, the United States' and Colorado's settlement with Aztec Minerals Company, Inc. required Aztec to grant an environmental covenant to the State of Colorado consistent with the statutory terms. Aztec granted this environmental covenant, which runs with the land in perpetuity, allowing CDPHE to continue its determination that the remedial action is protective of human health. Subject to the discussions in this document addressing the protectiveness for environmental concerns, the environmental covenant continues to facilitate remedial actions that will protect the environment at the completion of the remedial action.

4.0 REMEDIAL ACTIONS

The immediate risk that required abatement by the U.S. EPA in December 1992 was the potential for contaminated water to overtop the Heap Leach Pad's Dike No. 1. A breach of this dike would have resulted in a release of metals-bearing cyanide solution to Cropsy Creek, Wightman Fork, and the Alamosa River. Sufficient water storage and water treatment capacity were not present at the site to handle the volume of acid mine drainage issuing from these sources, particularly during the spring snow melt periods. Thus, plans were developed to plug the Reynolds Adit, to upgrade the water treatment facilities, and to upgrade the existing impoundment and dam.

Numerous, large accumulations of waste rock, ore stockpiles, and tailings were present at several locations throughout the site. The open-pit mines, which exposed high sulfide content ore and country rock to the atmosphere, served as focused groundwater recharge basins that funneled acid mine drainage to the Reynolds Adit system and adjacent highly fractured and faulted mineralized bedrock.

Five areas generating large amounts of acid mine drainage were the primary areas of concern during the emergency and interim remedial actions. The annual copper load (calculated by multiplying a concentration by flow rate) from the five areas was estimated to be 321,000 pounds in 1991 (U.S. EPA, 1995c). The estimated copper loads from these areas in 1991 were:

- Reynolds Adit - 143,000 pounds (44.5 percent of the site load);
- Cropsy Waste Pile - 33,400 pounds (10.4 percent of the site load);

- Heap Leach Pad or "overflow potential" - 84,000 pounds (26.2 percent of the site load);
- French Drain Sump - 14,600 pounds (4.5 percent of the site load); and
- Cleveland Cliffs Tailings Impoundment and Beaver Mud Dump - 17,000 pounds (5.3 percent of the site load).

Other areas throughout the site were estimated to contribute approximately nine percent of the site's 1991 copper load, or 29,000 pounds.

A Proposed Plan for the four interim actions at the site was released to the public in August, 1994. Preliminary remedial objectives for the interim actions to be implemented at the site were established in the 1994 Proposed Plan. These preliminary remedial objectives were developed in consideration of the then current regulatory guidelines and compliance with applicable or relevant and appropriate requirements (ARARs). The preliminary remedial objectives for the site were:

- Reduce or eliminate deleterious quality water flow from the site into Wightman Fork;
- Reduce or eliminate the need for continued expenditures in water treatment;
- Reduce or eliminate the acid mine/acid rock drainage from the manmade sources;
- Reduce or eliminate any human health or adverse environmental effects from mining operations downstream from the site, to include the Alamosa River; and
- Encourage early actions and acceleration of the Superfund process.

Five *"primary areas of concern at the site"* for emergency response actions or interim remedial actions were targeted. Emergency response actions included plugging of the Reynolds and Chandler Adits. The other areas of concern were addressed through Interim Record of Decisions as described below:

- Water Treatment, (OU0, U.S. EPA, 1995a).
- Heap Leach Pad Detoxification/Closure, designated (OU1, U.S. EPA, 1995b).
- Excavation of mine wastes from the Cropsy Waste Pile, Beaver Mud Dump and the Cleveland Cliffs Tailings Pond, placement of this material in the mine pits, and mine pit closure, designated (OU2, U.S. EPA, 1995c).
- South Mountain groundwater, (OU3).
- Site-wide reclamation activities, (OU4, U.S. EPA, 1995d).

The emergency response/interim remedial actions implemented by the U.S. EPA at the site are in various stages of completion. The following summarizes the status for each.

4.1 Reynolds/Chandler Adit Plugging

This work is completed and is currently in the monitoring phase. As anticipated, plugging of the adits has caused some increase in seepage downgradient of the mine pits. However, the plugging has been effective in reducing the direct copper load issuing from underground workings by 93 percent as compared to the copper load measured in 1991.

4.2 Water Treatment (OU0)

The Water Treatment Plant is located on the SCMCI property at the upstream end of the SDI. Consolidation of water treatment into a single facility was completed in 1995; however, water treatment continues with on-going efforts to improve efficiency. Operation of the Interim WTP will continue until the remedy selected in the OU5 Record of Decision is operational.

Remedy Implementation
Water Treatment was initiated on an emergency basis when the mining company that operated the facility, SCMCI, declared bankruptcy and abandoned the Site in early December 1992. On December 18, 1992, the EPA issued an Action Memorandum, documenting the need for water treatment as a time critical removal action. By mid 1996, water treatment operations were consolidated into a single water treatment plant with the Cyanide Destruction Plant and Metals Removal Plant discontinued and dismantled in 1995. All contaminated water is now directed to the SDI where it is then pumped to the WTP at a rate of approximately 1000 gallons per minute. The WTP is a conventional single stage, high density sludge lime precipitation process.

The Interim Record of Decision for Operable Unit 0, provides for treatment and storage of acid mine drainage generated from the Summitville Mine. Components of this selected remedy, as modified have been implemented. The components are described below.

<u>Collection and treatment of the French Drain.</u> Water from the French Drain is directed via pipeline to the SDI and eventually for treatment in the WTP.

<u>Collection and Treatment of Contaminated Water Throughout the Site</u>. Contaminated water from around the site is directed to the SDI via a network of ditches.

System Operations/O&M
The SDI is a 90-million gallon storage reservoir for acid mine drainage and was constructed by removing mining waste from the Beaver Mud Dump and by

raising the historic tailing pond dam (the Cleveland Cliffs Tailings Pond) located adjacent to the Beaver Mud Dump. During the winter months, acid mine drainage is collected and stored in the Summitville Dam Impoundment. Collecting, and storing this water allows the site to be closed during the winter months. A winter closure is preferred because the WTP could not be operated at an optimal treatment rate or removal efficiency. It is therefore considered to be cost effective to shut down the site during the winter, thus saving the cost of snow removal and maintaining an operational site and WTP. This method of operating the site treatment facility was mentioned in the USEPA Remedial System Evaluation (RSE) reports as a notable example of cost effectiveness and was recommended for continuation into the future.

Conformance to the effluent discharge criteria is calculated by use of a seven-day average values and is discussed in Section 7.2.1. The Interim Water Treatment Plant will continue to operate until it is replaced with a new Water Treatment Plant or a technology evolves that can replace an active treatment system.

4.3 Heap Leach Pad Detoxification/Closure (OU1)

Detoxification of cyanide in the Heap Leach Pad was accomplished through a rinsing program in 1994 and 1995. Comparison of pre- and post-rinsing concentrations indicates that the rinsing program has removed 98 percent of the liquid-phase cyanide from the Heap Leach Pad. The Heap Leach Pad was capped during the 1997 and 1998 construction seasons, and vegetated. Recent monitoring of groundwater downgradient of the Heap Leach Pad indicates that cyanide has not migrated off the site via a groundwater pathway. Infiltration into the Heap Leach Pad through the cap has been reduced. Monitoring devices are in place to detect possible future movement of the downstream Dike No. 1.

Remedy Implementation
Emergency response actions were initiated at the Heap Leach Pad after the mining company that operated the facility declared bankruptcy and abandoned the site. In December 1992, EPA issued an Action Memorandum, documenting the need for cyanide removal and to control the elevation of water contaminated with cyanide and heavy metals in the Heap Leach Pad as a time critical removal action. In December 1994, an interim Record of Decision was signed to complete closure of the Heap Leach Pad. The major components of the selected interim remedy were completed in two phases, as described below:

1. Phase I - Destruction of cyanide contained within the Heap Leach Pad using in-situ biological treatment methods.
2. Phase II - Recontouring, capping and vegetation of the Heap Leach Pad to reduce the volume of water entering the Heap Leach Pad.

System Operations/O&M

All components were in completed 2000. Ongoing activities include monitoring the ground water, seeps, inclinometers, and vegetation, which is part of the Final Site Wide Record of Decision (OU5).

4.4 Excavation of Cropsy Waste Pile, Beaver Mud Dump, and Cleveland Cliffs Tailings Pond / Mine Pit Closure (OU2)

The mine waste materials in the Cropsy Waste Pile, Beaver Mud Dump, and the former Cleveland Cliffs Tailings Pond have been excavated, placed in the mine pits, and the pits have been capped. With the complete removal of the Cropsy Waste Pile, the potential for acid mine drainage generation from waste rock materials in the Cropsy Basin adjacent to the Heap Leach Pad has been minimized. Data collected in 1999 and 2000 indicate that the Cropsy Waste Pile removal has reduced metals loading from this portion of the site. However, the former Cropsy Waste Pile is not wholly removed from contact with the environment. Placement of these materials in the mine pits, which are in contact with groundwater during a portion of the year, may result in some loading to the groundwater system.

Remedy Implementation

This work was stared in October 1993 as a non-time critical removal action to quickly control the generation and release of acid mine drainage. In December 1994, and Interim Record of Decision was signed for this action. The purpose of the interim remedy was to reduce or eliminate the generation of acid mine drainage from the Cropsy Waste Pile, Summitville Dam Impoundment, the Beaver Mud Dump and the Mine pits by isolating hazardous substances and inhibiting their contact with water and/or oxygen necessary to produce acid mine drainage. The major components of the interim remedy selected and constructed to achieve this goal are as follows.

1. Removal of mining waste in the Cropsy Waste Pile and Beaver Mud Dump that had covered naturally occurring surface seeps.
2. Excavation of acid generating tailings and sediment from the SDI.
3. Placement and capping of material excavated from the Cropsy Waste Pile, Beaver Mud Dump and SDI in to the Mine Pits. This action would decrease infiltration of groundwater into the underground mine workings via the Mine Pits.
4. Placement of an acid neutralizing material on the base of the Mine Pits prior to placement of the excavated material and capping the Mine Pits after placement of the material.

System Operations/O&M
This remedy is complete. Monitoring the structural components, the ground water, surface water, seeps and revegetation are the on-going activities that are part of the Final Site-Wide Record of Decision (OU5).

4.5 South Mountain Groundwater (OU3)

This non-time critical removal action consisted of characterizing the hydrogeology of South Mountain groundwater. Operable Unit 3 was incorporated into the site-wide Remedial Investigation/Feasibility Study in the late 1990s, and is addressed as part of OU5.

Remedy Implementation
Following the completion of the ground water model, no additional actions were taken. Instead, this Operable Unit was incorporated into the Final Site-Wide Record of Decision. As of this date, no other implementation is planned with the exception of on-going monitoring of the ground water in both the mine pool, the mine pits and around other areas of the site.

System Operations/O&M
At this time, the remedy is considered to be complete. Monitoring the ground water is an on-going activity that is part of the Final Site-Wide Record of Decision (OU5).

4.6 Site-Wide Reclamation (OU4)

Site-wide reclamation was implemented in multiple phases over several years, with major earthwork completed in 2002. Revegetated areas are periodically evaluated by the Colorado State University Department of Forest Rangeland and Watershed Stewardship. The Cropsy Valley has the longest history of reclamation and revegetation at the site, thus the area has shown significant improvements to water quality and suspended solids. The sub-basin that drains to the L-ditch by contrast has shown less improvements surface water quality and therefore is often diverted to the SDI for treatment. Figure 4-1 illustrates the site sub-basins and ditch system. Effectiveness of the remedy is discussed more fully in Section 7.2.4 and 8.3.

Remedy Implementation
The remedy consists of several elements intended to achieve stability of the surface through recontouring, replacing topsoil and reestablishing vegetation and constructing ditches so that water can be routed and controlled. The elements of this operable unit consist of the following:

1. Grading to reduce steep soil and fill embankments to 3:1 (horizontal to vertical) or flatter, and depressions filled to minimize infiltration of water. Mine waste materials were removed from the natural drainage ways and wet areas to reduce acid generation.
2. Permanent roads necessary to maintain access to key areas, such as the CDP, Cropsy Waste Pile, North Waste Dump, Adits and the top of South Mountain were constructed.
3. Site drainage control with a system of ditches were constructed and sized to pass the 100-year storm event. The ditches were designed to either pass water off-site without being routed to the SDI or to route contaminated water directly to the SDI. Ongoing work with site drainage control includes construction pipelines from the highwall and Reynolds Adit, french drains and seep collector to further separate contaminated water from less contaminated water. Contaminated water flows directly to the SDI for treatment. Uncontaminated or less contaminated water can be diverted off-site without treatment via turnout structures, if water storage space is not available.
4. Subsoils and topsoils in the disturbed areas were amended with limestone and mushroom compost. Revegetation was accomplished with acclimated native seeds. These activities reduce erosion and acid generation by reestablishing stable surfaces.

System Operations/O&M

This remedy is largely complete. In 2005, the final seep collection structures will be built. Monitoring the structural components and revegetated areas are the on-going activities. The ditches periodically require maintenance to remove debris and sediment build-up. Turnout gates are exercised annually to insure proper operation. In addition, cleanout structures are placed at intervals along the ground water interceptor drains for periodic clearing of accumulated sludges or debris. However, this has not been required to date. This OU will be considered complete with the construction of the final seep collection structures this year. Long-term maintenance is addressed in the monitoring program.

4.7 Final Site-Wide Record of Decision (OU5)

The final remedial actions for the Summitville Mine Superfund Site Operable Unit 5 Record of Decision addressed the threats to the environment that remained at the site after completion of emergency and interim remedial actions. The goal of the final remedy is to capture the mobile source material, (i.e., acid mine drainage), contain it in an on-site impoundment, and remove metals to achieve water quality standards in the Alamosa River. The final remedy continues the benefits achieved through the emergency actions and interim remedial actions and further reduces and controls threats to the environment. The final remedy will maintain interim remedial actions for

OU1, OU2, and OU4. The major components of the Final Site-Wide Remedy include the following:

1. On-site contaminated water impoundment upstream of the Wightman Fork-Cropsy Creek confluence;
2. Construction of a new water treatment plant downstream of the contaminated water impoundment (modified in the ESD 2003 to upstream of the impoundment)[3];
3. Possible breach and removal of the existing Summitville Dam Impoundment;
4. Construction of a sludge disposal repository;
5. Upgrade of Wightman Fork Diversion;
6. Upgrade of select site ditches;
7. Construction of groundwater interceptor drains;
8. Construction of a Highwall ditch;
9. Rehabilitation of Reynolds Adit;
10. Management of mine pool water;
11. Continued site maintenance, and groundwater/surface water and geotechnical monitoring on-site; and
12. Surface water, sediment, and aquatic life monitoring in the Alamosa River and Terrace Reservoir.

Determination of impoundment size, and exact location and capacity of the water treatment plant were deferred to the Remedial Design phase. Institutional controls, other than continued restricted access to the site and compliance with the environmental covenant provisions, are not components of the remedy.

It is expected that these actions, when implemented in total, will result in attaining the Remedial Action Objectives of restoring aquatic life use classifications and water quality in Segment 3c of the Alamosa River and below.

Remedy Implementation

Final remedy components implemented as of the date of this Five-Year Review consist of the following:

1. Upgrade of select site ditches;
2. Construction of groundwater interceptor drains;
3. Construction of a Highwall ditch and sedimentation/storage pond;
4. Continued site maintenance, and groundwater/surface water and geotechnical monitoring on-site; and
5. Surface water, sediment, and aquatic life monitoring in the Alamosa River and Terrace Reservoir.

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[3] An Explanation of Significant Differences (ESD) was issued and finalized in 2003. The ESD modified the new WTP location from downstream of the SDI to a location adjacent to the current WTP.

System Operations/O&M

Monitoring of all implemented Interim Records of Decision and Final Site –Wide Record of Decision are ongoing, inclusive of on-site structural components, ground water, surface water and seeps, and off-site surface water, sediments and aquatic life.

5.0 Progress Since Last Review

The following is a chronological summary of events since the last Five-Year Review in year 2000.

Prior to 2000

- Consolidation of Water Treatment Plant operations.
- Upgrade of Cleveland Cliffs Tailings Pond to its current configuration of the Summitville Dam Impoundment.
- Completion of Operable Unit 2, waste pile consolidation and closure.

2000

- In preparation for developing the Record of Decision (ROD) Remediation Levels at WF5.5, modeling of Alamosa River and Terrace Reservoir was conducted. The model had been substantially upgraded since 1998 to include coupled sediment and water column interfaces, allowances for an increased number of modeled parameters, pH was not fixed as before and could change within each segment modeled unit. In addition, a three-dimensional reservoir model was developed to assess transport through the Terrace Reservoir.
- Heap Leach Pad Closure is complete.

2001

- The EPA and CDPHE presented the proposed plan for the Final Site Wide Record of Decision to the National Remedy Review Board in March 2001.
- Remedial Investigation, Feasibility Study and Final Site-Wide Record of Decision were completed in September 2001.
- Site Wide Reclamation and Revegetation is completed.

2002

- WQCC triennial review for Alamosa River was scheduled for year 2002. The CDPHE worked with the WQCD to create Segment 3d based on significant changes in chemistry from the upstream to the downstream end of the segment (based on the model conducted for the ROD); thus, Segment 3c was subdivided to Segment 3c (Fern to Ranger Creek) and Segment 3d (Ranger Creek to Terrace Reservoir).
- CDPHE hired a contractor to design OU5 elements such as ditch upgrades, highwall ditch and sedimentation pond, ground water/seep interceptors, pipelines and turnout structures. An upgrade to the site electrical infrastructure was also included in the design.

2003

- CDPHE hired WTP contractor designing during year 2003 and the winter of 2004.
- April/May 2003 began discussions with CDPHE/WQCD regarding the Discharge Control Mechanism (DCM).
- Met with EPA DCM group in June and July 2003. During these two meetings, technical issues and regulatory inconsistencies were identified with respect to developing a DCM for the new SMSS water treatment plant.
- Construction of OU5 elements designed in year 2002 was constructed.

2004

- In May 2004, CDPHE issued an Explanation of Significant Difference (ESD) changing the location of the new WTP from downstream of the SDI to adjacent to the Interim WTP.
- In September 2004, RTG completed the design for the new WTP.
- In October 2004, the request for funding the construction of the new water treatment plant was reviewed by the Prioritization Panel. Summitville did not rank high enough to receive funding authorization to proceed with new WTP construction.
- EPA and CDPHE planned to transfer the lead role of site –wide operations and maintenance, inclusive of the WTP to the CDPHE. CDPHE issued a Request for Proposals for WTP O&M.

2005

- The CDPHE selected a WTP and site O&M contractor, Resource Technologies Group, Inc. The CDPHE assumed the lead role for site O&M in February 2005.
- WQCC triennial review of Regulation No. 31 June 2005 concerning changes to cadmium, aluminum and zinc were adopted. However, these changes will not be applied to Alamosa River Regulation No. 36 unless adopted in the next triennial review scheduled for 2007.
- The EPA and CDPHE met with the National Remedy Review Board in July 2005 to discuss the ARAR's and design basis for the New Water Treatment Plant.
- Design improvements to OU5 groundwater and seep interceptors were installed.

5.1 Protective Statement from Last Five Year Review

The Protectiveness Statement from the last Five Year Review August 2000 is as follows:

"Metals concentrations have decreased significantly and pH values have increased in the Alamosa River downstream of its confluence with the Wightman Fork as the implementation of the interim response actions at the Site has progressed. However, the Summitville Mine remains as a dominant contributor of copper, zinc, and cadmium to the Alamosa River Watershed. The aquatic water quality standards in the Alamosa

River have not yet been achieved. Aquatic life has not been completely restored in the impacted areas of the Alamosa River. It is anticipated that additional remedial actions may be necessary to achieve the water quality standards and restore aquatic life in the Alamosa River. Any additional remedial action will be evaluated in the Site Wide Remedial Investigation and Feasibility Study."

5.2 Status of Recommendations and Follow-up Actions from Last Review

'Deficiencies' identified in the 2000 Five-Year Review consists of the following italicized statements. Actions (not italicized) taken since the 2000 Five-Year Review immediately follow the italicized statement.

> *"Although water quality in the Alamosa River downstream of the Summitville Mine has significantly improved since the implementation of emergency response and interim remedial actions, aquatic life in the Alamosa River is not currently protected. The Site-Wide RI/FS will evaluate alternatives for achieving this goal."*
>
> Since the 2000 Five-year Review, the Operable Unit 4 - Site-Wide Reclamation and the Operable Unit 5 - Final Site Side Remedial Investigation, Feasibility Study and Record of Decision have been completed, both in September 2001. Implementation of all Final Site-Wide ROD remedial actions, necessary to attain Alamosa River stream standards, has not been completed. In year 2003, some components of the OU5 ROD were constructed. These include: the upgrade of select site ditches, construction of groundwater interceptor drains and a Highwall ditch and sedimentation pond. Continuing activities consist of operating the interim WTP and other site structures necessary to facilitate water management, as well as continued site maintenance, groundwater/surface water and geotechnical monitoring on-site; and surface water, sediment, and aquatic life monitoring in Alamosa River and Terrace Reservoir.
>
> *"The Beaver Mud Dump contains seeps and several block type earth movement which have become a debris flow down-slope toward the SDI."*
>
> As part of the OU4 Site Wide Reclamation completed in year 2002, the Beaver Mud Dump was regraded and vegetated to stabilize the slope. Seeps were channeled into the SDI using constructed ditches, further stabilizing the slope. Since this remedy has been implemented, there has been no evidence of debris flow and instability.
>
> *"It appears that the water within the Heap Leach Pad may be in contact with the local groundwater table. If this is true, the water within the Heap Leach Pad is*

likely to chemically evolve. The Site Wide RI/FS needs to consider how water will evolve and the potential of it becoming a source of acid mine drainage.'

In the Remedial Investigation Report (September 2001), the Heap Leach Pad was found to have limited hydraulic communication with the local groundwater, based on a draw down test conducted on the Heap Leach Pad in 2000. The liner is known to have leaked as evidenced by the presence of cyanide in the underlying drain system; however, cyanide nor cyanide degradation products have been detected in seeps or monitoring wells downgradient of the Heap Leach Pad.

Since 1996, the pH in the Heap Leach Pad had ranged from 6.5 to just over 9. The issue was raised as to the adequacy of the buffering capacity of the Heap Leach Pad and whether the water would become more acidic in the future. Barring any pumping of the HLP wells, the long-term HLP water level will likely mimic that of the bedrock groundwater system. A geochemical model MINTEQA2 (U.S. EPA, 1991) suggests that lime present in the HLP could continue to dissolve, because ground water enters and exits the HLP, creating a flow through circuit (Remedial Investigation Report 2001). However, the low recharge rate compared to the total volume of the HLP provides for a long residence time, on the order of 8.5 years. If groundwater recharge is assumed to average about 20 gpm, natural flushing would take about 50 years to evolve the HLP chemistry to acidic conditions.

The remedial response to the potential for water in the HLP to become acidic is to continue monitoring the Heap Leach Pad, the groundwater and seeps around the Heap Leach Pad and the Dike 1 stability as determined by annual inclinometer measurements.

The following table presents pH, cyanide and cyanide degradation products data for the Heap Leach Pad. To date there is no discernable trend in the data.

Sample Date	***pH***	***Total Cyanide***	***WAD Cyanide***	***Nitrate/Nitrite***	***Ammonia***	***Thiocyanate***
16-Jul-99	7.08		3.6	0.03 B	25.6	0.1 U
24-Jun-00	8.02	0.45	4.8	0.02 U	25.2	30
29-Jun-01	7.67	2.9		0.27	23.8	34.9
08-Jul-03	7.03	2.6		0.25	21.5	38.1
29-Jun-04	7.47	2.1		0.13	23.2	37

"The Summitville Dam Impoundment was designed as a temporary structure. The Site-Wide RI/FS should evaluate if this structure is to be part of the remedy.

If the Summitville Dam Impoundment is to be included in the Site-Wide remedy, this will need to be upgraded to pass the Colorado State Engineers minimum requirements of the 100-year flood."

Though the Summitville Dam Impoundment was originally thought of as a temporary structure; the design and construction conforms to the Bureau of Reclamation (BOR) standards for engineered dams. The BOR modifications to the SDI were designed for a five to 10 year life and completed in 1995 (RMC September 2000). The SDI spillway was designed to pass flow from the 25-year event for a drainage area of approximately four square miles, including the Wightman Fork watershed based on the assumption that the Wightman Fork Diversion adjacent to the SDI would fail during the design storm event (U.S. BOR 1998). Colorado State Engineers Office inspection reports for the years 2000, 2001,2002 and 2005 indicate that the dam is safe. The results of these inspections are discussed in greater detail in Section 7.2.5.2.

Due to changes in the water management systems constructed as part of OU4, the site hydrology has changed. The modifications to the water management system includes increased size of the upstream and downstream Wightman Fork Diversion culverts to pass the 500 and 100-year event respectively, diversion channel enlarged to pass the 100-year event and improvements to the SDI spillway channel. Turnouts constructed along certain ditches allow the 500-year event to be diverted off-site by default. Planned improvements for the Wightman Fork Diversion and the SDI spillway channel will require a revised site hydraulic model (with consideration of the recent changes to water management structures) so that the Wightman Fork diversion will safely pass the 500-year event through its length and culverts without the potential to fail into the SDI. With this analysis and the SEO review and concurrence, the design event that the SDI can hold as it is currently configured will be revised.

After a new WTP is constructed, the need for additional storage or upgrades to the dam and impoundment will be assessed.

"The adits will require rehabilitation and regular maintenance for continued safe access. This work is planned to be performed this summer and in the future, as needed."

In year 2000, limited Reynolds Adit and Chandler Adit maintenance was performed (CDM SOW June 2000). The maintenance consisted of reinforcements or replacement of deteriorated support timbers. In addition, debris and mud was removed from the adit floor, open channel flow drainage was improved, a walkway was constructed to permit safe access, and operation of the electronic and manual values on the pipe through the adit plug was restored. Adit inspections are conducted every year, with a detailed adit inspection conducted at five-year increments coinciding with the Five-Year Review. Discussion of the of the August 2005 adit inspection is presented in Section 7.2.5.6 and the 2005 Adit Inspection Report is presented in Appendix D.

The year 2000 Five-Year Review stated the following 'Recommendations and Follow-up Actions:'

"All of the Concerns identified in the five-year review shall be evaluated in the Site-Wide Remedial Investigation and Feasibility Study. All proposed additions or changes to the operations or remedies at the Summitville Mine will be included in the Proposed Plan and subject to public comments. The Site-Wide Remedial Investigation and Feasibility Study is scheduled to be completed by September 2001."

The Site-Wide RI/FS and ROD was completed by September 2001. All issues raised in the "Deficiencies, Recommendations and Follow-up Actions" have been addressed in the RI/FS and ROD.

5.3 Results of Implemented Actions

Section 7 provides a detailed evaluation of the each operable unit performance and effectiveness.

The Interim WTP process and capacity are optimized to the extent possible. The WTP is able to treat at a maximum rate of approximately 1000 gpm. That rate is achieved on a regular basis. Metals removal effectiveness at the SMSS WTP exceeded 99.5 percent for copper, iron, and zinc. Recent analysis for aluminum shows that aluminum is reduced by an order of magnitude; though the WTP is not specifically designed to remove aluminum.

Data at WF5.5, the downstream SMSS point-of-compliance, show that the contaminant load generated from the site has largely stabilized since the completion of major construction for OU0, OU1, OU3 and OU4. Additional source control is needed for seeps which continue to discharge to the Wightman Fork without collection or treatment. These are being investigated and are further discussed in Section 7, 8 and 9.

5.4 Status of Other Priority Issues

The CDPHE is preparing to issue a request for design and construction for the Wightman Fork Diversion and the SDI improvements to bring both of these important structures into compliance with the revised hydraulic model for the SMSS and the SEO requirements for dams.

The CDPHE awaits the decision for funds to construct a new WTP.

6.0 Five-Year Review Process

The five year review process is comprised of data and document review, community involvement activities and site inspections.

6.1 Data and Document Review

Data review is an ongoing and annual process, which is documented in annual reports The WTP operator (currently Golder RTG, and previously Camp Dresser McKee) produces an annual report for the water treatment plant and general site operations, inclusive of on-site monitoring data. The CDPHE consultant Tetra Tech RMC, conducts project monitoring for both on-site and off-site environmental media, and produces an annual report. These reports, in addition to specific inspection memorandums, assess the contaminant load generated from the SCMCI sources, conformance with effluent discharge criteria, compliance with the Remedial Action Objectives and Remedial Action Levels at the downstream site boundary, the Alamosa River stream standards and compliance with those objectives and standards.

6.2 Community Involvement Activities

Community Involvement is an important part of managing the Summitville Mine Superfund Site. To that end, regularly scheduled activities for community involvement have been the norm. A community meeting is planned for the spring in La Jara (Figure 2-1) to discuss activities for the upcoming field season and changes to funding or other regulatory issues. In the fall, a community site visit is planned at the Summitville Mine Superfund Site, specifically to discuss how the site performed that field season and upcoming activities. In addition, for those that can not attend either of these meetings, an annual newsletter is issued each winter, summarizing current and planned activities for the site. Based on the community interviews conducted in 2004, it was found that these mechanisms are an effective means of communication with the community on a consistent basis.

Important decision documents are stored in a locally accessible library in the La Jara Natural Resource Conservation Service and the Del Norte Library. Documents are made available to the public by means of the State of Colorado Summitville web page (www.cdphe.state.co.us/hm/summitville.asp). Access to the Summitville Master Database with mapping capabilities is available through an interactive downloadable user friendly and interactive database at www.cdphe.sate.co.us/hm/hmmapapps.htm. CDPHE has proactively created Internet based documents and data, so that the community, located four hour's drive from the agency administrative records, can readily procure information.

6.3 Site Inspections

Site inspections are conducted on an on-going basis. Site visits are generally conducted at least two times each month during the field season. Weekly conference calls are held with site contractors and personnel. These conference calls are documented in weekly minutes. Monthly water treatment plant reports are generated which document the site operations, monitoring and maintenance. Annual reports are produced documenting the year's activities and in the case of the Annual Monitoring Reports produced by Tetra Tech RMC for CDPHE, data trends for on and off-site data are continually updated and added to the previous years, so that multiple year data trends can be evaluated.

7.0 TECHNICAL ASSESSMENT

This section presents a technical assessment of the four interim remedial actions at the SMSS (OUs 0, 1, 2 and 4) and the final site-wide remedy (OU5). Data collected since the implementation of the various remedial actions included in the IRODs and ROD are assessed herein[4] with respect to the site-wide remedial action objectives and, where applicable, compared to remediation levels. The purpose of the technical assessment is: to evaluate if the remedies are functioning as intended by the IRODs and ROD; to assess if the various assumptions, ARARs, etc. considered at the time of the remedy selection are still valid and, if not, evaluate the consequences; and to discuss additional information that could impact the effectiveness of the remedial actions.

7.1 Remedial Action Objectives and Remediation Levels

This section presents the targets of the site-wide remediation actions presented in the ROD.

[4] Although historical data are considered herein, emphasis is placed on data collected since the publication of the first five-year review in 2000.

7.1.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) of the final site-wide remedy (OU5) address migration, exposure pathways, and potential receptors of contamination from the site. The RAOs for the final remedy of the site are presented below.

1. Control and treat surface water, groundwater and leachate, as necessary, to meet State and Federal ARARs.
2. Re-establish State aquatic use classifications and attainment of water quality numeric criteria in Segment 3c for the Alamosa River and downstream.
3. Ensure geotechnical stability of constructed earthen structures and slopes.
4. Mitigate erosion and transport of sediment into Wightman Fork and Cropsy Creek.
5. Control airborne contaminants from the site.

The Human Health risk assessments for the site and downstream study areas found there to be no adverse health risk to humans. However, sufficient acute and chronic risks were found to severely limit aquatic life (rainbow trout and macroinvertebrates) in the Alamosa River downstream of Wightman Fork.

7.1.2 Remediation Levels

Reactive transport modeling was used to assess improvements in water quality of Wightman Fork, the Alamosa River and Terrace Reservoir as part of the evaluation of the remedial alternatives for the site (HydroQual 2001). A final step of the modeling was to estimate remediation levels at the site boundary (WF5.5) that would be necessary to meet water quality standards in Segment 3c of the Alamosa River. Segment 3c was established as the offsite point of compliance for the selected remedy.

Surface water modeling was based on the WASP4 transport codes with the metal-speciation submodel, META4, to describe and control metal transformations and subsequent transport and fate. The WASP4/META4 model relies on the fundamental mathematics and solution approach contained in the equilibrium model MINTEQA2, developed by U. S. EPA (1991). The WASP4/META4 code is a fully three-dimensional model with transportable sediment regions. Physical and chemical processes that affect the transport of metals are taken into account in the model including advection, dispersion, sediment storage/release, chemical reaction, variable pH, adsorption, desorption, erosion, sedimentation, precipitation, and dissolution. The modeling of Wightman Fork and the Alamosa River (Segment 3b: Wightman Fork to Fern Creek and Segment 3c: Fern Creek to Terrace Reservoir[5]) included 31 surface water compartments along the main channels with 31 corresponding benthic compartments. For the reservoir modeling, four surface layers were utilized to represent the variability with depth with a total of 135 compartments, including 35 benthic compartments.

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[5] At the time that the modeling was performed, Segment 3c had not been divided. Stream segments are shown on Figure 3-1.

Following the detailed specification of system geometry, boundary conditions and initial conditions, the Wightman Fork-Alamosa River model was calibrated for both high-flow (June, 1999) and low-flow (October, 1998) conditions while the Terrace Reservoir model was calibrated to data collected from 1994 through 1999 (high-flow: June 1995 and 1999, and low-flow: October 1994 and 1999). The initial calibration activity, following the balancing of flows and travel time, included the simulation of conservative substances followed by the calibration of total recoverable iron and aluminum within Wightman Fork, the Alamosa River and Terrace Reservoir. The results of the calibration indicated a relative percent error between observed and calculated concentrations in the river of generally less than 10 percent. The calibrated model was used to estimate the maximum concentrations of metals (remediation levels) that could be discharged from the site while still meeting water quality standards within Segment 3c of the Alamosa River. Chemical inputs at the site boundary (i.e., WF5.5, the upstream model boundary condition), were obtained by mass balance analysis and MINTEQA2 simulations derived from estimated reductions in chemical loadings from various site sources. The estimated remediation levels for the selected remedy are presented in Table 7-1. The remediation levels are viewed as "goals" for the selected remedy due to the variability of acidity provided by the Alamosa River upstream of Wightman Fork and uncertainties of the model.

The form of copper (particulate versus dissolved) is extremely sensitive to pH. Figure 7-1 illustrates the distribution of dissolved and particulate copper as a function of pH in the upper portion of Alamosa River Segment 3c (Figure 3-1). The copper standard in Segment 3c is for dissolved copper. During low-flow periods, the pH of water in the Alamosa River upstream of Wightman Fork is strongly acidic (pH 4 to 5); whereas, that of Wightman Fork is only slightly acidic (pH 6 to 7). Consequently, particulate copper entering the Alamosa River from Wightman Fork converts from the particulate to the dissolved form due to the more acidic conditions present in the Alamosa River. When higher pHs are present in the Alamosa River, much greater concentrations of copper can be released from the site (Table 7-1) because the copper remains in the particulate form upon entering the Alamosa River.

7.2 Effectiveness of Interim and Final Remedial Actions

The USEPA and State of Colorado have implemented four interim remedial actions at the SMSS (OUs 0, 1, 2, and 4) in addition to the final site-wide remedy (OU5). Work on OU0, water treatment, is ongoing. Other major components were only recently completed, such as the Water Management Structures and Improvement Project under OU4, site-wide reclamation. Consequently, limited sampling data may be available for the assessment of the effectiveness of some of the remedial actions. Additionally, the extreme drought conditions impacting the site during 2002 and 2003 must be considered when evaluating both the quality and quantify of water generated on the SMSS. Data from 2005 collected through August 1 are considered herein.

7.2.1 Operable Unit 0 - Water Treatment

The interim water treatment plant (WTP) uses lime-based pH control to precipitate metals from the influent solution. Sludge generated at the plant is mechanically dewatered and disposed on-site. The existing plant has a treatment capacity slightly in excess of 1,000 gpm or 1.44 mgd. Contaminated water generated on-site is held for treatment in the Summitville Dam Impoundment, or SDI. The SDI has a storage capacity of approximately 90 million gallons. Water is pumped from the SDI to the WTP for treatment; treated water is discharged from the WTP to Wightman Fork via a pipeline.

The WTP treated the following quantities of water in the 2000 through 2004 period:

Year	*Volume Treated (million gallons)*	*Average Treatment Rate (gallons per minute)*
2000	172.0	740
2001	246.1	996
2002	132.8	820
2003	186.3	748
2004	243.0	962

Note: Average Treatment Rate calculated for on-line hours

Through July 31, 2005, approximately 160.7 million gallons have been treated at the WTP for an average rate of 929 gpm.

Treatment removed the following mass of metals from aqueous waste streams at the SMSS over the period 2000 through 2004:

Year	*Mass of Metals Removed (tons)*			
	Copper	*Iron*	*Manganese*	*Zinc*
2000	9.4			
2001	32.3	123	24.1	12.8
2002	23.6	96.1	14.4	8.4
2003	20.6	101	16.7	8.4
2004	26.0	112	20.8	10.2

In 2000, only copper concentrations were analyzed in the influent samples

Metals removal effectiveness[6] at the SMSS WTP exceeded 99.5 percent for copper, iron, and zinc. Manganese removal effectiveness was slightly lower, ranging from 91.5 to 95.3 percent. Through July 31, metals removal efficiencies in 2005 averaged greater than 99.8 percent for copper, iron and zinc, 93.7 percent for manganese and 96.3 percent for aluminum.

The Summitville WTP operates using effluent discharge limits for water discharged to Wightman Fork. The effluent limits are based on seven-day consecutive average concentrations, and apply to copper, iron, manganese, and pH. The following are the effluent limits established by the EPA for the Summitville WTP:

Analyte	***7-Day Consecutive Average (Start-up to May 31)***	***7-Day Consecutive Average (June 1 to Shut Down)***
Copper	1.0 mg/L	0.1 mg/L (goal of 0.03 mg/L)
Iron	N/A	50.0
Manganese	N/A	5.6
PH (daily composite value)	N/A	6.5 to 9 standard units

With the exception of copper in late 2000 and pH which, with the permission of the USEPA, has exceeded the upper limit of 9 during the past few years, the SMSS WTP effluent consistently met its discharge limits during the 2000 through 2004 period. The WTP effluent met the pH requirements in 2000, 2001 and 2002. The WTP effluent did not meet the copper standard of 0.1 mg/L during the mine pool drawdown test in late 2000. To facilitate the treatment of water discharged from the mine pool, the USEPA allowed the WTP operator to discharge effluent above the pH 9 limit beginning in June 2003. The WTP effluent remained within the pH limits of 6.5 to 9.5 throughout the period June 2003 through July 31, 2005.

The combined SDI storage capacity and WTP treatment capacity were sufficient to treat water generated onsite in 2000. In spite of runoff from the Highwall/mine pit areas being routed to Ditch R between May 3 and June 28, 2001 and the WTP operating at average rates of 1,040 gpm and 1,107 gpm during the months of May and June, 2001, respectively, rising water levels in the SDI required the release of untreated water from the SDI to Wightman Fork during 19 of the 21 days between May 27 and June 16, 2001. Approximately 11.8 million gallons (36.3 acre-feet) of water were released from the SDI in 2001. The combined SDI storage capacity and WTP treatment capacity were sufficient to treat water at the SMSS during 2002 and 2003. Use of the ditch turnouts installed in late 2003 prevented the need to release water from the SDI during the 2004 and 2005 runoff seasons. An estimated 56 million gallons of water [7] was directed

[6] Metals removal effectiveness calculated as (Concentration $_{Influent}$—Concentration $_{Effluent}$)/Concentration $_{Influent}$

[7] Continuous measurement devices were installed in the ditch turnouts in 2005; 2004 flow data are estimated.

offsite via the ditch turnout system in 2004. During the 2005 runoff season, 70 million gallons of water were directed offsite were using the turnouts. A comparison of the SDI elevation and the WTP processing rate during 2000 through August 2005 is illustrated on Figure 7-2.

7.2.1.1 Questions

Question A: Is the remedy functioning as intended by the decision documents?

Yes. Effluent discharged from the WTP to Wightman Fork meets the interim discharge limits for copper of 1 mg/L before June 1 and 0.1 mg/L after June 1. The discharge goal of 0.03 mg/L copper is infrequently met (see Figure 7-14).

Question B: Are the Assumptions made at the time of the remedy selection still valid?

For the most part, yes. However, the combined storage and treatment capacity is inadequate to handle the volume of water generated by the melting of snow packs generally greater than normal.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Yes. As discussed in Section 8.1, a significant capital investment may be required to bring the Interim WTP into compliance with acceptable OSHA standards. Additionally, increased O&M costs may be required to maintain outdated equipment.

7.2.2 Operable Unit 1 - Heap Leach Pad Detoxification/Closure

The cyanide in the Heap Leach Pad (HLP) was detoxified through a rinsing program in 1994 and 1995. Comparison of pre- and post- rinsing program cyanide concentrations indicates that the detoxification program removed 98 percent of the liquid-phase cyanide from the HLP. The HLP was regraded to stable configuration and capped during the 1997 and 1998 construction seasons, and vegetated. Following termination of the rinsing program and before the cap was completed, the water elevation in the HLP rose to a level of approximately 11,530 feet (Figure 7-3), just a few feet below the HLP outfall constructed by the U. S. BOR as part of the HLP closure.

As part of the remedial investigation (RI), approximately 13.3 million gallons of water was pumped from the HLP and discharged to the SDI in late 2000. Water levels in the HLP have remained depressed since the completion of the HLP pumping test in 2000 (Figure 7-3). Consequently, the completion of the HLP cap in 1998 appears to have successfully decreased the recharge of water in the HLP from direct infiltration of precipitation.

Groundwater and seep monitoring on both HLP dikes and in the Cropsy Creek valley downgradient of the HLP during 2001, 2003, and 2004 did not detect any significant presence of cyanide or thiocyanate in any of the wells or seeps sampled. Slightly elevated concentrations of ammonia and/or nitrate/nitrite were periodically detected in wells and seeps in both HLP dikes. However, these data are not consistent with a large-scale failure of the HLP liner system. Consequently, the drain system below the HLP and in Dike No.1 that discharges to the SDI via the French Drain pipeline apparently continues to capture leakage from the HLP.

Inclinometers were installed in the HLP downstream Dike No. 1 embankment in September 2000 (Figure 7-4). These inclinometers replace those previously installed by the U. S. BOR that were destroyed during the HLP closure construction. Baseline measurements were obtained in the replacement inclinometers INCLH-1R, -2R and -3R in October 2000 and the inclinometers have been resurveyed four times since then (2001, 2003, 2004 and 2005). The data obtained from INCLH-2R and -3R (Figure 7-4) indicate that the central and eastern portion of the HLP Dike No. 1 is slowly creeping to the north-northwest; INCLH-1R surveys consistently show no movement from year to year on the western portion of the dike. Approximately 50 feet of water was present in the INCLH-3R casing in 2004 and 2005; a water sample collected from casing in 2004 did not contain any HLP derived contaminants. The presence of water in this inclinometer is likely due to seepage through a settlement-induced crack in the casing; once water enters the solid PVC inclinometer casing it cannot escape. Monitoring wells DK1PW-4 and -4A, located approximately 200 feet downslope from INCLH-3R (see Figure 7-4 inset map), were both dry in 2004 and 2005.

7.2.2.1 Questions

Question A: Is the remedy functioning as intended by the decision documents?

Yes. The placement of the cap over the HLP has reduced infiltration as evidenced by the stable water level following the conclusion of the RI pump down test. Monitoring of groundwater downgradient of the HLP indicates that cyanide is not migrating off the site via the groundwater pathway.

Question B: Are the Assumptions made at the time of the remedy selection still valid?

Yes.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.2.3 Operable Unit 2 – Excavation of the Cropsy Waste Pile/Beaver Mud Dump and the Cleveland Cliffs Tailings Impoundment [SDI]/Closure of Mine Pits

OU2 included the removal of mine wastes from the Cropsy Waste Pile, the Beaver Mud Dump, and the Cleveland Cliffs Tailings Impoundment (now SDI). These and other mine wastes were placed in the former mine pits, and the pits covered and revegetated (except for the sludge disposal area).

Consolidation of mine waste materials in the mine pits has not wholly removed these materials from contact with the environment. The elevation of the mine pool as measured at the Reynolds and Chandler Adit plugs is illustrated in Figure 7-5 along with water levels from wells completed in the mine pits. Well BORMW-10 is completed in the South Mine Pit; manual water level measurements are occasionally taken in the well. Well RMCMW-8 is completed in the North Mine Pit; continuous water level data are available from this instrumented well. Material in the North Mine Pit is seasonally inundated as the bedrock groundwater/mine pool level rises in response to the spring snowmelt. Note that in 2002, the North Pit mine wastes did not become saturated, likely a result of the drought and early releases from the mine pool that year. The base of the South Pit is approximately 100 feet above the North Pit. Consequently, the mine waters in the South Pit are not inundated as frequently as those in the North Pit.

7.2.3.1 Questions

Question A: Is the remedy functioning as intended by the decision documents?

For the most part, yes. However, the mine wastes disposed in the North Mine Pit and, to a lesser extent, the South Mine Pit are seasonally inundated by groundwater (Figure 7-5).

Question B: Are the Assumptions made at the time of the remedy selection still valid?

For the most part, yes. However, as discussed in the response to Question A, the mine wastes have not wholly been removed from contact with the environment. Additionally, as discussed in Section 7.2.1, the SDI storage capacity is not sufficient to contain runoff from the site when the snow pack is above normal.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.2.4 Operable Unit 4 - Side-Wide Reclamation

Site-wide reclamation was implemented in multiple phases over several years with the major earthwork completed by 2001. Approximately 300 acres of disturbed land was reclaimed at the site. The goals of site-wide reclamation were to remove, reduce, stabilize, and/or contain non-point sources of acid rock drainage to prevent further releases from the site and impacts to aquatic receptors in the Alamosa River and Terrace Reservoir.

Reclamation involved reconfiguring disturbed areas to improve slope stability, moisture retention, and to reduce soil erosion. Amendments needed to produce topsoil capable of promoting and sustaining plant growth were added to the soil. Lime requirements were determined for either the total acid potential or the acid-base potential of soil samples. Lime application rates for the subsoil were based on the average lime requirement, plus the amount of limestone to neutralize 12 inches of subsoil to the 95 percent confidence level. This could leave an estimated five percent of the total area (15 acres) inadequately neutralized (U.S. BOR, 1998).

At the conclusion of the site-wide reclamation work, funds remaining in the OU4 budget allowed for the completion of some items included in the OU5 ROD under OU4. These included:

- Upgrade of select site-ditches;
- Construction of groundwater interceptor drains;
- Construction of the Highwall ditch and sedimentation basin; and
- Construction of various contaminated water pipelines and the impact basin.

7.2.4.1 Revegetation

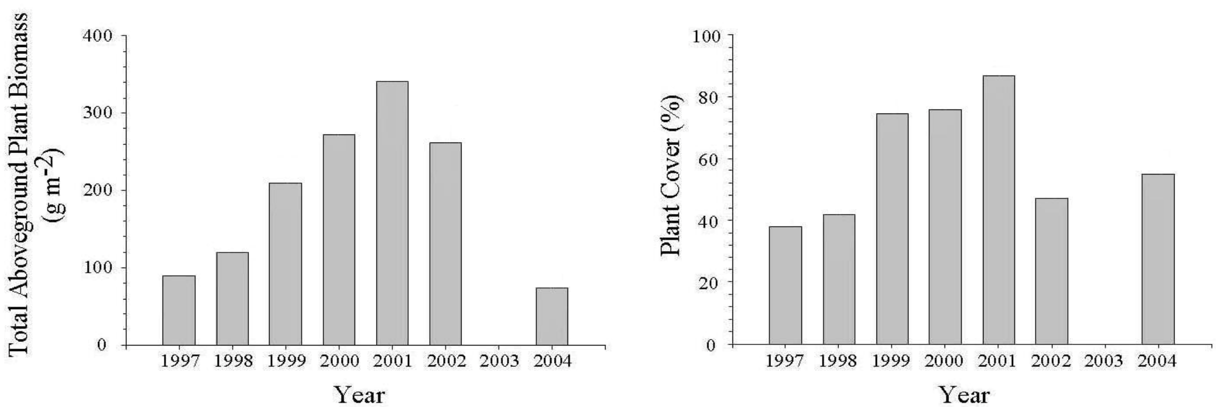
Measures of vegetative cover on reclaimed areas at SMSS indicate that there is considerable heterogeneity in vegetative cover within the reclaimed areas (CSU, 2003; CSU, 2005). Total vegetative cover generally increased between 2002 and 2004. In 2002, plant cover ranged from 3 to 83 percent in the 66 plots sampled (Table 7-2). In 2004, plant cover ranged from 17 to 96 percent in the 70 plots sampled (Table 7-3). The most common plant species on the reclaimed areas are slender wheatgrass (*Elymus trachycaulus*) and timothy (*Phleum pratense*). The percent cover of the third commonest species present in 2002, common wheat (*Triticum aestivum*), declined substantially from 2002 to 2004, while the percent cover of common yarrow (*Achillea millefolium var alpicola*) substantially increased. A few plots experienced declines in plant cover between 2002 and 2004. These included:

- The four plots on the North Waste Dump;
- The plots on the north half of the Heap Leach Pad; and
- Plots on the east side of the Cropsy drainage.

Most of the declines in these areas can be directly attributed to the decline in the dominant plant species, slender wheatgrass. Slender wheatgrass is a short-lived perennial grass. Most plots showing declining cover is on open north and northwestern aspects where the dry conditions of 2002 and 2003 and exposure to wind could have accelerated the demise of slender wheatgrass (CSU, 2005).

The increase in plant cover observed in most plots between 2002 and 2004 is due to an increased diversity of grass species and the forb, common yarrow (Table 7-4). Increases in other plant taxa as the dominant seeded taxa (slender wheatgrass) declines indicate that the plant community succession is progressing in a generally favorable manner at the SMSS (CSU, 2005).

Aboveground biomass (g/m) and herbaceous cover (percent cover) in select long-term revegetation test plots on the NWD were measured (one of eight treatments tested on the NWD since 1995, treatment SM is most similar to the soil amendments used in OU4 and was sampled by CSU in 2004). Total biomass and cover were greatly reduced in the revegetation test plots in 2002 compared to previous years. As illustrated below, total biomass continued to decrease in 2004, but total plant cover remained similar.



Source: CSU, 2005

The relatively consistent plant cover in recent years, despite the greatly reduced biomass, suggests that the cessation of fertilization in 2001 and reduced moisture in 2002 and 2003 has resulted in plants of reduced stature rather than a die-off of the vegetation (CSU, 2005).

The success of the OU4 reclamation work in reducing non-point source pollution from the disturbed areas at the site is discussed in Section 7.2.4.2.1.

7.2.4.2 Water Management Structures and Improvements

The objective of the Water Management Structures and Improvements project completed in 2003 was to further segregate clean water and contaminated water at the site, thereby optimizing water storage at the site. The purpose of the ditch turnout structures, which were installed as part of the project, was to enable the agencies to divert relatively clean surface water away from the SDI. By diverting this surplus water to Wightman Fork, the need to make untreated releases from the SDI will be minimized.

Work on the Water Management Structures and Improvement Project was performed during 2003. Work performed on this project included:

- Construction of the Highwall ditches, detention pond, and pipeline.
- Upgrade of Ditches P and L.
- Construction of diversion structures on A, L, P, Q, and T Ditches for turning out water to Wightman Fork.
- Extension of the Reynolds Adit pipeline.
- Construction of numerous groundwater interceptor drains, blanket drains, seep collection systems, an adit plug, and associated pipelines.

The construction of the diversion structures (a/k/a turnouts) on ditches A, L, P, Q and T also provided locations for obtaining flow measurements and collecting water quality samples. Instantaneous flows were estimated in 2004 from staff gages when water was directed offsite via the individual turnouts. In 2005, pressure transducers with attached data loggers were installed at each turnout to provide a continuous record of water diverted offsite. A straight line diagram illustrating surface water flow routing at the site during 2004 and 2005 is provided in Figure 7-6.

7.2.4.2.1 Surface Water Ditches, Sedimentation Basin and Pipelines

Current management of the site surface water has resulted in some significant improvements in water quality leaving the SMSS. For example, the concentration of total suspended solids (TSS) measured at Wightman Fork monitoring station WF5.5 has significantly decreased with the completion of OU4 activities. The concentration of TSS measured at WF5.5 for the period 1986 through 1994 (mining through initial response actions) are compared to those for the period 2000 through 2005 below:

Statistic	***TSS Concentration (mg/L)***	
	1986 thru 1994	***2000 thru 2005***
Median Concentration	47	23
Number of Samples (*n*)	117	117

These data indicate that the amount of sediment transported off the site has significantly decreased with the completion of the OU4 work.

Another area where a significant improvement in water quality has been realized is in the Cropsy Valley. When the USEPA assumed control of the site in 1992, the Cropsy

Valley was the second largest source of metals loading. Copper loading from the Cropsy Waste Pile itself was estimated at over 33,000 pounds per year. As discussed in Section 8.2.3, copper loading to Wightman Fork originating from the Cropsy Creek Valley within the SMSS boundary currently totals less than 2 pounds per year (only non-point sources remain).

Water quality improvements elsewhere at the site have not been as significant. Historic copper and pH concentrations measured at the various ditch turnout structures are illustrated in Figures 7-7 through 7-12. These data are discussed below.

Prior to the construction of the L-Ditch turnout (L-DITCH-TO), station L3-1 was located at essentially the same location. Consequently, data from 2000 through mid-2005 are available for this location (Figure 7-7). Concurrent with the construction of the L-Ditch turnout, the North and South Highwall ditches were constructed to direct water to the Highwall Detention and Sedimentation Pond. Water from the pond and discharge from the Iowa Adit are combined in the Highwall Pipeline and discharge directly to the SDI; whereas, historically flow for these two source areas passed through the L3-1 monitoring location.

The median pH values and copper concentrations measured at the L3-1/L-DITCH-TO monitoring locations from 2000 through 2005 are summarized below:

Year	***Median pH***	***Median Copper Concentration (mg/L)***	***Snow Pack (% of Normal)***
2000	4.5 *n* = 22	2.3 *n* = 22	67 %
2001	3.4 *n* = 40	6.6 *n* = 52	108 %
2002	4.5 *n* = 12	1.7 *n* = 12	10 %
2003	3.8 *n* = 25	3.4 *n* = 25	59 %
2004	3.5 *n* = 20	2.6 *n* = 20	102 %
2005	3.3 *n* = 20	3.4 *n* = 20	--

The 2005 snow pack was not surveyed, but was well in excess of 100%

Review of these data does not suggest significant improvement of water quality in the ditch system draining the Highwall and Mine Pits. However, by comparing two years with near normal snow pack (2001 vs. 2004) then a more than 50 percent decrease in median copper concentration is evident. This decrease may be a result of the construction of the Highwall Detention/Sedimentation Basin and Highwall Pipeline in late-2003. In the normal runoff year of 2001, snowmelt from the Highwall area would be reflected in the L3-1 data. In 2004, snowmelt from the Highwall area (and discharge from the Iowa Adit) would be routed to the SDI via the Highwall Pipeline (see Figure 7-6) and not pass through the L-DITCH-TO monitoring location. This copper concentration decrease, if real, is still less than the reduction assumed in the ROD. And, the median pH values have remained strongly acidic.

Monitoring at the terminus of the ditch system draining the North Waste Dump/Chandler Groin/Missionary Seeps area has been performed for numerous years. Station SC-7 has historically been the lower-most monitoring location on this ditch system. With the construction of the water management structures in late-2003, several new sources discharge to this ditch system above SC-7 via the Impact Basin (Figure 7-6). Consequently, water quality data collected post late-2003 from monitoring station T-DITCH-TO, which is located above the impact basin, should be compared to that from SC-7 pre-late 2003 as illustrated in Figure 7-8.

The median pH values and copper concentrations measured at the SC-7/T-DITCH-TO monitoring locations from 2001 through 200 are summarized below (no data collected at this location in 2000):

Year	***Median pH***	***Median Copper Concentration (mg/L)***	***Snow Pack (% of Normal)***
2000	- -	- -	67 %
2001	3.0 *n* = 23	78 *n* = 23	108 %
2002	3.1 *n* = 25	59 *n* = 25	10 %
2003	3.1 *n* = 34	48 *n* = 34	59 %
2004	3.3 *n* = 20	12 *n* = 20	102 %
2005	3.1 *n* = 34	35 *n* = 34	--

The 2005 snow pack was not surveyed, but was well in excess of 100%

There appears to have been a steady decrease in the median copper concentration at these locations from 2001 to 2004, with the 2004 value representing an 85 percent decrease over the 2001 value. However, copper concentrations at the T-DITCH-TO monitoring location in 2005 have been much higher than those observed in 2004 (Figure 7-8), possibly due to more runoff and higher groundwater levels in response to the higher 2005 snow pack.

For the turnouts on the P and Q ditches, data are only available for 2004 and 2005 (Figures 7-9 and 7-10). In the case of A2-1-TO (Figure 7-11) and A2-2-TO (Figure 7-

12), data are available from late-2003 to 2005. Additional data will be required from these locations to evaluate meaningful trends.

7.2.4.2.2 Groundwater Interceptor Drains

Groundwater interceptor drains were constructed in late 2003 along the toe of the North Waste Dump, in the Chandler Groin area and along the Missionary Seeps. The objective of these drains was to capture groundwater underflow, thereby decreasing the non-point source metals load to Wightman Fork. The groundwater captured by these drains is routed to the SDI. A diagrammatic illustration of the current groundwater interceptor drain system is provided in Figure 7-6.

A large non-point source metals load enters Wightman Fork adjacent to the North Waste Dump and Chandler Groin. The majority of this load enters Wightman Fork above surface water monitoring location WF2.5 (Figure 7-6). The copper concentration and load, and the relative percent that this load represents at the SMSS downstream monitoring location WF5.5 is illustrated in Figure 7-13 for years 2000 through 2003. Only one year's worth of data (2004) of post-groundwater interceptor drain data are available. The snow pack status is also illustrated in the timeline on the bottom of Figure 7-13. When the WF2.5 data for 2004 (snow pack = 102% of normal) are compared to 2001 data (snow pack = 108% of normal), there appears to be a slight decrease in copper concentration at WF2.5. However, this area remains the largest non-point source of metals loading at the SMSS. Additional data will need to be evaluated to determine the effectiveness of the groundwater interceptor drains.

A smaller set of drains was installed in late 2003 on Dike No. 1 of the Heap Leach Pad (HLP). Groundwater captured by the HLP drains is routed into the French Drain Pipeline, which discharges to the SDI.

With the inclusion of the discharge from the groundwater interceptor drains in the French Drain Pipeline, the chemical characteristics of the pipeline discharge to the SDI, sample point FD-1 Figure 7-6), should reflect this new source. The median copper concentrations and loads measured in samples collected from FD-1 over the last 5 ½ years are summarized below:

Year	***Copper in FD-1***	
	Median Concentration (mg/L)	***Median Load (pounds/day)***
2000	11.3	6.0
2001	23.5	13.3
2002	8.7	3.5
2003	12.5	6.7
2004	19.4	10.5
2005	36.8	47.5

The 2004 data from FD-1 (snow pack = 102%) are similar to the 2001 data, which had a about the same snow pack (108%). Although the 2005 data are significantly higher than the 2001 data, the 2005 data are only through July 31; the 2005 median concentration and load values may decrease through the remainder of the year.

Additional drains will be constructed in the fall 2005 to capture more groundwater and surface seeps.

7.2.4.3 Questions

Question A: Is the remedy functioning as intended by the decision documents?

Yes and no. The revegetation of the site appears to have been successful, even withstanding the severe drought of 2002. The amount of sediment exported from the site has decreased. Metals' loading originating in the Cropsy Valley has significantly decreased. However, the quality of the water in other site ditches has not improved to the extent anticipated.

Question B: Are the Assumptions made at the time of the remedy selection still valid?

Yes and no. Those assumptions made with respect to amending the soils to establish a growth media and in developing the seed mixtures appear to have been appropriate. The revegetation of the site has also decreased the amount of sediment transported off the site. However, the assumption that reclamation would decrease the generation of poor quality surface water has proven not to be as correct.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.2.5 Operable Unit 5 – Final Side-Wide Remedial Action

The following sections describe progress made toward implementation of the Final Site Wide Remedial Action, and what improvements to water quality and conformance to RAOs and RALs have been realized, if any.

7.2.5.1 New Active Water Treatment Plant

The OU5 ROD called for the construction of a new, conventional water treatment plant. The ROD specified that the new plant would be constructed downstream of the on-site impoundment, outside of the 500-year floodplain, with the exact location to be determined in the Remedial Design phase. The new plant was to be located at an elevation such that sufficient pressure will be available to provide gravity operation of the plant.

In an August 2003 Explanation of Significant Difference (ESD), the location of the new water treatment plant was specified at the same location as the existing plant, upstream of the SDI. Additionally, the contaminated water from the SDI would be pumped to the new water treatment plant rather than delivered by gravity feed.

The CDPHE is the lead agency responsible for the design and construction of the new water treatment plant. The CDPHE selected Resources Technologies Group (RTG), now Golder Associates, in November 2002 to design the new water treatment plant. RTG's design analysis included an evaluation of the contaminants for the water treatment process and effluent. The most significant metals affecting the design of the new water treatment plant are copper and aluminum, aluminum being the most intractable of these in terms of obtaining adequate removal efficiencies and meeting downstream standards.

RTG evaluated the following water treatment processes for the SMSS:

- 1-stage High Density Sludge lime precipitation where metals are precipitated in a single pH adjusted process.
- 2-stage High Density Sludge lime precipitation with an initial pH adjustment to precipitate aluminum followed by a second pH adjustment to precipitate the remaining metals.
- Zeolite adsorption utilizing a 1-stage or 2-stage system with final polishing and aluminum removal using zeolite.

Both the EPA and the Colorado Water Quality Control Division (WQCD) determined that the new water treatment plant discharge must meet Alamosa River Segment 3b numeric standards at "the end-of-pipe". The Summitville design team met with both EPA and the WQCD in June and July 2003 to discuss the apparent conflicts between the:

- Alamosa River underlying standards;
- Total Maximum Daily Loads;
- Alamosa River background (upstream of Wightman Fork) metals load;
- Summitville 2001 Record of Decision CERCLA waivers; and
- Bench scale and wet tests.

After these two scoping meetings, the Summitville water treatment plant design team and EPA/WQCD were at an impasse because the determination of the discharge standards has, in addition to the technical practicability of attaining the end-of-pipe standards, a policy/cost benefit component. Therefore, a third meeting with the EPA and CDPHE managers was held on July 24, 2003. At the 24 July meeting, the agencies agreed to apply the effluent standards to the "end-of-pipe" for the new water treatment plant based on the Alamosa River Segment 3b.

Historical sampling of discharges from the Summitville Site and environmental data indicate that, with the exception of aluminum and copper, metals concentrations in the treatment plant effluent are below future discharge standards (see copper effluent concentrations vs. current and future standards in Figure 7-14). Additionally, historical data indicates that compliance with the aluminum criteria of 0.087 mg/liter in either Segment 3c (AR41.2) or Segment 3d (AR34.5) may be difficult due to the significant amounts of aluminum produced in the Alamosa River basin upstream of Wightman Fork. The impact of this upstream aluminum contribution from Iron, Alum and Bitter Creeks is well documented in previous studies. The concentration of aluminum upstream of Wightman Fork (AR45.5) exceeds the water quality criteria in a significant number of samples, particularly at low flow conditions.

Order-of-magnitude capital and operating costs for both the one and two-stage lime HDS with zeolite options are provided on the table below. Capital costs are for the process facility itself and do not include infrastructure items such as the lift station, influent and effluent conveyance systems, and utility connections (electrical, gas, potable water, sanitary).

Estimated Capital and Operating Costs

Plant Configuration	Capital Cost	Operating Cost
One stage	$12,000,000 to $14,000,000	$1,000,000 to $1,500,000
Zeolite polishing (added cost)	$7,000,000 to $9,000,000	$1,100,000 to $1,700,000
Two stage	$15,000,000 to $16,000,000	$1,100,000 to $1,700,000
Zeolite polishing (added cost)	$7,750,000 to $9,000,000	$1,600,000 to $2,200,000

7.2.5.1.1 National Remedy Review Board

In 2004, the EPA conducted a Superfund 120 Day Study, which included the Summitville Mine Superfund Site. As a result, the OSTRI decided to conduct a review at the Summitville Mine Superfund Site to assess whether the selected remedy incorporated new technology and the most cost-effective cleanup approach based on the technical advances and experience developed since the OU5 Final Site-Wide ROD, particularly as it relates to water treatment technologies. The National Remedy Review Board (NRRB) requested a thorough re-evaluation of active and passive treatment technologies, the site contaminants, an ARAR's analysis and a value engineering of the current design for the new water treatment plant. This assessment was performed and presented to the NRRB in July 2005 (EPA and CDPHE July 2005). Following the NRRB, a series of recommendations were provided to the EPA Region 8 and CDPHE. These are presented in Appendix B. The recommendations, which could result in remedy modification that would also be protective of the environment, will be considered in implementing the final remedy.

The NRRB offered comments concerning:

1. Differences between the discharge criteria for the water treatment plant and the Superfund policy on background;
2. The chemical form and toxicity measurement of contaminant metals, whether flexibility exist in state standards, and whether evaluation tests are appropriately applied; and
3. Evaluation of a phased approach to the new water treatment plant to include a determination of the impact of a one-stage plant on the Alamosa River, and if a second stage is necessary. This phased approach, with monitoring, would also allow additional investigation of potential innovative technologies to lower treatment costs. The single stage treatment design would include pH adjusted to maximize the reduction of aluminum and copper concentrations with respect to aquatic toxicity.

7.2.5.2 Storage Impoundment

The SDI serves as the storage structure for contaminated water at the SMSS. Historically, the combined treatment rate of the existing water treatment plant and the storage capacity of the SDI have been insufficient to capture all the water generated on-site during the spring run-off from above normal snow packs. In years with above normal snow packs, controlled releases were made via the SDI's outlet works (1997, 1998, 1999, and 2001) or through the ditch turnouts (2004 and 2005) to prohibit uncontrolled releases through the SDI's spillway. The routing of surface water flow at the SMSS has remained the same since late-2003.

The major inflows to the SDI during 2001, 2002, and most of 2003 included the French Drain (FD-1), P-Ditch (L3-1), T Ditch (SC-7), Missionary Seeps (MS), Pumphouse Fault (PF-0), Reynolds Adit (AD-0), and Reynolds Adit pipeline (AD-0P). The SDI inflow system was reworked in late 2003 as part of the OU4 Water Management Structures and Improvement Project. In addition to the six turnout structures (Section 7.2.4.2), the impact basin (IMPACT BASIN) was constructed and the Pumphouse Fault (PF-0-NEW) was diverted into the SDI. The IMPACT BASIN combines the discharges from pipelines conveying contaminated water from the NWD drains, the Missionary Seep drains, the Highwall and Iowa Adit discharge pipeline[8], and the Reynolds Adit pipeline, discharging them into the T Ditch which flows into the SDI. Figure 7-6 depicts the current configuration of the surface water ditch system, groundwater interceptor drains and portal discharge pipeline conveyance systems.

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[8] Under the OU4 reclamation, the water produced from the Highwall and Iowa Adit would no longer pass through the L3-1 ditch, but be diverted into a pipeline that leads to the impact basin.

The areas contributing the largest volume of water to the SDI during 2001, 2002, and 2003 were the NWD and Missionary Seeps area, as measured at station SC-7. Not considering releases from the mine pool via the Reynolds Adit pipeline (AD-0P), surface water from the highwall/mine pits area (station L3-1) was the second largest contribution of water to the SDI. During the 2002 drought, groundwater inflows from below the HLP via the French Drain (FD-1) eclipsed L3-1 as the second largest source of water delivered to the SDI.

Following the reconstruction of the SMSS ditch system, the P-DITCH-TO (which combines the flow of both P and L Ditches) contributed the highest quantity of flow to the SDI in 2004. Flow through the T Ditch (T-DITCH-TO) contributed the next highest quantity of water to the SDI in 2004.

For the period 2000 through 2003, the largest source of metals loading to the SDI was the ditch system draining the NWD, Chandler Groin, and Missionary Seeps area, as measured at SC-7. Additionally, the Reynolds Adit invert (AD-0) was a significant source of copper, while the French Drain (FD-1) was a significant source of manganese. Both the Reynolds Adit invert and French Drain also contributed significant amounts of zinc, iron, and aluminum. However, when prolonged releases were made from the mine pool via the Reynolds Adit pipeline, as happened in 2002 and 2003, the pipeline was the dominant source of metals to the SDI.

Following the reconstruction of the SMSS ditch system, the metal loading contributions to the SDI were significant from the P- and T-Ditches as well as at SC-7 and FD-1 in 2004. SC-7 contributed the largest average load of copper (190 lbs/day), zinc (60.4 lbs/day), iron (611 lbs/day), and aluminum (543 lbs/day) to the SDI. The P-Ditch contributed the largest average load of manganese, 94.0 lbs/day; and the second highest average load of aluminum and zinc, 387 lbs/day and 30.3 lbs/day, respectively, to the SDI. The French Drain, FD-1, contributed the second largest average load of iron, 323 lbs/day, to the SDI. The T-Ditch contributed the second largest average load of copper, 59.4 lbs/day, to the SDI, while contributing the third largest average load for zinc, iron, manganese, and aluminum. The A2-1 contributed the smallest average load of copper and aluminum, 0.59 lbs/day and 8.74 lbs/day, respectively, to the SDI. The L-Ditch contributed the smallest average load of zinc, iron, and manganese, 0.79 lbs/day, 1.1 lbs/day, and 3.1 lbs/day, respectively, to the SDI.

Loading to the SDI in 2005 increased over that observed in 2004 due to higher runoff from the larger 2005 snow pack. The relative ranking of the various ditches in 2005 was similar to that observed in 2004.

At a height of 71 feet, the existing SDI embankment should fall into the intermediate dam classification. Additionally, the state would likely classify the structure in the hazard class III category. A representative of the Colorado Division of Water

Resources (DWR) inspected the SDI dam on July 14, 2005. The dam safety inspection report prepared by the DWR concluded that the overall dam condition was satisfactory (the highest possible ranking). The report noted the following items requiring action by the owner (i.e., CDPHE) to improve the safety of the dam. These items were presented in two categories:

Maintenance/Minor Repair/Monitoring Items

- Lubricate and operate outlet gates through a full cycle on an annual basis to check for corrosion
- Monitor area of seepage above the outlet works for change in size, quantity and quality
- Remove pipeline and support piers and log debris from spillway approach channel

Engineering

- Consider placement of additional erosion protection in the lower spillway channel

The DWR concluded that the SDI could be safely operated to its full storage level without restriction. The 2005 SEO inspection report is contained in Appendix C.

7.2.5.3 Wightman Fork Diversion

Wightman Fork is diverted around the existing on-site contaminated water impoundment, the SDI. The diversion flows back into the historic Wightman Fork channel below the SDI. The OU5 ROD included the upgrade of the Wightman Fork Diversion to safely convey the flows generated by the 500-year thunderstorm and the 100-year snowmelt around the SDI.

The design of the Wightman Fork Diversion should consider a potential raise in the SDI embankment if, in the future, additional capacity for storage of contaminated water is required on-site. Upgrade of the diversion may require relocating a portion of U.S. Forest Service Road 330.

7.2.5.4 Sludge Disposal Repository

The exiting disposal area for the sludge generated by the Water Treatment Plant was constructed on the South Mine Pit in 1995. The disposal area reportedly has a footprint of about 2 acres. Runoff from the sludge disposal area is contained by a dike and routed to the SDI via a pipeline.

In 2004, the existing Water Treatment Plant generated an average of one cubic foot of sludge for every 3,000 gallons of water treated. Assuming this rate is representative of prior years, the WTP is estimated to have generated the following quantities of sludge during the 2000 through 2004 period.

Year	*Volume Treated (million gallons)*	*Sludge Generated (cubic feet)*
2000	172.0	57,300
2001	246.1	82,000
2002	132.8	44,300
2003	186.3	62,100
2004	243.0	81,000

Through July 31, 2005, approximately 160.7 million gallons have been treated at the WTP. Sludge production in 2005 is higher, averaging about one cubic foot of sludge for every 2,250 gallons of water treated (Joe Fox, Golder, electronic commun.). At this rate, approximately 71,400 cubic feet of sludge was generated at the WTP through July 31 of this year.

From 2000 through July 31, 2005, an estimated 400,000 cubic feet of sludge was generated at the WTP and disposed of at the on-site disposal area. Spread evenly over the 2 acre footprint of the disposal area, this volume of sludge would be approximately 4.5 feet thick. For the 5 ½ year period of data evaluated, this represents a disposal rate of about 0.8 feet per year over the footprint of the disposal area.

It is not known how much airspace remains at the existing sludge disposal area. Consequently, the airspace reserve, or remaining service life of the existing facility cannot be estimated. The OU5 ROD included the construction of an engineered sludge disposal repository on the North Pit.

7.2.5.5 Mine Pool Management

The OU5 ROD called for maintaining the mine pool at a maximum elevation below the Chandler Adit. The objective of managing the mine pool is to reduce the generation of acid mine drainage by (1) eliminating the fluctuation of the mine pool level thereby minimizing the contact of the mine pool and adjacent groundwater with the oxidized ore zone and wastes disposed in the mine pits, (2) reducing the hydraulic gradient thereby decreasing the discharge from seeps and springs, particularly in the Chandler Groin area, and (3) eliminating the seasonal discharge from unplugged adits above the elevation of the Chandler Adit (e.g., Ida Adit, Dexter Adit).

Over the last several years, short duration tests have been performed to maintain the mine pool at elevations (1) below the Chandler Adit, and (2) just above the Reynolds Adits. During other years, minimal or no releases have been made, allowing the mine pool to freely fluctuate. The elevation of the mine pool since monitoring began in late 1999 is shown in Figure 7-5. Absent early releases from the mine pool in 2002, the elevation of the mine pool has risen above that of the base of the North Mine Pit for an extended period each year. However, the elevation of the mine pool only rises above that of the base of the South Mine Pit every few years (e.g., 2001 and 2005), and then only for a short (~one to two month) period.

Historic releases from the mine pool were made during years of low snow pack (e.g. 2002 and 2003), when low runoff provided excess capacity in the Site's water storage and treatment system. If a long-term management plan were to include releases from the mine pool, then implementation of the plan could not occur until the volume of water to be released was included in the Site's annual water storage and treatment budget.

The future disposition of the mine pool has implications on the long-term maintenance requirements of the plugs and adits. For example, if the mine pool is completely drained then there will be no pressure on either the Reynolds or Chandler Adit plugs and minimal maintenance may be required on the plugs (the Reynolds Adit plug should be kept in place for surge protection).

7.2.5.6 Reynolds Adit Rehabilitation and Control Valve

The plugs in the Reynolds and Chandler Adits were installed during the winter 1994, and the Chandler Adit plug was repaired (lengthened) in the spring 1995. Consequently, both plugs are beginning their second decade of service. Timbers were replaced in both adits in 1995 and again in 2000.

A detailed inspection of both the Reynolds and Chandler Adits was performed in July 2005. Conditions inside both adits were wetter and more deteriorated since the 2004 inspection. Overall, the access and drainage in both adits are fair. There was noticeably more water present this year than in 2003 and 2004. The bulkheads in both adits were in good condition. The Reynolds Adit pipeline and associated valves are in working order with the exception that the portal valve has a small leak when the pipeline is pressurized. The timbers in both adits are showing signs of aging. The timbers and lagging are deteriorating and the foundations of some posts are starting to erode. There are numerous stretches of poor quality timber in the Reynolds Adit and, to a lesser extent, in the Chandler Adit. The 2005 adit inspection report is contained in Appendix D.

7.2.5.7 Monitoring

The SMSS onsite environmental monitoring program consists of the weekly sampling of key locations and the monthly sampling of all stations. Additional sample is performed during the spring run-off period to guide decisions on the configuration of ditch turnouts. Recent on-site monitoring locations are illustrated in Figure 7-6. Offsite environmental monitoring is limited to twice-a-year sampling (spring and fall) of six locations from the SMSS boundary (WF5.5) to Terrace Reservoir. Terrace reservoir sampling includes the collection of zooplankton samples.

7.2.5.7.1 On-Site Monitoring Program

The results of the environmental samples collected at many of the on-site locations are evaluated in previous sections of this document. This section will focus on the results of samples collected at the SMSS downstream boundary, Wightman Fork monitoring location WF5.5 (Figure 7-6).

Historical copper and aluminum concentration data measured at WF5.5 are summarized in the box-whisker plots provided in Figures 7-15 and 7-16, respectively. Noted on the time scale on these figures are significant milestones in the site remediation. The largest improvement in water quality at WF5.5 occurred following the installation of the Reynolds and Chandler Adit plugs in 1994 and 1995. Additional improvements were realized following the consolidation of surface water flows to the SDI and centralized water treatment at the Interim WTP in 1996. Continued work on site-wide reclamation (OU4) activities through 2003 resulted in gradual improvements in water quality throughout the remainder of the 1990s and 2000s.

Remediation goals for select water quality parameters were published in the 2001 ROD for station WF5.5. These remediation goals are provided in Table 7-5 for both low- and high-flow regimes. Water quality data collected at station WF5.5 for the period 2000 through July 31, 2005 are compared to the WF5.5 remediation goals. The concentrations of iron, manganese, and zinc were below their respective remediation goals in all samples (100% attainment). Of the remaining four parameters, attainment of remediation goals occurred more frequently under high-flow conditions than under low-flow. For aluminum, the remediation goal was attained in 71 percent of the high-flow samples, but only 24 percent of the low-flow samples. The cadmium remediation goal was attained for the five high-flow samples, but none of the low-flow samples. Copper concentrations attained the remediation goal in 92 percent of the high-flow samples, but only four percent of the low-flow samples. The pH of the WF5.5 samples was greater than the remediation goal in 36 percent of the high-flow samples; there was zero attainment of the pH remediation goal under low-flow conditions.

7.2.5.7.2 Offsite Monitoring Program

Results from recent low- and high flow monitoring programs will be presented. Metals concentrations will be compared to stream standards. When concentrations exceed standards, the excess load will be quantified. With particular emphasis on the results from the Terrace Reservoir zooplankton sampling and fish testing program and what this implies about the restoration of the reservoir and the ability to sustain aquatic life there.

Water quality samples are collected from the site boundary (WF5.5) down Wightman Fork, through the Alamosa River and into Terrace Reservoir. Samples are collected sequentially in a downstream order based on estimated travel times between adjacent stations. In 2000 and 2001, several offsite sampling events were performed each year as part of the remedial investigation (RI) for the site. Offsite sampling was not performed in 2002. Since 2003, offsite monitoring has been performed twice per year; once in the spring (high flow/snowmelt runoff) and again in the fall (low flow).

Yearly summaries of offsite surface water quality sample results from the Alamosa River and Terrace Reservoir compared to State of Colorado aquatic life standards for 2001 and 2003 through 2005 (partial year) are presented in Tables 7-6 through 7-9. Instances where the sample result exceeded the chronic (> Chronic) or acute (> Acute) aquatic life standards are noted on the tables. A blank indicates that the sample concentration was less than the applicable standard. With the exception of the chronic copper standard in Segment 3b, the copper standards are table value standards (TVS), and were calculated using the paired hardness values. The Segment 3b chronic copper standard is an ambient standard, fixed at 0.03 mg/L. There is no acute copper standard in Segment 3b. Alamosa River stream segments are illustrated in Figure 3-1. The results are discussed below, by stream segment.

Segment 3a – AR45.5

The lack of pH and aluminum standard exceedances in Segment 3a (upstream of Wightman Fork) compared to the number of exceedances downstream of Wightman Fork (Segments 3b, 3c, etc.) is misleading. There is no chronic aluminum standard in Segment 3a. The Segment 3a pH standard is seasonal, with minimum values ranging from 3.52 to 4.73; whereas, the minimum pH standard for segments downstream of Wightman Fork is 6.5. Consequently, if Segment 3a possessed the same pH and aluminum standards as Segment 3b, then the number of exceedances in Segment 3a would be at least the same as that in Segment 3b.

Segment 3c – AR41.5

With the exception of 2003, the copper concentration in Segment 3c (station AR41.2) consistently exceeded the acute standard. In 2003, the copper concentration at AR41.2 only exceeded the chronic standard under high flow conditions and, for the first time in recent history, the low flow copper concentration was less than the chronic standard. Zinc concentrations have not exceeded stream standards since 2001.

Aluminum and total recoverable iron concentrations exceeded the chronic concentrations during the high flow event in 2005. These exceedances were likely due to the extremely high flow conditions this spring, which resulted in a high sediment content of the water.

The pH values are sometimes just below the minimum value of 6.5. This is typically the case under low flow conditions, but also occurred during the spring 2005 high flow.

Segment 3d – AR37.5 and AR34.5

Water quality generally improves between the upper portion of Segment 3d (AR37.5) and the lower portion (AR34.5). Under the high flow conditions during the spring 2005, copper concentrations at AR37.5 exceeded the acute standard.

Segment 8 – T1A (Terrace Reservoir)

The data presented on Tables 7-6 through 7-9 for Terrace Reservoir represent the results from three to four samples collected from a profile in the reservoir. Water quality conditions in the upper portion of the reservoir are generally better than those at depth. For example, the copper and aluminum concentrations in the high flow 2005 surficial sample were below the chronic standards; whereas, the concentrations in the mid- and lower- levels both exceeded the chronic standard.

Zooplankton samples are collected in Terrace Reservoir during the spring and fall. Samples were not collected in the fall 2003 due to the draining of Terrace Reservoir in 2003 to facilitate repair of the dam's outlet works. Results of zooplankton sampling in Terrace Reservoir indicate that zooplankton are more abundant during the fall than in the spring. Results from 2004 are summarized below:

Zooplankton Identification	***September 2004 400-meter Tow (total number)***
Leptodiaptomus minutus	935
Daicyclops thomasi	45
Eucyclops speratus	0
Acanthocyclops vernalis	0
Ceriodaphnia spp.	749
Daphnia galeata mendotae	1,861

Daphnia are a typical test organism for metal effects. Consequently, the presence of Daphnia provides physical evidence of the improved water quality in Terrace Reservoir since the late 1980s and 1990s.

Excess Copper Loads in the Alamosa River

As previously discussed, copper concentrations in the Alamosa River typically exceeds the State of Colorado acute and chronic aquatic life standards in Segment 3c (AR41.2). The amount by which the copper load exceeds the chronic standard (termed "excess" copper load) is summarized by flow regime below for 2000, 2001, 2003 and 2004:

Year	***Alamosa River Flow Regime- Excess Copper at AR41.2 in Pounds/Day***				
	Early Spring	***High Flow (Spring Snowmelt)***	***High Flow (Snowmelt with SDI Release)***	***Monsoonal (Summer)***	***Low Flow (Fall)***
2000	5.2	4.8	*No SDI Releases*	14.6	16.5
2001	17.0	21.5	115	2.1	- -
2003	- -	*No Flow Data*	*No SDI Releases*	- -	*< Std*
2004	- -	*No Flow Data*	*No SDI Releases*	- -	4.8

Sampling was not performed in 2002. The continuous gage was removed from AR41.2 in the spring 2003. Because the river can not be safely accessed under high flow conditions, high flow loads can not be calculated. However, the copper concentration exceeded the chronic standard under high flow conditions in both 2003 and 2004. The fall 2003 cooper concentration at AR41.2 was below the chronic standard.

Station AR37.5 was established near the upstream boundary of the then new Alamosa River stream segment 3d following the spring 2003 high flow event. The amount by which the copper load exceeds the chronic standard (termed "excess" copper load) is summarized by flow regime below for 2003 and 2004:

Year	***Alamosa River Flow Regime Excess Copper at AR37.5 in Pounds/Day***	
	High Flow (Spring Snowmelt)	***Low Flow (Fall)***
2003	*No Flow Data*	*< Std*
2004	1.2	*< Std*

The continuous gage was installed in AR37.5 after spring 2003. Because the river cannot be safely access under high flow conditions, high flow loads for 2003 can not be calculated. However, the copper concentration exceeded the chronic standard under high flow conditions in 2003.

7.2.5.8 Questions

Question A: Is the remedy functioning as intended by the decision documents?

Yes and no. To the extend OU5 ROD remedial elements have been implemented, the remedy is functioning. But there are substantial final remedy elements that have not been funded nor constructed.

Question B: Are the Assumptions made at the time of the remedy selection still valid?

No. Based on data gathered to date, it appears that a larger capacity WTP will be required to treat the volume of contaminated water generated at the SMSS.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.3 Operation and Maintenance

This section summarizes information from the annual reports prepared by the site operators about the Interim WTP performance.

7.3.1 System Performance

Figures 7-14 and 7-17 illustrate the WTP performance since 2000 as it relates to both the volume water treated and conformance to the effluent discharge criteria applicable to the Interim WTP.

Figure 7-14 illustrates the Interim WTP effluent concentrations from 2000 to present as compared to the discharge criteria. The copper discharge criteria prior to June 1 is 0.1 mg/L. The WTP generally meets this criteria. After June 1, the copper discharge criteria goal is less than 0.03 mg/L. Conformance to this goal is not met on a regular basis.

Figure 7-17 shows that during greater than average precipitation years, the combined water treatment and storage capacity are unable to contain the volume of contaminated water generated at the site. Though the WTP is operating at a maximum capacity or 1000 gpm, some contaminated water is discharged offsite without treatment. This untreated water exceeds the WF5.5 RALs and contributes to noncompliance with the Alamosa River standards.

WTP Annual Reports (CDM Annual Reports 2001, 2002, 2003 and 2004) summarized problems encountered during the season, which lead to a failure to operate a maximum capacity and efficiency. The problems encountered are as follows:

- The process water demand exceeds the water supply. This problem is generally encountered in the fall when ground water level has fallen or during drought years. The process water wells is prone to silting and must jetted regularly to increase the water production.
- There have been periodic failures to the filter press due to: failed auger underneath, frame out of alignment, or not opening or closing properly.
- The lime guppy that is used for supplemental lime storage was damaged by snow falling from the WTP roof onto the guppy. In addition, there have been problems with the delivery of poor quality lime which contained debris causing plugging of the lime eductor feed system.
- Unusual temperature variations caused the SDI to freeze, thaw and refreeze during the spring, causing a second layer of site to form and limiting the distance the SDI pump could be pushed out to obtain sufficient water quantity for treatment.

In 2005, there have been increasing incidents of equipment breakdowns and failures. Though treatment capacity has not been compromised, the cost of these failures is approximately $200,000. It is anticipated that with this aging WTP, failures of this magnitude are will continue.

7.3.2 Cost of System Operations/O&M

7.3.2.1 Findings of Remedial System Evaluations made during 2000-2004

EPA Technology Innovation Office (TIO) and the EPA Office of Emergency and Remedial Response (OERR) commissioned a Remediation System Evaluation (RSE) to be conducted at the Fund-lead Summitville Mine Site during FY00, FY01, and FY02. The initial and follow-up efforts were designed as ways for EPA to provide assistance to the individual site managers with management and operation of their Fund-lead pump and treat systems. The RSE involved a team of experts not previously associated with the site that reviewed site documents, inspected the site operations, and compiled a report including recommendations to improve the system. The observations made and the recommendations given were not intended to imply a deficiency in the work of the designers, operators, or site managers but are offered as constructive suggestions.

The RSE reports made recommendations in several areas of Site O&M. The RSE report recommended reducing the mine pool volume especially in years of drought. It recommended that any planned sediment removal from the SDI be conducted in ways that are consistent with the final remedy, including a permanent extraction point and a larger storage volume. The report recommended against the sediment removal so that valuable sludge disposal area would not be occupied by the removed sediments. The RSE report recommended conducting hydrogeological analyses to determine if the constructing more groundwater interceptor trenches would be cost effective. There was concern that the trenches might not provide sufficient capture to warrant their construction. The RSE report recommended making reductions to the sampling program. The annual monitoring has been reduced from 24 to 15 groundwater monitoring wells. The offsite sampling has also substantially been cut back from 4 to 2 events and from 7 offsite stations to 4 offsite stations. The report recommended eliminating snow removal over the winter (four months from December through March) while the treatment system is shutdown. The RSE report recommended scaling back or eliminating the Del Norte office. The site team is looking for a smaller place to reduce rent, and at the same time, provide a place of business in the nearest small town that has regular UPS and Federal Express service. The report recommended that a new source for potable water be developed to supply make-down water for polymer blending that is so essential for the water treatment process. The RSE report also recommended that the site electrical power distribution system be supplied by the local utility grid so that the costly reliance upon a diesel motor generator set is eliminated. The returning RSE team was pleased that major cost reductions were achieved by eliminating winter snow removal and cutting back at the Del Norte office without sacrificing the effectiveness of the remedy. The site team estimates that the resulting savings is approximately $185,000 per year.

7.3.2.2 Historical USEPA contractor cost summary

Prior to 1999, the U.S. Bureau of Reclamation managed the water treatment contracts at Summitville. By 1999, USEPA had assumed the management of all contracts and cooperative agreements performing work. USEPA turned to the Response Action Contracting Strategy (RACS) program under one of its mission contractors (Camp, Dresser, & McKee) to take over operation and maintenance of the site water treatment facility. The RACS is a cost-reimbursement, award fee-based contracting strategy that provides a flexible mechanism for responding to an evolving site situation. The contract type allows for incremental funding and was best-suited to the uncertain stream of federal dollars allocated to meet the project needs. Measurable or observable performance criteria were used to determine how much fee the contractor would earn in any given year. The following criteria were used to gauge the effectiveness of the contractor's operations as long as the proposed costs in the work plan were acceptable:

Performance Indicator	Goal
▪ Date of Park Creek Road Opening to the Site	15 April
▪ Date of treated effluent discharge	1 May
▪ Date to achieve 1000 gpm treatment rate	1 May
▪ Annual average influent rate	1020 gpm
▪ Plant online availability rate (30 days/month)	98.6%
▪ Average copper effluent concentration	< 0.05 ppm
▪ Unplanned event downtime	< 24 hours per event

	1999	2000	2001	2002	2003	2004
CDM Federal Programs Corp.	$2,268,736	$2,948,962	$2,591,785	$2,151,158	$1,780,129	$1,350,077
Millions of Gallons Treated	n/a	172.0	246.1	132.8	186.3	243.0

The CDM contract delivered "best efforts" or "level of effort hours" measured in labor dollars and other direct costs subject to an annual "Not-to-Exceed" budget amount that was adjusted to allow for extended operating seasons during heavy precipitation years and for unplanned repairs or replacement of critical equipment breakdowns. During the early years, major capital improvement projects were completed to improve the effectiveness of the water treatment plant. Higher costs than average were incurred during 2000 to install a more reliable sludge press and to replace the lime slurry feed system. Higher costs were experienced during 2001 to accommodate a longer operating season because of a higher than average volume of water treated. As can be seen in the contract performance indicators, a planned maintenance program was not a focus during the contractor's operation and a backlog of deferred equipment maintenance or replacement items, especially during 2004, awaited the State's contractor when they arrived in 2005.

7.3.2.3 CDPHE contractor cost expectations

During 2004 the CDPHE requested lead agency responsibility for managing all the remaining aspects of the site response activities, including solicitation and management of an operation and maintenance contractor that would come onto the scene for the 2005 operating season (March-October) and complete the transition from the USEPA contract. CDPHE's contracting strategy was to issue a request for proposal for fixed-prices or lump sums for specific work items in a contract with a base performance year and four one-year options. Reasonable competition and innovative proposals full of cost-reduction initiatives were obtained during the solicitation. Resource Technologies Group, now one of the new water treatment services groups within Golder Associates, was selected among competing proposals from a field that included the incumbent contractor and other highly successful water resource engineering consultants.

	Base year 2005	**Option Year 2006**	**Option Year 2007**	**Option Year 2008**	**Option Year 2009**
Proposed Cost before seasonal adjustments	\$1,634,000	\$1,635,000	\$1,712,000	\$1,832,000	\$2,136,000

Includes water treatment April through October, utilities and non-routine repairs

8.0 ISSUES

The following components of the final site-wide remedy identified in the OU5 ROD were constructed at the SMSS in late-2003 (Section 7.2.4):

- Upgrade of select site-ditches;
- Groundwater interceptor drains;
- The Highwall ditches and sedimentation basin; and
- Contaminated water pipelines.

Additional groundwater interceptor drains will be constructed in the fall 2005. Annual maintenance, monitoring (on- and off site), and adit inspections are ongoing.

The following components of the final site-wide remedy have not been addressed or constructed:

- New active water treatment plant (design for a two-stage HDS plant has been completed);
- Storage impoundment upgrade, if necessary (to be determined);
- Wightman Fork Diversion upgrade;
- WTP sludge disposal repository; and
- Mine pool management.

Several issues have come to light since the publication of the ROD and/or the construction of select components at the site. These issues are discussed in this section.

8.1 Interim Water Treatment Plant

In February 2005, the CDPHE assumed the lead role and selected a new contractor to operate and maintain the WTP and site. As a result of this change of management and contract, the O&M contractor, Golder RTG, has been evaluating the condition of the site, in particular the WTP with respect to demands for repairs, maintenance and compliance with OSHA regulations. The WTP and several site facilities were constructed as temporary structures implementing the Interim Record of Decision OU0. These facilities were not intended to be permanent, though they have been operating for nearly 10 years and at a minimum, they will be operate for an additional 5 years for a total of 15 years or more. The future years are expected to realize ever greater cost of repairs to keep the existing facilities operating. In addition, significant upgrades are required to bring the WTP and facilities into compliance with OSHA, which is the industry standard.

8.1.1 OSHA Standards and Improvements

In June and July 2005, inspections were performed at the SMSS to assess conformance with OSHA standards. Inspections were conducted by electrical engineers, civil engineers, and health and safety specialists. Numerous deficiencies were noted and documented in a Golder RTG memorandum, dated July 2005. The deficiencies were divided into two categories:

- <u>Immediate</u> – Items for which immediate corrective action is recommended. These are Code violations and safety related.

- Urgent – Items for which near-term corrective action is recommended. Though the items may not comprise a violation of an existing Code, they are considered important due to the increased hazards of the operating environment, travel time and physical distance to sources of medical attention and maintenance and repair parts and materials.

A total of 58 deficiencies are noted with 45 of them specifically related to the WTP and associated facilities such as the SDI and potable water well. The total cost of these repairs, only estimated at this point, is approximately $1,100,000. The repairs fall into three general categories 1) safety, 2) infrastructure and 3) process.

8.1.2 Inadequate Water Treatment Capacity

Based on data gathered to date, a treatment capacity of 1000 gpm is insufficient to treat the amount of contaminated water generated at the site. Since the completion of OU4 Site Side Reclamation in year 2001, the water quality of the ditches (with the exception of the Cropsy Valley) has not improved sufficiently so that it can be released without treatment. With only a few years (2004 – average snow pack - and 2005 – above average snow pack, with 2002 and 2003 much less than average snow pack) to assess this data trend, it appears that the site has stabilized and there has been no significant improvements to over all site chemistry as measured at WF5.5 (Figures 7-15 & 7-16) since site-wide reclamation and revegetation was completed in year 2001. Because of limits to treatment capacity and storage, 56,000,000 and 70,000,000 gallons of contaminated water were released in years 2004 and 2005. If adequate storage and treatment capacity were available, this water would have been treated prior to release to Wightman Fork.

8.2 Non-Point Source Contaminant Loading

Point sources from the SMSS contributing to contaminant loads in Wightman Fork and the Alamosa River are limited to the Water Treatment Plant effluent discharge and the ditch turnout structures. Historically, releases of untreated water from the SDI through the outlet works were also point source discharges. However, with the construction of the ditch turnout structures in late 2003, discharging better quality water off site before it enters the SDI can avert releases from the SDI. Ditch turnout locations are illustrated in Figure 7-6. The last release of untreated water from the SDI was made in 2001.

The remaining major non-point source loads from the SMSS impacting the Wightman Fork-Alamosa River system are:

- Groundwater underflow downgradient of the North Waste Dump and Chandler Groin;
- Seepage from the SDI; and
- The Cropsy Creek basin within the SMSS boundary.

In addition to the non-point source loads from the site, elevated background concentrations of select metals (e.g., zinc and manganese from the Cropsy Creek basin above the SMSS) negatively impact the water quality in Wightman Fork.

8.2.1 Groundwater Underflow to Wightman Fork Adjacent to the NWD

Non-point source metals loading to Wightman Fork occurs in the reach starting approximately 500 feet downstream of confluence with Pipeline Creek. Diffuse metals loading occurs throughout the next approximately 1,000 feet down to monitoring location WF2.5. However, tracer injection tests performed by the USGS determined that the majority of the loading entered Wightman Fork in a 60 meter (approximately 200 foot) stretch near the upper end of this reach.

Copper concentrations measured at WF2.5 are illustrated in Figure 7-13. As discussed in Section 7.2.4.2.2, one of the objectives of the construction of the interceptor drains along the toe of the NWD and Chandler Groin was to reduce groundwater loading to Wightman Fork through this reach. Comparing 2004 (snow pack = 102% of normal) to 2001 data (snow pack = 108% of normal) there appears to be a slight decrease in copper concentration at WF2.5 (Figure 7-13). However, this area remains the largest non-point source of metals loading at the SMSS. The flux of metals entering Wightman Fork in this reach can be estimated by subtracting background loading (e.g., WF-1 and NWDUT) from the loads measured at WF2.5. This evaluation is presented below for copper loading.

Year	Non-Point Source Copper Loading at WF2.5	
	Loading (pounds/day)	Percent of Load at WF5.5
2000 n = 8	9.0	35.0%
2001 n =17	10.6	25.5%
2002 n =19	6.0	40.5%
2003 n = 12	6.9	38.9%
2004 n = 6	13.9	55.9%
2005 n = 4	11.8	46.3%

Where n represents the number of samples collected at WF2.5. Median load values are presented. The percent of loading is calculated using paired measurements. 2005 data through August 1.

Limited aluminum data are available for 2003, 2004 and 2005 (through August 1). Median non-point source aluminum loading observed at WF2.5 ranged from 92 to 204 pounds/day. This represented from 68 to 86 percent of the aluminum load measured at WF5.5.

8.2.2 Seepage from the SDI

Non-point source metals loading to Wightman Fork occurs as a result of seepage through the SDI embankment. Seepage is channeled from the base of the embankment and joins Wightman Fork above monitoring location WF5.5. The seepage from the SDI embankment is measured at location SDI-TOECHAN (Figure 7-6). Additional subsurface seepage may also be present. Seepage rates are greatest when the SDI is full (compare results below to SDI levels in Figure 7-2). The copper flux in the seepage through the SDI embankment is presented below.

Year	Non-Point Source Copper Loading at SDI-TOECHAN	
	Loading (pounds/day)	Percent of Load at WF5.5
2001 n =15	7.4	13.6%
2002 n =18	0.9	4.4%
2003 n = 17	1.5	6.9%
2004 n = 7	1.6	15.1%
2005 n = 3	0.9	<1%

Where n represents the number of samples collected at SDI-TOECHAN. Median load values are presented. The percent of loading is calculated using paired measurements. SDI-TOECHAN was not sampled in 2000. 2005 data through August 1.

Limited aluminum data are available for 2003, 2004 and 2005 (through August 1). Median non-point source aluminum loading observed at SDI-TOECHAN ranged from 3.1

to 11.1 pounds/day. This represented from <1 to 8.7 percent of the aluminum load measured at WF5.5.

8.2.3 Cropsy Creek Basin

Cropsy Creek flows into Wightman Fork just upstream of monitoring location WF5.5. Cropsy Creek discharge into Wightman Fork is monitored at location CC-5 (Figure 7-6). The upper Cropsy Creek basin is mineralized and abandoned mine waste piles are present in the basin above the SMSS. Water entering the SMSS from the upper Cropsy Creek basin is monitored at CC-1 (Figure 7-6). However, CC-1 is in a remote location and typically not accessible until late in the season. Consequently, loading data from the upper Cropsy Creek Basin during spring runoff is rare. Water can also be imported into the Cropsy Creek basin from the Mine Pits area through the L3-1/L-DITCH TO location when this water is "turned out" (i.e., it does not report to the SDI). The non-point source loading evaluation for Cropsy Creek is performed using only those CC-5 data that have paired CC-1 data; the CC-1 "background" load is subtracted from the load at CC-5. In addition, when the L3-1/L-DITCH TO water is "turned out", this load is also subtracted from the load measured at CC-5. This evaluation is presented below for copper loading.

Year	Non-Point Source Copper Loading from the Cropsy Creek Basin in the SMSS	
	Loading (pounds/day)	Percent of Load at WF5.5
2000 n = 24	0.34	1.2%
2001 n = 15	0.6	2.3%
2002 n = 24	0.1	0.9%
2003 n = 18	0.8	5.5%
2004 n = 17	1.4	7.4%
2005 n = 1	1.7	7.4%

Where n represents the number of samples collected at CC-5 with paired CC-1 samples. Median load values are presented.

There appears to be an increasing trend in the copper load emanating from the Cropsy Creek basin within the SMSS boundary. Additional monitoring is required to evaluate whether this is a meaningful trend or an artifact of the 2002-2003 drought.

8.3 OU4 Site-Wide Reclamation Assumptions

The U.S. BOR assumed that the OU4 site-wide reclamation efforts would be 95 percent successful (U.S. BOR, 1998). Therefore, the selected remedy for the SMSS assumed that surface water drainage from the majority of the site would be diverted offsite. Based on this assumption, the hydrologic basins tributary to the SDI would be reduced to the Highwall and the Beaver Mud Dump/SDI sub-basins. Groundwater from the HLP French Drain system, the portal discharges from the Reynolds and Chandler Adits, and the Pumphouse Fault discharge would continue to be routed to the SDI. Construction of the groundwater interceptor drains would result in additional groundwaters being delivered to the SDI.

The ROD held contingencies for the final sizing of the on-site contaminated storage reservoir and treatment rate for the new active water treatment plant. However, the selected remedy for the site assumed that the reduced future water balance would render the existing SDI capacity (±90 million gallons) and current water treatment rate (±1,000 gpm) sufficient for the site.

As discussed in Section 7.2.4.2.1, a significant reduction in surface water loading from remediated areas other than the Cropsy Creek basin has generally not been observed. Consequently, the ditch turnouts have generally only be used to divert water away from the SDI during the spring runoff because there is insufficient storage capacity. At all other times, surface water from the majority of the site has been routed to the SDI.

The consequence of allowing surface water from areas other than those envisioned in the ROD to flow to the SDI has impacted the implementation of other remedial components. Specifically, until such time that the combined storage and treatment capacities are adequate to contain runoff from the design events, implementation of a mine pool management plan that involves continuous, controlled releases is impracticable. Additionally, an upgrade to the Wightman Fork Diversion must consider a possible increase in the SDI capacity. The design for the new two-stage HDS treatment plant is for a 1,400 gpm plant, approximately 400 gpm more than the existing plant. At many times during the spring 2005 snowmelt, more than 400 gpm was diverted offsite via the ditch turnouts.

8.4 Mine Pool Management

As discussed in Section 8.3, a mine pool management plan has not been developed for the site. During 2002 and 2003, when drought conditions plagued the region, controlled releases were made from the mine pool via the Reynolds Adit pipeline. Water from the pipeline drained to the SDI for storage prior to treatment at the site water treatment plant. Experience gained in water treatment during the 2000 mine pool drawdown test indicated that treatment to a slightly higher pH (pH > 9) held effluent metals concentrations below their discharge limits (Section 7.2.1).

The historic elevation of the mine pool is illustrated in Figure 7-5. Also shown on this figure are:

- The elevation at the portal of the Chandler and Reynolds Adits;
- The elevation of the base of the North and South Mine Pits; and
- Elevation of water detected in wells completed in the North Mine Pit (RMCMW-8) and the South Mine Pit (BORMW-10).

Absent releases from the mine pool, mine wastes in the North Mine Pit become saturated for an extended period during the spring and summer months of each year (Figure 7-5). However, it appears that the mine wastes in the South Mine Pit (which is approximately 100 feet in elevation above the North Mine Pit) only become saturated every few years (e.g., 2001 and 2005) and then only for a short period (Figure 7-5).

Two unplugged adits, the Ida and the Dexter, are located approximately 105 feet in elevation above the Chandler Adit. The Ida Adit is located on the hillslope just southeast of the Chandler Adit. Although covered during OU4 reclamation activities, flow with high metals concentrations emanates from the general location of the Ida Adit when the mine pool, as measured at the Chandler Adit, reaches the elevation of the Ida. The Dexter Adit was completely buried during the OU4 reclamation activities, and is in a protected location where snow drifts linger late into the season. Consequently, flow that can be credited to the Dexter Adit has not been observed in several years. However, like the Ida, it can reasonably be assumed that the flows emanate from the Dexter Adit when the mine pool reaches an appropriate elevation.

Because there was excess capacity in the SDI as a result of the severe drought, continuous releases were made from the mine pool during a prolonged period in 2002. During 2002, the mine pool was maintained at an elevation that kept the Reynolds Adit behind the plug completely submerged. During a second, shorter test in 2003, the mine pool elevation was maintained at a level below the Chandler Adit.

As discussed in Section 8.3, a mine pool management plan that involves continuous releases cannot be implemented until there is sufficient excess capacity in the combined SMSS contaminated water storage reservoir and treatment plant system. The September 2001 OU5 ROD contained a provision for maintaining the mine pool at an elevation below the Chandler Adit. However, a mine pool management plan should consider the results of the mine pool releases in 2002 and 2003, along with those from previous testing when determining the final disposition of the mine pool. The site water budget must also consider the volume of water annually released from the mine pool, as well as the timing and rate of the releases required in the plan.

8.5 Heap Leach Pad Reservoir

During the 2000 pumpdown test, approximately 13.3 million gallons of water were removed from the HLP, lowering the water level approximately 9.5 feet. The HLP water level has remained suppressed since the (Figure 7-3), evidence that the cap has reduced infiltration as designed. The HLP still holds approximately 80 million gallons of water. If the existing well PW-2 were used, an additional 50 million gallons could potentially be removed from the HLP. About 30 million gallons of water would remain in the HLP below well PW-2. The presence of cyanide and cyanide degradation products in the water pumped from the HLP may require additional treatment beyond that of the existing treatment plant.

The September 2001 OU5 ROD held a contingency for pumping down the HLP should monitoring suggest that the downstream embankment (Dike No. 1) was unstable. Annual monitoring of the inclinometers completed in Dike No.1 indicates that the embankment is currently stable, with two of the three inclinometers indicating slow creep to the north-northwest. However, the amount and rate of the creep is currently not problematic. Additionally, monitoring of seeps and wells downgradient of the HLP in 2000, 2001, 2003 and 2004 did not detect HLP derived contaminants at levels that would be indicative of a major breach of the HLP liner system.

8.6 Water Source for the Existing and Future Water Treatment Plants

The existing and proposed water treatment plants at the SMSS require a reliable supply of known quality water ("process water") to support the operation of the facility. In the existing water treatment plant, use of the process water is currently limited to mix polymers. Historically, the process water was also used as polymer "push" water; however, this use was abandoned during a water shortage in October 2000 and the system was re-plumbed to use effluent for push water (CDM, 2000).

Snowfall, which is the primary source of groundwater recharge at the SMSS, can vary dramatically from year to year. In years of normal to below normal snow pack, production from the wells that supply process water to the existing water treatment plant declines. During recent years, the well production has decreased to the point where it has impacted the operation of the water treatment plant. For example, the 2002 Annual Report (CDM, 2002) stated that, in September, the wells "could only meet a supply rate of 2 gpm, which limited [the water treatment plant] throughput to between 650 and 750 gpm."

Currently, water is supplied to the SMSS water treatment plant by two wells that are referred to as the "17-mile well" and the "inside well". A review of recent records indicates that the 17-mile well was "jetted" in 2000, 2001, 2002, 2003 and 2005; new pumps were installed in both wells in 2000; and a new pump was installed in the 17-mile well in 2002 and 2003 (CDM, 2000; 2001; 2002; 2003). As evident in this record, maintenance of the existing wells has been frequent, costly, and largely ineffective. The maximum practical treatment rate of the existing plant is about 1,000 gpm, or 1.44 mgd. Fresh water usage averages approximately 3 gpm (4,320 gpd) at a polymer dose of 3.5 ppm (CDM, 2004). The proposed water treatment plant will have a maximum treatment capacity of approximately 1,400 gpm, or approximately 2.0 mgd.

8.7 Summary of Issues

The following table summarizes the major issues related to the IRODs and the final site-wide ROD and whether these issues impact the protectiveness of the remedy.

Summary of Issues	Affects Protectiveness (N/Y)	
	Current	Future
Interim Water Treatment Plant OU0, continued repairs and upgrades	Y	Y
Non-Point Source and Point Source loading to Wightman Fork	Y	Y
OU4 Site Wide Reclamation Assumptions	Y	Y
Mine Pool Management	Y	Y
Heap Leach Pad Reservoir	N	N
Potable Water Source for the Current and Future Water Treatment Plant	N	Y

9.0 RECOMMENDATIONS AND FOLLOW UP ACTIONS

This section provides a discussion of recommendations and follow-up actions that could occur at the SMSS or in the Alamosa River basin downstream of the site. The items are not presented in any particular order.

9.1 SMSS Water Balance

Most of the outstanding components of the final site-wide remedy deal with conveyance, storage and treatment of water. These include:

- New active water treatment plant;
- Storage impoundment upgrade, if necessary;
- Mine pool management;
- HLP Reservoir; and
- Wightman Fork Diversion upgrade.

The volume of water and the rate at which this water is delivered are critical to the design and operation of these remedial components.

As discussed in Section 8.3, the selected remedy for the SMSS assumed that surface water drainage from the majority of the site would be diverted offsite and that the existing SDI capacity (±90 million gallons) and current water treatment rate (±1,000 gpm) would be sufficient. However, a significant reduction in surface water loading from remediated areas has generally not been observed (Section 7.2.4.2.1). The ditch turnouts have generally only be used to divert water away from the SDI during the spring runoff. At all other times, surface water from the majority of the site has been routed to the SDI.

A detailed water balance should be developed for the SMSS. The budget should consider the following inputs:

- Surface water;
- Groundwater;
- Mine Pool; and
- HLP Reservoir.

The components of a conceptual water budget for the SMSS are illustrated in Figure 9-1. The surface water and groundwater inputs of the SMSS water balance are already in place. However, the assumption in the OU5 ROD that the OU4 site-wide reclamation efforts would be 95 percent effective should be re-evaluated.

In the future, the site's annual water budget could also include releases from the mine pool. The volume and rate at which water would be released from the mine pool depend upon the elevation that the mine pool would be maintained, as determined during the development of the mine pool management plan. Additionally, approximately 50 million could be pumped from the HLP using the existing well, PW-2. The pumping of the HLP would represent a one time event.

9.2 Reynolds Adit Access

The Reynolds and Chandler Adits have historically been inspected on an annual basis. Timbers were replaced in both adits in 1995 and again in 2000. Additional work in 2000 included work on inverts to promote drainage in both adits, repair of the ventilation systems in both adits, and repair of the boardwalk in the Reynolds Adit.

A detailed inspection of both adits was performed in July 2005. Although access to both adits was generally good, deteriorating timbers and lagging were noted that should be addressed over the next five years.

Until such time that a mine pool plan is developed, it will not be clear whether long-term access to one or both adits will be required. Options that should be considered for the Chandler Adit range from continued periodic rehabilitation or abandonment. Options for the Reynolds Adit are more numerous and include:

- Continued periodic rehabilitation of the entire 1,265 foot adit back to the existing plug;
- Installation of the second plug at 630 feet; and
- Use of cellular concrete to permanently stabilize all or a portion of the adit.

The final disposition of the Reynolds Adit will be determined during the development of the mine pool management plan.

9.3 Reintroduction of Fish in Terrace Reservoir

With the financial assistance of the CDPHE, the Colorado Division of Wildlife (DOW) stocked Terrace Reservoir with approximately 7,000 rainbow trout in July 2001. The purpose of the stocking was to perform a long-term chronic survival study.

In October 2001, the DOW set two gill nets in the reservoir and retrieved them early the next day. There were 153 fish trapped in the nets: 147 rainbow trout; 1 Snake River cutthroat trout; 1 Rio Grande cutthroat trout; and 4 Rio Grande chub. Based on their size, all but one of the rainbow trout appeared to be have been from the July 2001 stocking. The growth rate of the stocked rainbows is summarized below:

Measurement	***July 2001***	***October 2001***	***Percent Increase***
Mean Length (cm)	17	22	29 %
Mean Weight (g)	55	103	87 %

In August 2002, the DOW set two gill nets in the reservoir and retrieved them early the next day. There were 70 fish trapped in the nets: 49 rainbow trout; and 21 Rio Grande chub. Based on their size, all of the rainbow trout appeared to have been from the July 2001 stocking. The mean length and weight of the stocked rainbow trout were 25 cm and 154 grams, respectively. The growth rate of the rainbows since their stocking is summarized below:

Measurement	July 2001	August 2002	Percent Increase
Mean Length (cm)	17	25	47 %
Mean Weight (g)	55	154	180 %

The growth rate observed in rainbow trout stocked in Terrace Reservoir is about normal for other lakes in the San Luis Valley, with a two-year old trout averaging about 25 cm (10 inches). However, the relative weight of the rainbow trout stocked in Terrace Reservoir was slightly low, at 80 to 90 percent of normal (John Alves, Colorado Division of Wildlife, electronic commun., January 30, 2004).

The rainbow trout stocked by the DOW appeared to have thrived in Terrace Reservoir between July 2001 and the last sampling in August 2002, increasing in both size and weight, although weight gain was slightly below normal. The DOW did note that the rainbow trout catch rate was lower in the August 2002 sampling (24.5 fish/net night) than in the October 2001 sampling (73.5 fish/net night). However, Rio Grande chub, which are native to the area, increased in abundance during the same period from 2 fish/net night in October 2001 to 10.5 fish/net night in August 2002; their average length also increased from 13 cm to 15.7 cm. Metals testing of fish tissues indicated that the aquatic risk driver associated with the site, copper, was not accumulating in the fish.

Unfortunately, Terrace Reservoir was drained during the summer and fall of 2003 to facilitate repair of dam's outlet works. As a result of the draining of the reservoir, there was a significant decrease in the amount of habitat in the reservoir for the fish. It is likely that few, if any, of the fish in the reservoir survived the draining. Based on the success of the 2001 through 2003 study, we recommend that the Terrace Reservoir be stocked with fish again in the future. The DOW will be consulted as to the appropriate species for the reservoir to fit into their long-term plans for the region's recreational fishery. Stocking should be performed in summer, after the snowmelt runoff. Fish should be periodically netted, weighed and measured, and tested for metals content.

9.4 Addressing SMSS Non-Point Source Loads

Remediation goals for select water quality parameters were published in the 2001 ROD for station WF5.5 (Table 7-1). Attainment of these goals was discussed in Section 7.2.5.7.1 (Table 7-5). In summary, concentrations of iron, manganese, and zinc were below their respective remediation goals in all samples (100% attainment) for the period evaluated (2001 through July 31, 2005). Of the remaining four parameters, attainment of remediation goals occurred more frequently under high-flow conditions than under low-flow. For aluminum, the remediation goal was attained in 71 percent of the high-flow samples, but only 24 percent of the low-flow samples. The cadmium remediation goal was attained for the five high-flow sample, but none of the low-flow sample. Copper concentrations attained the remediation goal in 92 percent of the high-flow samples, but only four percent of the low-flow samples. The pH of the WF5.5 samples was below the remediation goal in 36 percent of the high-flow samples; there was zero attainment of the pH remediation goal under low-flow conditions.

As discussed in Section 8.2, the remaining major non-point source loads from the SMSS impacting the Wightman Fork-Alamosa River system are:

- Groundwater underflow downgradient of the North Waste Dump and Chandler Groin;
- Seepage from the SDI.

Non-point source contamination originating from the SMSS potentially impedes the attainment of remediation goals at WF5.5.

Seepage through the SDI embankment can be dealt with using standard engineering practices. Many dams possess downstream groundwater capture and pump back systems. We recommend that such a system be constructed at the SDI.

We recommend that a sampling and analysis plan be developed and implemented to confirm that current groundwater underflow to Wightman Fork is consistent with the results of the USGS tracer injection study performed in 1997. The study should be performed under low flow conditions when groundwater underflow is easiest to detect and quantify. Following confirmation of the location of the groundwater underflow, a feasibility level design and cost estimate for a groundwater capture system would be developed. Wetlands issues will be considered as part of the design and cost estimation process.

9.5 Monitoring

Both on- and offsite monitoring should continue as currently scoped for the next five years. In preparation for the next five-year review, we recommend that aquatic life and sediment be sampled. The last comprehensive samplings of benthic macroinvertebrates and sediment were performed in 2000 and 2001, respectively.

9.6 Operable Units

The following summarizes specific recommendations for the existing operable units, in terms of what actions should be implemented to verify their conformance with interim and final remedial action objectives and goals.

Water Treatment Plant Operable Unit 0

- Make repairs, improvements and OSHA upgrades
- Cover for clarifier to prevent snow from accumulating
- Paint clarifier to inhibit rust and metal deterioration
- Monitor evolution of influent chemistry of SDI
- Monitor WTP effluent and internal performance, optimizing were feasible
- Add lightening protection and surge suppression to key electrical facilities that support the WTP

Heap Leach Pad Detoxification/Closure Operable Unit 1

- Annually monitor water quality and its evolution
- Annually monitoring inclinometers

Excavation of Cropsy Waste Pile, Beaver Mud Dump, and Cleveland Cliffs Tailings Pond/Mine Pit Closure Operable Unit 2

- Annually monitor slope stability, revegetation and seeps chemistry

South Mountain Operable Unit 3

- Monitor ground water elevation and chemistry

Site Wide Reclamation Operable Unit 4

- Continue to clean ditches of debris as needed
- Exercise the turnout gates
- Monitor revegetation and soil chemistry and pH
- Monitor flow and chemistry of water release to Wightman Fork via turnouts

Site Wide Final Remedy Operable Unit 5
Implement remaining Final Site-Wide remedial components

- Construction of a larger capacity water treatment plant and if the additional storage should be required, an on-site contaminated water impoundment
- Construction of a sludge disposal repository
- Upgrade of Wightman Fork Diversion
- Rehabilitation of Reynolds and Chandler Adits
- Management of mine pool water

The State Engineers Office 2005 inspection recommends a number of improvements to the SDI spillway channel and dam that should be implemented to improve safety. They are:

- Removal of pipeline, support piers and debris from spillway channel
- Placement of additional erosion protection in lower spillway channel

9.7 Recommendations for Action for the Next Five-Year Review Period

1. Implement the remaining OU5 remedial components as funding becomes available.
2. Investigate remedy options for controlling non-point source discharges.
3. Revise the site hydraulic model and water balance.
4. Reynolds Adit rehabilitation or long-term stabilization.
5. Placement of fish in Terrace Reservoir.
6. Continue monitoring of on-site and off-site remedial elements and affected media.
7. Prior to the next Five-Year Review, conduct on-site ground water and seep sampling.
8. Prior to the next Five-Year Review, conduct off-site sediment and aquatic life sampling in the Alamosa River.
9. Continue to explore remedies that might result in permanent, passive or semi passive control of contaminant sources.

10.0 PROTECTIVENESS STATEMENTS

As reported in Baseline Human Health Risk Assessment (Morrison Knudsen Corporation, ICF Kaiser Engineers, Inc., 1995a) and the Public health Assessment (ATSDR, 1997), releases of contaminants from the site have not posed an unacceptable risk to human health. Risks were either below health advisories or below benchmarks, below the U.S. EPA's acceptable risk range of 10^{-4} to 10^{-6} for carcinogens, or non-carcinogenic risks were below a hazard index (HI) of 1.0. These determinations were based on water quality data collected in 1994 and 1995, which were years before many of the interim remedial actions at the site were complete. Considerable improvement in water quality has been evident in the Alamosa River and Terrace Reservoir since that time (Rocky Mountain Consultants, Inc., 2001).

In terms of environmental protection, the current remedy minimizes risks to downstream ecological receptors. The final and interim remedy components that have been implemented to date have reduced the risk to downstream ecological receptors but it is not currently protective to the environment. The Tier 2 Ecological Risk Assessment (CDM Federal Programs, 2000) found that the aquatic life, primarily trout and macroinvertebrates, downstream of the site were severely impaired. The primary risk driver was copper, over 90 percent of which comes from the Summitville Mine site. Reactive transport modeling of the Alamosa River estimates that if the Remedial Action Levels can be attained at the site downstream boundary, as measured at WF5.5, water quality ARARs should be achievable in Alamosa River Segment 3c and downstream. To that end, the remedy incorporates impoundment of contaminated drainage from the site and proven, active water treatment that has a high long-term reliability. Since the site wide reclamation was completed in 2001, the vegetative cover is now fairly well established. The reclamation, though resulting in significant contaminant load reductions, has not fulfilled the anticipated 95% load reduction in some areas of the site. Therefore, more water must be stored and treated. Additional remedial efforts aimed at specific contaminant sources, such as seeps collected either at the surface or in the subsurface may bring additional contaminant load reductions. These efforts are designed to separate, to the extent possible, contaminated water from uncontaminated water so that the demand for storage and treatment can be reduced. With the maturation and success of other engineering controls (some which have yet to be implemented) at the site, it is the goal of the Final Site-Wide Remedy to decrease the amount of acid mine drainage entering Wightman Fork and ultimately the Alamosa River.

10.1 Operable Unit O Water Treatment

The OU0 Water Treatment Plant is expected to continue to operate in its current capacity with periodic repairs, upgrades and OSHA improvements. Since it is an interim WTP, the intention was that it would be replaced with a larger capacity and more efficient water treatment plant as a component in OU5. Until the new WTP, a critical component of the Final Site Wide Remedy, is constructed, protection of the environment cannot be assured.

10.2 Operable Unit 1 Heap Leach Pad Detoxification/Closure

OU1 is complete. Based on current data, the OU1, Heap Leach Pad Detoxification/Closure is stable and protective of human health and the environment. However, the condition could change with time, and therefore annual monitoring is required to continue to verify that the remedy is protective. Specifically, there is the chance of instability to the downstream Dike No. 1. Annual inclinometer measurements are intended to provide information of any pending earth movement within Dike No. 1. Further, water within the HLP could evolve from a relatively neutral to an acidic condition in approximately 50 years. Ground water chemistry will be assessed prior to the next five-year review and at five-year increments thereafter. At this time, no other actions are anticipated.

10.3 Operable Unit 2 Excavation of Cropsy Waste Pile, Beaver Mud Dump, and Cleveland Cliffs Tailings Pond / Mine Pit Closure

OU2 is complete. Aside from periodic monitoring of vegetation, seep chemistry and slope stability, no other actions are anticipated. The remedy is protective of human health and the environment.

10.4 Operable Unit 3 South Mountain Groundwater

The OU3 has been incorporated into OU5, the Final Site-Wide Remedy. Groundwater may be the contributor of non-point source loads in the vicinity of the North Waste Dump and WF2.5 monitoring point. This non-point source load will be assessed as part of OU5. Groundwater will be monitored for the prior to next five-year review.

10.5 Operable Unit 4 Site Wide Reclamation

The OU4 Site Wide Reclamation has been successfully implemented. It has provided a system to manage water and has achieved significant contaminant loads and suspended solids reductions, though something less than the anticipated 95% contaminant load reduction. This is important, because certain sub-basins at the site cannot be diverted off-site without treatment due to copper concentrations that exceed the RALs.

The remedy is protective of human health, however, protection of the environment has not been fully achieved. Therefore contaminated water continues to flow into the system ditches, which must either be treated or diverted off-site if treatment/storage capacity has been exceeded. The additional source collections structures and extensions to the groundwater and seep collection systems constructed in 2005 will further the goal of segregating contaminated source segregation from clean ditches, but it appears unlikely that the 95% contaminant load reduction will be realized.

10.6 Operable Unit 5 Final Site Wide Remedy

OU5 Final Site-Wide Remedy is largely incomplete. Though the site does not pose a risk to human health, protection of the environment has not been achieved. The primary reasons for this lack of protectiveness (to the environment) are:

- Contaminant load reduction is less than anticipated for some remedial elements, specifically OU4, therefore it is necessary to treat large volumes of contaminated water that exceed system capacity.
- Water treatment and storage capacity is not able to manage greater than average conditions encountered during spring run-off.
- Highly unpredictable precipitation and melt-off conditions.

The following OU5 remedial elements are complete:
- Upgrade of select site ditches;
- Construction of groundwater interceptor drains, pipelines and impact basin; and
- Construction of a Highwall ditch and sedimentation basin.

The following OU5 remedial elements are not complete:
- Construction of a new water treatment plant;
- Possible enlargement or replacement of an on-site contaminated water impoundment;
- Construction of a sludge disposal repository;
- Upgrade of Wightman Fork Diversion;
- Rehabilitation of Reynolds Adit; and
- Management of mine pool water.

The following OU5 remedial elements are ongoing:
- Continued site maintenance, and groundwater/surface water and geotechnical monitoring on-site; and
- Surface water, sediment, and aquatic life monitoring in Alamosa River and Terrace Reservoir.

Aside from the source collection structures being built in 2005 and upgrades to make the Wightman Fork Diversion and SDI spillway channel safe and compliant with the SEO regulations, the single most important element of the Final Site Wide is to construct a new large capacity WTP to handle peak flows. Protection for the watershed depends substantially upon all of the remaining elements of the remedy that have not yet been authorized for construction funding.

10.7 Protectiveness Summary Table

The following table summarizes the questions (A, B and C) developed by the Comprehensive Five-Year Review Guidance (EPA 540-R-01-007), Section 4 for assessing the protectiveness of the remedy. These questions were discussed and presented in Section 7 of this Five Year Review for the Summitville Mine Superfund Site.

Questions	A	B	C	Protectiveness Comment per Guidance Section 4.5
OU0 - WTP	Y	Y	Y	Defer protectiveness because more information is needed to make a determination
OU1 - HLP Closure	Y	Y	N	Remedy is protective
OU2 - Cropsy, Mine Pits and SDI	Y	Y	N	Remedy is protective
OU3 - Ground Water				Incorporated in to OU5
OU4 - Reclamation	Y/N	Y/N	N	Defer protectiveness because more information is needed to make a determination
OU5 - Final Remedy	Y/N	N	N	Defer protectiveness because more information is needed to make a determination

11.0 NEXT REVIEW

The Summitville Mine Superfund Site is a Statutory Site that requires ongoing 5-Year Reviews. The next 5-Year Review will be conducted within 5 years of the completion of this 5-Year Review report. The completion date is the date of the signature shown on the signature cover page attached to the front of this report. All Summitville Mine Superfund Site Operable Units without a Notice of Completion (NOC) will be included in future Five-Year Reviews, due in September 2010.